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PREFACE

Sixth conference *Technics and Informatics in Education – TIO 2016* which acquired the status of an International conference for the first time this year, pursues an important objective to promote and support research in education of new generations in technical and technological fields at all levels of education, and contribute to technology development and education improvement.

For this Conference, some 86 papers have been submitted within various fields of technical, IT and technology-supported education at all education levels – primary, secondary, high education and education for adults. After reviewing, 71 papers have been accepted for current edition of Proceedings in the form of plenary lectures and original scientific papers by the authors from countries within the region and beyond.

Authors are responsible for any spelling, grammar and stylistic errors in their work.

Conference papers in the *Proceedings TIO 2016* are organized in the following topics:

- Plenary lectures
- Challenges in technical and IT education – from preschool to university
- Information and Educational Technologies
- Professional development of IT and technical education teachers and European educational perspective
- Engineering Education.

Special activities within the Conference are the following:

- Remote experiments - NeReLa Demo session
- Day of Computing
- Poster Session: Research project on Faculty of Technical Sciences

The Scientific and Organizing Committee wish to thank all the scientific and professional employees from various fields who contributed to the Conference.

We would like to thank Partner Institutions which participated as co-organizers of the Conference.

We express special thanks to the Ministry of Education, Science and Technological Development of the Republic of Serbia for financial contribution to this scientific gathering

Chairman of the Organizing Committee
Dr Ivan Milićević, Assistant Professor

CHAIRMEN'S FOREWORD

Faculty of Technical Sciences Čačak, University of Kragujevac, has the honour to organize International Scientific Conference 'Technics and Informatics in Education – TIO 2016'.

The Conference continues the tradition of gathering scientific associates and professionals in technical, technological and IT education in primary and secondary schools in Serbia. For the last 50 years this assembly has been organized in various forms (scientific and professional conferences and consultations on technical education, information technologies, technical seminars, etc.). These scientific and professional conferences have had a huge impact on the development of technical education, mostly in primary education, as well as in secondary education. The impact is also noticeable in both higher and university education. Five National conferences with International participation titled Technics and Informatics in Education were held in 2006, 2008, 2010, 2012 and 2014. Still, the necessity for continuous, organized scientific assembly related to technics and informatics in new surrounding and connection with other technologies has increased.

The aim of the conference TIO 2016 is to improve the exchange of knowledge and experience between experts, scientific associates and professionals from Serbia, neighbouring countries and Europe, engaged in the subject matter. The conference will provide an analytical review of technical (technological) and IT education, as well as education regarding technical (technological) and IT achievements including assistive technology, teaching aids, student books, etc. Teacher training is considered highly significant for research and development in education in this field.

The Conference includes technical (technological) education at all levels: from preschool institutions, primary and secondary schools over higher and university education, to various forms of lifelong learning.

Furthermore, the special emphasis will be given to the place, importance, and role of informatics and IT in technical and professional education, as well as correlation with other natural, social and education science.

A comprehensive analytical review will be given on the state of education in the fields of technics and informatics, as well as the contribution of technical and IT education to other fields.

The conference results are expected to provide the basis for planning the development of education in Serbia, especially in the fields of technical (technological) education, engineering, IT and informatics. The results are also expected to support and contribute to the exchange of educational patterns in the neighbouring region and coordination with European trends in this field.

We hope that experience gained at the Conference will be very useful both for the participants and for the development of technical-technological education field.

Chairman of Honour
Prof. Dragan Golubović

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PLENARY SESSION

TECHNICS AND INFORMATICS IN EDUCATION
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Proposal with regarding to teaching programme on Technics and informatics in elementary schools and high schools in Serbia

Dragan Golubović[1], Siniša Ranđić[1], Dragoš Golubović[2]
[1] Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia
[2]Dage Holdings Ltd, Rabans Lane, Aylesbury, Buckinghamshire, HP19 8RG, UK
e-mail dragangolubovic947@gmail.com; sinisa.randjic@ftn.kg.ac.rs

Abstract: *Both technical and computer literacy are a part of the know-how, skills and understanding that a student should be able to comprehend at the end of its compulsory education, which should further promote proper professional guidance, further education and daily functioning. To fulfill most of these general aims of the subject called Technical Education and Computer Literacy (Informatics), teaching process should most certainly be guided by the standrads, programs, defined goals, outcomes as well as by other elements throughout the teaching process. The paper [5], which is based on the European experience, shows the projection of the Standard for the course entitled Engineering and Informatics, where pre-school children (level 0), children of four-year primary education (level 1), fifth and sixth graders (level 2), seventh and eighth graders (level 3) and the first / second graders of secondary education - gymnasiums and secondary vocational schools (level 4) have all been included. Goals with regard to formation of the subject in question have been defined, as well as the expected student achievement for all four levels of education, i.e., for students aged between 7-18 (5-16-year old students- an option for an elementary education of 9 years). This paper suggests some guidelines in terms of redefinition of the techniques and informatics in elementary schools as well as some guidelines for children and students concerning the program by covering the entire educational system at all levels.*

Keywords: *education, redefining, technology, information, programme*

1. INTRODUCTION

Previous papers produced by the author showed the then-current state of technology and information technology, the possibility of applying modern methods as well as creating desirable environments for further development of the subject in question ([1] - [4]), whereas paper [5] shows the projection of the Standard, i.e., outlines needed for the development in the field. When it comes to current situation and development of technology and information technology and procedures, which seem to be the key strategic point in development of education in Serbia, one must say that some further changes are most certainly needed and not just in this field but in other educational fields as well. ([6], [7]).

Even though we see that some significant improvements have been made as regards the school subject Technical and IT education, especially in the sphere of modernization of programmes and introduction of information technologies, however, due to its complexity, the subject has come across a series of problems [5].

We all know that both technical and IT subjects in Serbia are learnt from the subject called Technical and IT education, which is a regular teaching programme in elementary schools in the second cycle of education (from 5th-8th grade, students aged 11 to 15). Compared with other educational systems of other countries, especially European countries ([9] - [12], where this subject is learnt in the first grade – at the age of 5), we can draw a certain conclusion that our educational system slightly ignores technology and informatics, meaning that the subject in question has not been sufficiently present at schools neither in terms of scope nor structure (stages) of learning, i.e., it definitely falls behind other countries.

To attain most of these general goals from the subject called Technical Education and Informatics, the school curriculum should most certainly be guided by standards, programs, defined goals and outcomes as well as other elements of teaching process planning.

Paper [5] shows details of the standard regarding technique and informatics - a proposal for redefining; below you will find only a programme proposal for all levels of education.

2. THE IMPORTANCE OF TECHNICS AND INFORMATICS

2.1. Importance of technics

Learning techniques (design-construction and technology, the term has become more accepted in Western countries) prepare students to follow the increasingly rapid technical and technological development. They should learn to think and act creatively to improve the quality of life. The subject prepares students to become independent and solve problems in a creative manner, both as individuals and as team members. They need to look at the needs, aspirations and opportunities and confront them by developing a number of ideas and producing specific products and systems. They combine practical skills with an understanding of aesthetics, social and environmental issues, function and industrial practices. In doing so, they look back and evaluate present and past design and technology, its use and impact. With the help of design and technology, all students can become informed users of products and thus can easily become innovators. The product most often defines its meaning and usefulness. The nature of the relationship between technology and people is determined by the manufacturer. Understanding the available technical features, together with the interest and sensitivity of language use allows a person to express its design ideas with more ease. There is one famous phrase which perfectly depicts learning through practise and it goes as follows: "Tell me and I will forget it-show me and I will be able to remember it- allow me do it and I will learn".

2.2 Importance of information and communication technologies

Information and communication technologies prepare students to participate and be trained for technologies for future jobs that are rapidly changing and developing. Students should use the tools (a software) to explore, analyze, exchange and present information in a responsible, creative and original way. They need to learn how to access both ideas and experiences from a large number of people, societies and cultures. By mastering it, ICT students boost their self-initiative, independent learning and development. It allows them to make informed decisions about when and how to use ICT and to understand the implications of using these systems at home and work in the future. It is a well-known fact that the ICT has a great potential. It will bring about a change in both the teaching and learning method, as well as a way students perform their tasks. The modern world requires new skills. By understanding the ICT, but more importantly the ability to use it for problem-solving, will be without a shadow of a doubt of great importance in the future. More and more will ICT will affect the prosperity of one's country economy. The expansion of ICT has made the world become closer and more compact.

2.3 Integrative approach to learning the technics and informatics

Already applied twenty-year integrative analytical concept of techniques, computer and communication tehnologies in the subject called Techniques and Informatics (formerly Technical Education) had justified set out goals and requirements. The swift development of technique and technology has enabled the rapid development of information-communication technologies as one of the technique's and technology's segments of engineering and technology, which has been broadly implemented in technique and technology. Implementation of applications in already existing technical systems has helped the level of technical and technological systems significantly modernize owing to a multidisciplinary approach of these fields. That is how the 'new baby' has enriched its creator, which was the main reason why 20 years ago our country analysed new information technologies coupled with the technique all joined in one subject called Technical and Information Technology taught 2 times a week all the way from the fifth to the eighth grade. Application of information technologies has been foreseen in all subjects as well as additionally in an optional subject called Accounting and Informatics.

Therefore, there are significant reasons as to why this unique subject called Technical and IT education should be preserved and taught 2 times a week by continually improving both the realisation method and subject content especially when it comes to information technologies. In addition, computer and information-technology literacy, apart from the current subject Accounting and Informatics, should be broadly spread out and included in elementary schools and harmonized with other digital competences that appear in other subjects, i.e., to make these competencies grow through various subjects from the very beginning of going to school, with special emphasis on the development of ICT competences in the subject called Technical and IT education.

2.4 Know-how, skills and understanding

Teaching should ensure that the knowledge, skills and understanding is something that a student will apply when developing its own ideas, planning, developing its own products/applications and participatating in the rating of the achieved results.

3. PROPOSAL WITH REGARDING TO TEACHING PROGRAMME ON COMPUTER TECHNIQUE AND INFORMATICS

In accordance with the standards of learning techniques and informatics global operational program, as well as the proposal is still given to all levels of education.

LEVEL 1: from 1st 4th grade

PROGRAMME TECHNIQUES

NATURAL RESOURCES

Resources that create life conditions on Earth: matter and energy. Over the centuries there has been a tendency of a man to adapt natural resources to its needs. Meet the world of technology: technology in shaping materials, use of technical means, natural resources on Earth: solid matter (rocks, minerals, clay, earth, coal ...), liquid (water, rivers, lakes, seas, oil ...) and gaseous (atmosphere, gas ...) matter.

MATERIALS

Natural materials: Natural materials: metal, stone, clay, wood, wool, silk, leather, fur, cotton, etc. Artificial or synthetic materials: metal alloys, polymers, semiconductors, technical ceramics, composites, biomaterials, etc. Exercise: creating a product with an aesthetic designs material: choosing the subject, creation of various handicrafts, for example, souvenirs or performing other suitable works or making similar objects from different materials, without using tools, equipment or simple tools, describe and comment the process of making.

HUMAN SETTLEMENTS

Development of human habitats starting from: forests, caves, stilt houses, the house made from solid material to modern residential buildings. Construction and architectural development. Exercise: making houses, resorts and other, from natural materials and materials used by contractors on site.

HANDICRAFTS

Development of handicrafts, traditional crafts: cobblers, blacksmiths, tailors, potters, carpenters,... Nurturing tradition of crafts. Exercise: Using craft tools and accessories.

POWER SUPPLY

Energy: forms (mechanical, thermal, light, chemical, electrical, nuclear) sources (non-renewable-coal, natural gas, oil, uranium ore), renewable (water, wind, muscles), alernative renewable energy sources (solar energy, hydrogen energy, biomass). The need for rational use of energy. Exercise: Create a model that points to the rational use of energy.

INDUSTRIAL REVOLUTION

The invention of steam engine-the first major industrial revolution. The invention of internal-combution engine- other great industrial revolution. Electrification - the third great industrial revolution. The era of information technology- the fourth large-scale industrial revolution. The time when information technology was first applied in machines-time mechatronics. Exercise: see a film about industrial revolution and provide feedback.

TIME OF GREAT INVENTIONS- MACHINES AND MECHANISMS

Inventions-basic principles of machines and mechanisms: ramp and wedge, lever, wheel, shaft, drum, four-wheeler, reel, pulley and winch, pulleys and belts transmissions, gears and gear drives, gearboxes, bevel gears and transmissions, worm and worm gear, rack, piston mechanism, cam mechanism, braking mechanism and other.

ELECTRICITY AND MAGNETISM

What is electricity: static, mobile electricity. Where does it come from? Magnetism: What is a magnet, an electromagnet. Conductors and insulators. How does a battery work? Hazard from an electric shock. Electric circuit with a battery. What are sockets, plugs and switches/circuit-breakers. Electric machines and devices: transformer, electric motor, electromagnet. Small electrical appliances. Exercise: Develop a model of an electric device or a machine by assembling components from the constructor.

TRAFFIC SAFETY AND RESOURCES

Development of transport means from the sled and chariot to ships, automobiles, locomotives, airplanes and hovercrafts. Traffic safety: traffic signs, traffic rules and children.

NEW TECHNOLOGIES

Matertials: plastic materials - nylon, polyester, vinyl, plastic film, glass fiber, composites. Electronics and materials at work: semi-conductors, silicon chips, computers. Robotics: computer controlled machine. Lasers in new technologies: cutting, welding, gauging, recording and reproduction of sound, holograms. CNC controlled machines. Exercise: get to know some modern machine. Construct and design your robot.

COMPUTER PROGRAMME

INTRODUCTION TO COMPUTERS

It's time to get started. Meet PC. Computer Hardware. Connectivity. External devices, computer terms. Applications - Software. Applications in Windows. Microsoft Office. Start menu in Windows. Shutting down the computer.

LEARN BY PLAYING

Program Windows. Windows help. Games: Games with maps, interactive games. Calculator. Create a logo or image. Drawing Tools. Computer discs. Listen to music. Media Player - play. Save the music on your computer. Make a list of songs. Burn CD.

PERSONALISE / SET WINDOWS

Topics for the monitor. Variable wallpaper screens. Screen saver. Gadgets - program application, time and space. Add shortcuts. Program Pinning. Shortcut to start or task bar. Setting the display. Access Center - Center for easy access. The buttons on the mouse. Pointer options. Change the picture on your account.

COMMUNICATION

Mail applications. Make your e-mail address. Configure Live Mail. Using of Live Mail. Live Mail folder. Receive e-mail. Create a message. Manage your mail applications. Reply and forward. Attachments. Receive attachment. See attachments. Security and "fishing". Create a list of contacts. Travel and send e-mail. Chat with your friends.

INTERNET SEARCH - "SURFING"

What is the Internet? Web Addresses. Hyperlinks. Select your home page. Search web pages. Tabbed browsing. Back to page. Save image from the web site. Online PDF document. Antivirus Software. Updating Windows. Manage your search engine. TV and Radio. Useful website.

SHOPPING ON THE INTERNET

Subscribe to RSS. Newspapers. Electronic books. Explore products. Set filters. Compare prices. Register on the web site. Buy online. Order groceries online. Buy and sell on eBay. Preventing Internet scam.

LETTERS AND REPORTS

Inscriptions note. Save note. Manage files. View Documents Folder. Organize your documents. Open the document. Governing document. Print the document. Working with text. Move and copy. Improve document. Write a letter. Write a header. Add image. Create a table.

MONEY MANAGEMENT
Household budget. Show cost and value. Budgets. Automatic summation. Copy and fill. Formatting. Keep track of your shares on the market. Internet market of stocks. Online banking. Find Online Bank. Open online account.

DIGITAL PHOTOGRAPHY
Camera. Connecting the camera. Transferring images. Safely Remove Hardware. Windows Live Photo Gallery. Adding tags and evaluation. Changing the size of views. Improving the image. Advanced photo editors. Slide show. Print. Pictures on the internet. Making movies with Windows Live programs. Share movies. Creating DVDs. Tips for Digital Photography.

ORGANIZATION OF COLLECTION - DATABASE
What is a database? Planning. Create a catalogue of CD-s. Sort collection. Search. Advanced Search. Printing catalogues.

PLANNING PROJECT
Plan project. Customize the invitation. Add a photo, drawing, animation, message. Add more creative tools. Add folder. Add the recipient's address. View and change of address.

COMPUTER MANAGEMENT
Sharing your computer. Creating a task. Initial monitor. Passwords. The order for the customer. Choosing the user. Fast User Switching. Home Network. Maintenance and security using Action Center. Uninstall the program. Sets the power and connectivity using Mobility Center. Creating a secure copy of the System. Recover files. System repair.

LEVEL 2: from 5st 8th grade

PROGRAMME TECHNIQUES

INTRODUCTION TO TECHNIQUE
Natural resources on Earth: matter, energy, space and time. The concept of engineering and technology. The impact of techniques development on life on Earth. The subject and the importance of technical and IT education, work and organization of the workplace in the cabinet and the application of protective measures.

GRAPHIC COMMUNICATIONS
Modeling from concept to realization. Technical drawing as the basis of graphic communication: sketches, technical drawings, paper sizes, types of lines in the technical drawing, spatial presentation of cases, technical letter labeling, measures on technical drawing, scale, basic equipment for technical drawing, model (model) - concept and graphics display.

FROM IDEA TO REALIZATION
Constructors algorithm modeling from concept to realization. Introducing elements Constructors sets and ways to connect them into a whole. Algorithm development model based on their own idea. Individual work with the constructor sets and pre-fabricated elements according to their idea. Technical documentation models.

MATERIALS
The concept and classification of technical materials (natural, artificial). Types and properties of materials (physical, chemical and mechanical): wood, paper, textile, leather, plastic materials.

PROCESSING TECHNOLOGY

Processing method (principles of tools for the mechanical processing of materials, materials testing). Preparation for processing. Proper use of tools for manual processing of materials, performing operations and safety at work: marking, cutting, finish (drilling, planing, filing, sanding). The choice of materials, operations and sequencing tools and their application. Material recycling and environmental protection.

POWER SUPPLY

The concept and importance of energy. Sources of energy (non-renewable, renewable and alternative). The transformation, utilization and conservation of energy. Use of energy: sun, wind, water.

CONSTRUCTORS MODELING OF MATERIALS

Constructors Modeling: students are free to choose the activity (project), based on which we get the algorithm: making sketches and forming technical drawings (in pencil or on a computer), planning and preparation of necessary materials, planning and sequencing of processing operations, realization of projects: development of models according to your own design from easily manipulated material or Constructors' elements. Practical application of knowledge about design modelling through mastered technologies and using materials from: wood, paper, fiber, textile, leather, plastics and other. Students who are especially interested in working on the computer can use software for physical modeling and construction (SketchUp, Visio).

TRAFFIC

Traffic (concept): types, structure, function. Regulation and road traffic safety. Pedestrian traffic. Bicycle traffic. Horizontal, vertical and light signals. Duties and responsibilities of the participants. The impact of transport on the environment.

INTRODUCTION TO ARCHITECTURE AND CONSTRUCTION

Introduction to architecture and construction. History of Architecture (building styles). The types of buildings.

TECHNICAL DRAWINGS IN CONSTRUCTION

The structural elements of the building structure. The construction systems in construction engineering. Activities and phasing over the course of building construction (technical documentation). Technical drawing as the form according to which the building is built.

CONSTRUCTION MATERIALS

Classification and types of construction materials. Power supply in construction

POWER SUPPLY

Measures for the rational use of heat energy in the construction industry. Tools and equipment for the construction industry

TECHNICAL RESOURCES IN CONSTRUCTION

Tools and equipment for the construction industry. Measures to protect buildings.

TRAFFIC SYSTEMS

Buildings in traffic: highways, railway stations, airports, ports. Ethics related to housing. Creating a plan of the apartment and a proposal for its construction.

CULTURE HOUSING

Water supply and sewage systems. Both interior and exterior.

TECHNICAL RESOURCES IN AGRICULTURE

Work organization and the application of modern machines in agricultural production. Both machinery and equipment in agricultural production. Work on your own project (technical documentation, creation of mock-ups, building structures, models of agricultural machinery and equipment, computer skills). Work on your own project.

CONSTRUCTORS MODELING IN CONSTRUCTION

Systematization content mastered in the 6th grade. Occupations in construction.
Housing culture –flat outline for its interior design development.

PROGRAMME INFORMATION TECHNOLOGY

OPERATING DESIGNS COMPUTER SYSTEM

Graphical desktop operating system. Working with the keyboard and mouse. Switching on and off the computer. Adjusting the working environment. Organization of data. Working with folders and files. Starting the program. Installation and removal program. Malicious programs and protection. Legal and pirated software. Installation of additional devices. Installing fonts. Search for files. Group program accesories (accessory).

BASIS OF WORKING WITH TEXT

Choice of working language in the program. WORD Starting, Operating environment. Getting ready to write the text. Create a document and enter text. Capture documents and completion of work. Loading of the recorded document. Changes in the document. Text formatting. Print. Working with images. Drawing in Microsoft Word.

INTRODUCTION TO MULTIMEDIA

Multimedia Players. Application of multimedia in teaching.

WORKING WITH TEXT

Basics of working with a word processor MICROSOFT WORD : WORD launch , prepares to write, record, document and upload the recorded document changes in a document , format text , spreadsheets, printing. Operation : forming table changes to the table , making the frame, line drawing , shading , move or copy a table. Design by : Framing and shading of the paragraph , frame and change to the background of the page , a page break , insert a page number, insert date and time , creation (modification) headers and footers.

INTERNET

Computer networks : the notion of global and local area networks , connect to the Internet, basic Internet services . Search the Internet: Web - (*WWW - WORLD- WIDE WEB*), electronic mail . Security on the Internet : protection of personal information , misuse of e-mail programs to spy (*SPYWARE*) and privacy violations.

GRAPHICS

Types of digital images records: Presentation of graphics on the computer, basic formats for storing drawings and paintings. Sources of digital images: drawing, painting screens, downloading from the Web, scanning, photography, creating images in image editing programs. Image processing: tagging, move or copy, resize the highlighted part, highlighted the work of manipulation, cutting and delete parts of the image, adjust brightness and colors, resizing the image, change the aspect ratio, preparing images for printing, display graphics and computer and internet presentations.

ANIMATION
What is animation? download and install *BENETON MOVIE GIF*, launch programs BENETON MOVIE GIF, create your own animations: bouncy balls, traffic lights, the use of effects built into the program to create animations

PROGRAMMING
Install and run the program: Download and install Visual Basic.net, launch Visual Basic.net, load and run existing programs, programming calendar, additional settings, writing a program that add up two numbers, variables and variable declaration. Branching in the program: commands for branching, write a program that determines whether a given number is even, writing the program according to which the bigger number is chosen out of two numbers. Repeat the program: writing programs which produce all integers that sit between two specified integers, write a program that simulates a calculator.

INTERACTIVE GRAPHICS
Download and install GEOGEBRA. GEOGEBRA start up and first examples: drawing points, longer and elementary transformation of drawn objects, parts of the base of the screen and the basic controls, draw a triangle, labeling and renaming objects. The construction of the circle circumscribed around the triangle, and entered into a triangle. The construction of a right triangle. Working with corners. Measuring distances and areas.

LEVEL 3: 7th and 8th grade

PROGRAMM TECHNIQUES

INTRODUCTION TO MECHANICAL ENGINEERING
The concept and the tasks of machines and mechanisms : transformation of matter and energy , transmission and transformation of load and movement .

TECHNICAL DRAWING IN MECHANICAL ENGINEERING
Technical documentation in mechanical engineering. Orthogonal projection . Dimensioning, cut and simplification, spatial representation. From idea to realization.

INFORMATION TECHNOLOGY
Draw using a computer and making presentations. Interface system computer connection. Management models using a computer. Working with designers based interface technology. Mechanical Engineering Materials: metals, alloys, composites, non-metals, operating materials. The properties of metals and alloys (testing the hardness, strength, etc.).

MEASUREMENT AND CONTROL
Measurement and measuring devices: length, angle, mass and momentum. Marking and measuring metal. Control definition.

MATERIAL TECHNOLOGY
Principles of metal processing with and without merging and cutting metals. Safety precautions.

MACHINES AND MECHANISMS
Principles of machines and mechanisms. The elements of machines and mechanisms: components for connection elements for power transmission and motion, special elements. Production machines: operating principles, composition, use. External machines (bike, car, rail vehicles, ships, aircraft, etc.) And internal (conveyors, cranes, etc.). Transport: operating principles, composition, use.

ROBOTICS term robot. The types of robots, purpose, construction (mechanics, drive and manipulation). Modeling of the robot from constructors sets and user interfaces.

POWE SUPPLY, use and transformation of energy. Power Machines Motors: hydraulic, pneumatic, thermal (cylinders, turbines, steam engines and turbines, two-stroke gasoline engines, four-stroke gasoline engines, diesel engines and other engines).

MODELING OF MACHINES AND MECHANISMS

Constructors modeling for independent work on their own project according to the algorithm: defining the task, solution to energy sources, selection of motion, transmission and executive mechanisms, management solution, composition or structure of the model, checking compliance with environmental and ergonomic requirements, technical documentation. Modeling of production machinery, transport equipment, transportation machinery and equipment and others.

ELECTRICAL SYSTEMS AND MATERIALS

Electrical materials and accessories - properties and applications (conductors, superconductors, insulators, switches, plugs, lamp holders, fuses, heaters, thermostats). Household wiring. Risks and protection against electric shock. Electrical machinery and apparatus production, transformation and transmission of electricity. Alternative sources of electricity. Electrical machinery, apparatus and appliances in household and industry.

DIGITAL ELECTRONICS Fundamentals of analogue and digital tehnologies. Basic electronic components. The structure of a computer: motherboard, processor, memory, interface, modem. Electronic devices in the household. Telecommunications and audiovisual media: mobile phones, GPS systems, internet and cable TV.

MODELING OF ELECTRICAL AND ELECTRONIC CIRCUITS

Practical development of electrical circuits - experiment - research - modeling of constructors materials and using computer simulation software according to students' preferences. Practical examples of management using a computer. Modeling of electrical machinery and apparatus, automatic systems and robots.

PROGRAMME INFORMATION TECHNOLOGY

INTERNET

Electronic communications: the concept of electronic communication, safe behavior on the Internet. E-mail: The structure of the electronic letters, functions of email programs, programs for e-mail, Web mail. Communication in real-time, instant-Thu (chat), messages, phone calls over the Internet, video conference. Discussions on the Internet forums, discussion groups, blog, dating network. Use of the Internet for learning, distance learning, digital libraries, using information gathered from the Internet.

SOUND PROCESSING

Sound and computer generated sound and how we hear it, sound digitization and playback. Sound formats: uncompressed formats, compressed formats without loss, compressed formats with losses. Conversion between different formats. Recording and processing of voice and other sounds. Practical work on the sound recording and processing.

VIDEO PROCESSING

Image, video and computer. How the image is created in the eye. The first film. Record a video. Record a video by mobile phone. Record a video with a digital camera. Record a video by digital camera. Processing of video sequences. Edit video, sound, graphics and text materials as a whole: video installation, installation of sound recordings, edit text material. Independent film making. Formats and Conversion.

MAKING PRESENTATIONS

Basic concepts: presentations, slides, presentation devices, displaying computer presentations. Forming a presentation: preparation for making presentations, organizing images in a presentation. Computer presentations: launching a program to create presentation, the start of making a presentation, navigate menu and basic toolbar, basic settings, review text in the presentation, add, delete and hide slides, change the order of slides, non-text part of the presentation, animation of objects on a slide, the effects of the transition between the slides, display presentations, record presentations, printing of both presentations and business materials. Hold a presentation.

AUTOMATED COMPUTER DRAWINGS

Introduction to computer drawings: basic formats for storing drawings and images, programs for graphic design elements and principles of graphic design. Program *INKSKAPE*: launch programs, prepare to draw, draw basic graphic elements, change of style in the drawn object, drawing of lines, drawing in a record file, work completion, uploading files from drawings, labeling, global overview of image changes made to objects, move objects, duplicate buildings, align and relocate facilities, transformation of facilities using text in the drawing, working with bitmaps, prepare drawings for internet and printing.

WORKING WITH TABLES

Spreadsheet workbook and worksheet: description, placing commands in Microsoft Excel, adjustment of the working environment, setting worksheet, entering data into a table, data manipulation, shift tables, manipulating worksheets, recording a document to a file, complete the work, upload a document from a file. Entering data into a cell: formatting the display of the cell contents, automatic data entry. Formatting cells and creation of tables, determining alignment, formatting characters and blocks, drawing edges around the cell, deciding the color and shading cells. Formula: values or constants, operators, entering and editing formulas, referencing the cells. Using built-in functions: classification, administration. Creating charts: types, creation, modification, examples. Working with building structures in the drawing, print a document.

INDEPENDETLY DEVELOPED PROJECT

Preparation for project development: Selection of form according to which the project will be shown, the choice of theme in the presentation, Terms of Reference, plan development. Example of the project called "History of Photography": sorting and analysing materials, form by which the project is shown, units of text and image, final observations. The project called " Program making for issuing of fiscal receipts": what is a project, the choice of topics, project development, program making.

LEVEL 4: 1st and 2nd class Colleges and Vocational Schools

PROGRAMME TECHNIQUES

PROGRAM GRAPHIC COMMUNICATION TECHNIQUES

Display object in the drawing in plane and space (2D and 3D models) using the appropriate software on your computer (CAD / CAM / CAE platform). Programs for drawing, production preparation and simulation: AutodeskCAD, AutodeskInvertor, SolidWorks, Catia, etc. ProEngener. CAD / CEM / CAE platform to support: programming of numerically controlled machines (NU, CNC), integrated product development (IRP), numerical analysis using finite element method (FEM), rapid prototyping (Rapid prototyping), motion simulation models and simulation process processing (SIM), computer integrated production (CIM).

MODERN MACHINES AND TECHNOLOGY

Development of components in modern machines, tools and machinery of complex systems;

development of control, drive, measuring and manipulating systems. Designing of machine tools and their components; new methods in designing, construction and budgeting. Numerically controlled machines and processes. Computer integrated manufacturing systems - conceptual solutions, achievements and development.

MANAGEMENT OVER SYSTEMS USING ICT
The use of computers in management over systems and processes that improve their efficiency and effectiveness. Interface technologies in management over machines and processes. Computer hardware and software for managing the systems.

MODERN MATERIALS AND TECHNOLOGIES
Modern materials-production and use: composite materials, fiber optics, superconductors, super insulators and other. New methods of material processing: electric erosion, plasma technology and laser processing and other. Practical knowledge and skills so as to manipulate modern materials, develop technical and technological Pack documents, choose the right technological procedure, choice of tools, equipment, machinery and other technical means of work through corresponding procedure and testing of technology, measurement and control of the results achieved, application of high-tech machines and implementation of safety measures.

ARTIFICIAL INTELLIGENCE
Use of computers in the field of artificial intelligence and its implementation in expert data search systems, its application in the game theory, learning systems and neural networks. Getting to know the basics of artificial intelligence; artificial intelligence and translation - speech recognition; its application in robotics.

MECHATRONICS
Mechatronics as an integrated (synergistic) blend of mechanical engineering, electrical engineering and information and communication technology (computer science, informatics, automation, signal processing, etc.). Machine control systems and processes: direct and feedback, input, output, system transfer function. Sensors, transducers and signal processing. Mechanical, electrical switch and hydraulic mobile systems. Digital logistics, programmable logic controllers, microprocessors. Communication and programming of mechatronic systems. Designing mechatronic systems.

INDEPENDENT PROJECT DESIGN PRODUCTION
Solution to construction and technical documentation development for the selected products. Solving technological process of the work plan and the launch of production. Simulation of the production process using computer simulations. Organization of the production process on school machines. Selection of forms showing the project, the choice of theme for the presentation. An example of work on the project "a machine for the production of brackets': sorting and analysing material, the form of presenting the project, analysis and final conclusions.

PROGRAMME INFORMATION TECHNOLOGY

COMPUTER SIMULATION
MatLab simulation: mechanical systems, power systems, hydro and pneumo systems, mathematical simulation, robots. *RoboSimuling*: robot simulation software modeling and presentation.

PRESENTATIONS ON THE NET
Web presentations. the basic elements of *HTML*: introduction, tags and elements, attributes,

color and background image. Working with the text: insert, edit and delete text, move to the next line, the distance between words, special characters, alignment, lists, headings, fonts, style. Working with images: insert image on the page, change image size, positioning of the image on the screen, set up and call the image source. hyperlink - link: text and links, images and link, *E-mail* and links. Working with tables: defining tables, rows and columns, merge table rows and columns, frames, tables, work with text and images in a table. Create web presentations: tools for creating presentations, other tools.

DISTANCE LEARNING

Use of the Internet for learning , distance learning - distance learning , digital libraries , using information gathered from the Internet.

PROGRAMMING

Loops and other control structures: Counting program structure - *FOR-NEXT* loop, cyclic program structure - *WHILE* loop, other control structures. Subroutines, procedures and functions. Sequences: basic concepts of arrays, sorting arrays. Solving of problems. The process of problem solving tasks. Additional content (selected programming language, eg. C ++).

INDEPENDENT PROJECT DEVELOPMENT

Logistic preparation for project development: Internet search to define the Terms of Reference, design plan preparation, the choice of project presentation form, the choice of presentation theme. For example, project called "computer logistics for production of bracket machines": sorting and analyzing material, project presentation form, analysis and final conclusions.

3. CONCLUSION

This paper represents a draft form for the course entitled Engineering and Computer Science starting from level 1 - a four-year basic education, level 2 - the fifth and sixth grade, level 3 - the seventh and eighth grade, level 4 - the first and second grades of secondary education - gymnasium and secondary vocational schools for the existing eight-year education model, as set out in paper [5]. An option also included nine years of elementary education where the main elements of the subject complete with five levels of learning among students of different age have been specified. According to proposed Standard and the accompanying Curriculum, classes should ensure that the attained knowledge, skills and understanding are applied by all students so as to help them develop their own ideas, plan and develop their own products / applications and participate in the evaluation of the achieved results.

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Where the Computing Ends, and Begins …?

Siniša Ranđić[1]
[1] Faculty of Technical Sciences Čačak, University of Kragujevac, Čačak, Serbia
e-mail sinisa.randjic@ftn.kg.ac.rs

Abstract: *The development of computer science at the beginning of this century has seen great momentum. Further development of semiconductor technology offer faster components with greater procedural possibilities. This is particularly evident through the emergence and increasing dominance of mobile computing devices. At the same time, the possibilities for users in terms of independent development of application software have significantly increased. It was created as a result of the emergence of powerful software development tools, which fixed the boundaries of computing. Regular users can now develop a wide range of applications without the need for a deeper understanding of the essence of the computer, both hardware and system software. In order to achieve this transparency of computers operations, in the development of application software a major work of computer specialists is required. Therefore, it came to the creation of a fairly sharp boundaries between computer engineering and what is colloquially treated as information technology.*

Keywords: *computing, system software, application software, software development*

1. INTRODUCTION

Computing, what most people are familiar with, is quite a young technique. However, in these few decades, although perhaps computing did not experienced significant conceptual changes, technological certainly did. The most significant consequence of technological change is certainly a significant expansion of the field of computer applications. However, we should point out another change that has occurred, and is related to the design and implementation of computer. Although since the beginning of the era of computing there have been considerations that computers are as adapted as possible to the specific application, they are primarily designed as a general-purpose devices. The end of the twentieth century and the rapid development of semiconductor technology have enabled the development of computer-based highly integrated electronic circuits. This caused the computers to be increasingly designed according to the specific application requirements. In this way, computing has become a kind of "slave" of other areas of human activity where they have found their wide application.

Unlike the past period in which the originality of computing could be seen, today it is significantly lost in the multitude of other areas in which computers find their application. As a result, the boundaries between design and implementation of a computer are not as sharp as they used to be. Such a condition was highly contributed by the phenomenon of highly integrated circuits such as microprocessors, microcontrollers, and graphics processors on the hardware, or software development tools. Thanks to that, the illusion that for their use and implementation of computers and appropriate software the fundamental computer skills are not necessary is created.

Within the computing there have been significant conceptual changes, which caused that under the same terms today are meant different things in relation to the not-so-distant past. This is a common misunderstanding within the computing community. Simultaneously with these changes in computer practice, especially in the field of computer applications, the concept of information technology was introduced. This term in some way was a replacement for the previously domesticated concept of informatics. Although the term Information Technology primarily relates to the use of computers, there are tendencies to extend the domain of meaning to the field of design of computers and computer equipment.

Without neglecting the dynamics of the future of computing and the increasing adaptation to specific computer applications, the question of boundary of computing as a technique must be risen. This is not an academic question, but more of a determination of the framework for the acquisition of knowledges needed to practice the computer technology.

This paper will only indicate some structural changes within computing. In doing so, emphasis is on the software subsystem, because it has gone through significant changes, especially with the advent of mobile computing devices. Although of the provocative title, the paper does not pretend to offer a definitive answer to the question. It just opens up a space for discussion, which may be the subject of a special conference dedicated to this issue.

2. STRUCTURE OF COMPUTING

For the widest range of people who have contact with computers, they consist of hardware and software. In fact, even if it is an intuitive understanding, most of them have relatively good sense of what constitutes the hardware and software of the computer. However, when trying to parse these terms the doubts arise, in terms of concepts such as:

- Architecture and organization of computers;
- System software;
- Operating Systems.

In order to give the correct answer to the question what represent the aforementioned, and also the other terms related to the computer, it is necessary to start from the possible views to the computer as a device. Elemental approach to this problem is shown in Figure 1.

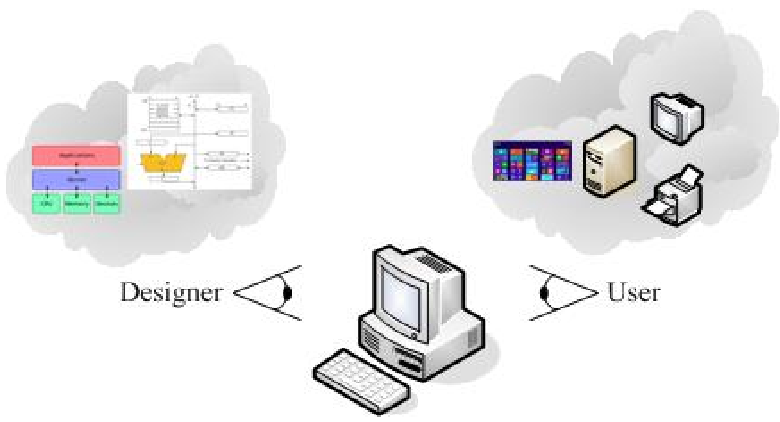

Figure 1. *Possible views to the computer as a device*

The designer sees the computer architecture and organization as hardware features that affect the development of the upper levels of a computer system, such as software compilers and operating system, having the compiler software directly depended on the computer architecture. Program compiler has the task of mapping the program written in a suitable high level programming language to the architecture of the computer [5], [6]. This is precisely served as a basis for defining computer architecture as a set of attributes that designer of computer program compiler sees [1], [2]. Unlike architecture, computer organization assumes the flow and control of data, logical design, and physical realization of the computer [3]. Through the operating system, designers provide control of computer hardware, the interface between computer and user, and a framework for developing application programs [4].

On the other hand, a user usually thinks of architecture as the structure of a computer system, i.e. a set of components from which the computer consists. In doing so, this approach is often linked to the physical realization of the computer and to the computer that is most commonly used. The ad hoc question of what are the parts of the computer, the following answer is given - chassis, motherboard, monitor, keyboard, etc. It is obvious that most standard users see the computer through the PC.

As for the operating system, users usually reduce them to the level of user interface. When it comes to program compilers, vast number of ordinary users is not aware of their existence.

In line with the development and the level of applications of computers, at the beginning of the computer era not much attention was given to differentiating computers particularly to designers, and particularly to customers, through proper education, especially because the user is required to have a high degree of knowledge of the computer. Also, it was influenced by the fact that the development of the user or application software was closely associated with designing computer.

The broad commercial application of computers has influenced that in the context of computing a clear differentiation of the areas in which the designers of various subsystems of the computer was made. These areas are shown in Figure 2.

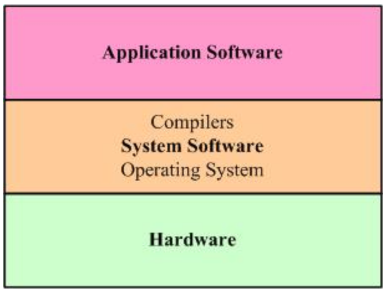

Figure 2. *The subsystems within the computer system*

The basis of every computer makes its hardware, on to which architecture the software system or software leans. This part of the computer system consists of system software and application software [7]. This division of the software is initiated by the need of facilitating the development of programs to meet the needs of their users. This idea will be followed by the development of a software subsystem elements to the present day. This is what will lead to a situation in which the development of modern application programs significantly exceeds the scope of computing.

In addition to the other, one of the main goals of computer science was that the development of application programs is as much as possible released from the necessity of knowing the characteristics of the hardware. The development of operating systems and high level programming languages made it possible to achieve this goal considerably [8]. The operating system allowed the hardware characteristics to be hidden from the programmer. Rather than directly programming the computer hardware, the programmer worked in the so-called virtual machine [9]. Therefore, although the same programming language was used in programming, the executable program was not portable to computers with different operating systems [10].

The next step in the development of computing was the development of programming languages in which the resulting programs were transferable from computer to computer, regardless of the operating system used. This practically means that such programming languages have their own virtual machine. The corresponding virtual machine is hiding from developers all the features of the computer that are below it. This meant that such programs could be transferred from system to system. In doing so, the destination computer has to have and enforce appropriate virtual machine on which portable version of the program is performed. A typical example of this is the JAVA programming language [11].

Simple development of modern application software is provided by the lower levels of the software that include the necessary software modules from which the desired application is built. This generally remains hidden from the developer of application software, because the software modules are transparent to him. The set of modules and their location within the computer system can be represented as in Figure 3.

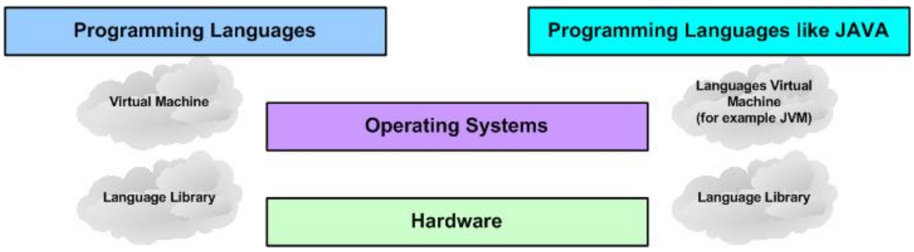

Figure 3. *Distribution of program modules within the software development environment*

Software modules, such as language libraries, virtual machines, and language virtual machines, provide interfaces between the individual computer subsystems. Thanks to them, the developer is released from having to know the characteristics of the subsystem that are below the level of the application program development.

The evolution in the process of software development has led to the emergence of tools for the design of the programs. Thanks to that, the context of computing was introduced with another subsystem, as shown in Figure 4. This subsystem is located between the system and application software, and includes a collection of programs that can be collectively labeled as tools for software development.

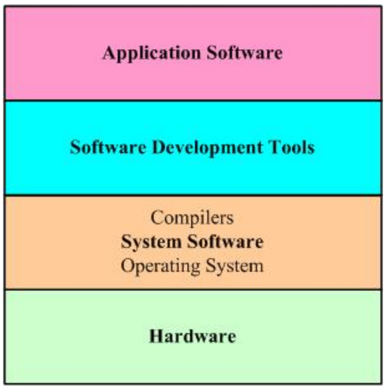

Figure 4. *Modified structure of computer system*

Thanks to the development of the environment for the design and implementation of application software, the computing in the classic sense ends at the level of design of software development tools.

3. CONCLUSION

Development of Computer Science at the beginning of this century occurred in two directions. One followed the developments in the field of semiconductor technology aiming the integration of multiple number of functions in the same circuit board. On the other hand, in the field of software development, the objective was that the approach to software development, especially application one, is much more accessible to the user. This creates the possibility that experts in the specific field can participate in the development of software, even when they are not sufficiently familiar with the computer itself. This is particularly important in case of realization of Internet applications in which software is developed for remote, virtually unknown users. In order to achieve that, the software environment for computers for which the applications are developed, must be significantly expanded. The result of this approach was the expansion of computing framework through the preparation of powerful software development tools. Thus, the boundaries of computing became more specific, particularly in terms of the knowledge required to implement elements of the system software and tools for developing application software.

In the paper, the development of the hardware was not discussed in detail, as it is in terms of development less interesting for a wide range of users. However, the market is offered with "open" hardware solutions that have the possibility of upgrading by users who are not necessarily experts in this field [12]. It should soon be expected to have discussions on the extension of the computing framework in the field of hardware.

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SECTION I:
CHALLENGES IN TECHNICAL AND IT EDUCATION – FROM PRESCHOOL TO UNIVERSITY

TECHNICS AND INFORMATICS IN EDUCATION
6th International Conference, Faculty of Technical Sciences, Čačak, Serbia, 28–29th May 2016
TEHNIKA I INFORMATIKA U OBRAZOVANJU
6. međunarodna konferencija, Fakultet tehničkih nauka, Čačak, Srbija, 28–29. maj 2016.

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Importance of TIE subject in education

Natalija Diković[1]
[1] Elementary school "Petar Lekovic" Pozega, Republic of Serbia
e-mail dikovicnatalija@gmail.com

Abstract: *Developed countries pay special attention to education, in which an important place occupied by the creation of technical culture and proper attitude towards work and the production. These principles are the foundation of subject technology and IT education (TIE) and it should be one of the most important subjects, from 5th grade (and possibly before) of the primary school to the end of high school. The curriculum is based on studying the basis of all branches of engineering and technology. Classes are theoretical and practical, encourages creativity, initiative, independence and teamwork also. Introduces students to the world of work and production, and provides a choice of possibility of future occupations and opening the way for an independent production and entrepreneurship.*

The work contains evidence that the TIE meets all requirements of the law on education, agrees with the plans of economic development and sustainable development. The work is carried out by surveys of students using online questionnaires on education and teaching as seen through the prism of the importance and needs of TIE.

Keywords: *education, teaching, TIE, entrepreneurship, professional orientation*

1. INTRODUCTION

Elementary school is the first and primary level of education. At this age, children acquire basic knowledge of humanitarian, natural and social sciences, engineering, arts and culture, develop socialization, through friendship and teamwork, and gain skills necessary for further education and future careers. At the same schools together with family and throughout the community affects the education of students. The course Technics and informatics education (TIE, on Serbian TIO), among other things, develops love and a proper attitude towards work and creation, which is the basis for the survival and development of human civilization.

1.1. Legislative provisions

Law on the Basis of the Education System, which is an umbrella Education Act, defines the objectives, outcomes and standards. The objectives of the courses are in line with the requirements, EOQ this law.

The overall outcomes of education are the result of the whole process of education that students should ensure the acquisition of knowledge, skills and value attitudes, which will contribute to their overall development. For this must create the conditions for obtaining these outcomes so that the students had the competence to continue their education, organization, teamwork, and to "effectively and critically using scientific and technological knowledge, by showing responsibility towards their lives, the lives of others and the environment." (Law, 5).

The Law on Primary Education, the introduction states that basic education is implemented in accordance with the Constitution, the law regulating the basics of education, according to established international conventions, charters, agreements and this Act. At the same time point out the objectives of primary education such as: the development of key competencies necessary for life in modern society, the acquisition of scientific and technical literacy, creativity and creative skills, application of acquired knowledge and skills, the ability to make the correct choice of further education and professions as well as taking care of their own health and safety, the safety of others and maintain a healthy living environment, with the principles of sustainable development, taking advantage of modern information and communication technologies.

After completing primary education, are provided and the outcomes of this level of education, which are in accordance to the set objectives.

Legal frameworks are included into manuar “Teaching directed to the outcomes, competence and standars of education – Manual for Technics and informatics education” (Razvionica, 2015).

"... General education provides the foundation and support any education. The change consists in the fact that it no longer intended social elite or individuals who are focused on the academic world. It can not be denied to anyone. The high level and quality of general education must be available to all students, and those who are academics as well as those who will opt for other professions. in order to answer its purpose ie. to enable the development of the necessary competencies, general education must ensure a balance between academic and practical, functional. " (Razvionica, 2015: 6).

The content and manner of realization of teaching contents of technical subjects and Information Education (TIO) fully satisfies the objectives, standards and outcomes set out in both the Act and is fully compatible with the development plan of education by 2020.

1.2. Economy and Education

The development concept of the Republic of Serbia until 2020, states: "In contrast to the successful transition countries (Slovakia, Poland, Slovenia) in Serbia after the first few years of transition, there has been no re-industrialization of the economy. This is, among other things, led to a very small share of exports in GDP (the lowest in the region). Continued economic growth in the previous assumptions except that is not desirable, it is no longer possible. "

In the draft of the National Strategy for Sustainable Development Education is very important. One of the key priorities is to invest in human resources through the "investment in knowledge and skills of people through quality, efficient and practically applicable education and continuous training for members of all groups in society based on the principles of equal opportunities".

In the countries with the similar educational history like in Serbia, the attitudes to the technics education is similar. „Technical education… is the qualitative prerequisites of the vocational technical education which is necessary for system of production, manufacturing, for development and sustainability of the technical-production system, as garantue of the economic and social stability of a country/state… Actual economic crisis in Croatia is reflection of the cultural phenomenon which disrupted work-integrated educational culture of the country… This phenomenon can considered as direct proof of importance of the technical and work-integrated culture in education, and importance of the course Technical culture in the system of general education of the people" (Purković, 2013).

Wars, inflation, transition, global economic crisis and Fig. left an indelible mark on the economy, spiritual and mental state of the whole nation. In some states are investigations that our sanctions godna nineties of the last century, inflicted more damage on the development of society, from centuries of slavery under the Turks. The lack of healthy competition, loss of markets, lack of cooperation and exchange of scientific achievements and so on. only an introduction to the economy down time, failed privatizations, the decline in living standards and the loss of confidence in institutions, which should be a pillar of modern states.

This turmoil and change did not miss the education system. Attempts by various reforms, similar to Western education, have not yielded the desired results. Comprehensive curricula, a large number of cases, the introduction of inclusions and others. in primary education have led to very poor results (outcomes) at the end of this level of education. In the PISA and similar tests our students are among the last in Europe. Quality education is the basis of the indicator of development of society. It must be based on careful planning and harmonization of the large number of parameters and in the process must be included psychologists, professional public but also the economy, with clear plans and indicators required number and profile of future industrial and scientific personnel. In addition, we must take into account the specificities, the mentality, the culture and traditions of the people and the proper distribution of the economy on the whole territory of the Republic of Serbia. Changes in education to speed, pressure, driven by narrow interests, incompetent and inadequate decisions made deep analysis yields incalculable consequences for generations, who should be the bearers of the future development of the country. Something that is great in other countries and cultures should not, as a rule, be sure to answer each community.

First, it is necessary to determine the real goals of education, with all the peculiarities and the situation you are currently in our society, and the vision of the future, which will be governed. Make sure that they comply with the age and abilities of students. Each job in the end should have the final product. The key question is: What is the "product" at the end of this level of education? Do our students have the necessary competence for further education and the gradual inclusion of all segments of life and work? One can make an excellent product with a great effort but if there are no conditions for the use of the effort is futile. The same is the case with education. Goals can be European, can be great effort of all relevant stakeholders of education or to the end product of this process, the student who has a certain perception of their abilities, often overemphasized, can't find their place in society. The development of entrepreneurial competencies must be in accordance with the economic offer, otherwise many young people will find themselves in a situation that they do not have the opportunity to prove themselves in real, their work environment and ensure survival. It is very important that the children of early school age children in an interesting and comprehensive way to present different opportunities and professions offered by the economy. The education system needs to be set so that each child fully understands, for which they will use the knowledge and skills that are acquired, and where they can be applied in a real environment and the future.

Curricula for TIE/TIO students, through theoretical and practical work, taking advantage of information and communication technologies, the large number of manufacturing jobs in the field of engineering, technology, agriculture, transport and so on. Cooperation with secondary technical schools, with the help and support of local communities, visits to manufacturing facilities, etc. Students get acquainted with the functioning and working methods in production. In this way, students can present different types of future interest that can be defined on the basis of their own preferences and abilities. TIE/TIO is the basis for the different levels of future technical professions, crafts and engineers, scientists and inventors.

1.3. Subjects and relieve students

Number of subjects in primary school exceeds the legally defined framework, for all classes, except the first. Apart from the question of quantity and scope of teaching content through the subject, to be processed, on this, the primary, level of education. Elementary school should provide permanent basic knowledge and skills in a large number of natural, social and humanities, culture, art, technology and sports. The amount of knowledge and skills necessary to meet the largest part of the student population and not only the best among them. "About a third of students falls within the category of those who are not functionally literate in the domain of reading, which means that every third student in the Republic of Serbia has difficulty reading complex texts, which is a significant obstacle to their further education. Thus, students coming from elementary school without enough developed basic competencies that they need and importance for continuing education and for better orientation in private and public life. " It is illogical to primary school students learn two foreign languages and a large percentage do not have basic literacy in their native language. They learn the details about a number of countries, on all continents, but they do not know the major cities, mountains and rivers in her; Dynasty pharaoh, social strata of the Roman Empire and the like. but do not know their own history; wave motion, optics and the laws, and not know how to convert units of measure for length, mass and time, etc.. Basic knowledge of elementary school should bear the greatest number of students and must find a way to get to really realize and not be just a wish and the idea defined in the form of a law.

Often textbooks are too extensive, written almost at the academic level and intended for a small number of exceptional students. A large amount of information and data that the students mostly learn by heart, at the time the Internet became easily accessible. A student of average ability should make a great effort to permanently remember such events. Most of them give up teaching because of this situation, it is obvious that the education system does not follow the modern method of storage and access to the knowledge base. This is, of course, be punished by the teachers, reducing score. It is not surprising that the most popular subjects students physical education and technical and IT education, because that students develop creative and motor skills, and all modern research show how important it is to develop intelligence and physical health of students. It is intolerable that it does not recognize the relevant factors which create Curricula for primary school, although constantly emphasize the slogan "School Fit for Children" and "The student in the spotlight." Teaching TIO is organized so that really puts students at the center of the teaching process and respects his individual abilities and interests.

Plans envisages a large number of hours of treatment without the possibility of prior knowledge determines the largest number of students. The big problem is that the practical application of acquired knowledge is almost nonexistent, except in class technical and IT education. An important segment of the so-called children's development. fine motor skills, which directly affects the development of both brain hemispheres and increasing the number of connected neurons, synapses, thereby increasing intellectual capacity and cognitive abilities. In no event should not be neglected educational role of the school. Socialization, cultural behavior and team work are essential prerequisites for entry of young people into the adult world and future interest.

Often teachers unfairly blamed for the paradoxical situation which is imposed upon them by the Ministry of Education to the low level of student outcomes and competencies associated with relatively large numbers of excellent students. It is forgotten that the GPA included two estimates of physical education, one of music and fine arts, technical and IT education, where the majority of assessing the skills and commitment of students, as well as an assessment of governance. It has been six score, which can realistically be very high, and the average grade of any other object enters the engagement and interest in the subject. All this results in a relatively high overall success of students, which generally does not have to follow the planned outcomes. A particular problem is that students often acquire an unrealistic picture of the actual amount of knowledge that they own.

Education is a complex system made up of a large number of elements that must be carefully assembled into a functional unit. This system needs to produce emotional, intellectual work and improving the ability of students and give them the ability to find and develop their own interests, as a prerequisite for professional orientation. That is why his every segment is very important and must be carefully planned and professionally implemented.

2. IMPORTANCE AND NECESSITY OF THE COURSE TECHNICS AND INFORMATICS EDUCATON (TIE/TIO)

Technical and IT education in the classroom is represented with two connected classes a week, so-called. Block classes, from fifth to eighth grade elementary school. It was reformed and modern subject, which provide students with basic knowledge in all branches of art and agriculture. Addresses the teaching topics: graphic communication, types and ways of processing of materials, energy, use of information and communication technologies in engineering, machinery and equipment, transport etc. These teaching topics are represented in all four classes and are interconnected both vertically and horizontally. Students learn about the application of acquired knowledge in physics, chemistry, mathematics, biology, etc. Develop skills for practical application of knowledge through the development of various items, models, mechanisms and devices, creating simulations of intersections, electrical and electronic circuits, using ready-made software and the like. The course work is realized through the module where the students according to personal affinity, independently, in pairs or in a group, working on their own projects algorithm "From idea to realization." Application of theoretical knowledge through practical application ensures the sustainability of that knowledge, skills development, creativity and sense of aesthetics.

A very important area is the behavior of road, which is in elementary school, ending in fifth grade with the predicted number of eight hours for teaching this subject. Not in high school and not a high school, in addition to traffic, this important element of traffic culture is not mentioned. The consequences were disastrous, considering that a large number of children and young people are killed in road accidents, either as pedestrians and young drivers. No knowledge of regulations, a condition in which there are roads, substrate quality, weather conditions, etc., Lack of sense of power and speed of motor vehicles and the like. the causes of this financial statement. Increasing the number of hours for teaching this subject and its "broach" through all classes until the end of high school and gymnasium might impact on different picture on our roads. It is necessary to do and see the results of a deep and expert analysis on this topic.

Given the importance and topicality of the constant themes that are processed, and the dizzying development of technical and technological achievements realistically examine the possibility and necessity of vertical mobility of this case in all the years and all directions gymnasium. The technique is constantly changing and progressing. Knowledge and skills acquired in primary school only basis for the limitless space of study and promotion techniques, technology and production. This knowledge will be increased from year to year so that the base, which brought high school students graduate from elementary school and with whom are enrolling in technical faculties, insufficient for future engineers.

For improvement of pupils’ knowledge sustainability, Ministry of education considers the idea of integration of two-three courses. In that way, pupils can to learn comprehensive knowledge from different fields. In the subject TIE/TIO this concept of integrated learning was realized: two fields – technics and informatics – are connected and integrated.

3. RESEARCH

3.1. Organization of research

Analyzing the foundations of the system of education, the needs and plans for the development of the economy, the real outcomes of primary education, the level of competence for the selection of future interest, entrepreneurial competence and the current reform of the elementary school the impression that the Ministry of Education aware of the necessity of changes in the level of education.

Based on the defined research problem, the subject of the status of research subjects TIO, as part of the education process, which directly contributes to enhancing outcomes and competencies.

The aim of the research is to establish rapport, opinion and interest of the students for the contents of the object TIO, through a complex view of important elements of education.

The study was conducted on 468 students in several elementary schools Zlatibor region.

In order to determine the students' opinions on this issue is set gugl online questionnaire with 11 statements. Nine types of statements are multiple choice, a "true-false" a statement in the eleventh students are invited to express their opinion on the possible changes that would lead to improvement of the educational process.

3.2. Research results

The results of the electronic questionnaire is immediately read as a diagram to the percentage of each proposed option. Considerable research has options for additional shading.

The first statement was related to professional orientation and select one of the multiple choice options from different economic and social activities (Fig.1). The largest number of children that would like to play sports (29.6%), followed by technicians (17%), natural sciences (13.1%), education (11.3%) and music (11.1%), etc. The sixth statement is offered all subjects for measurement of the items and what percentage helps students to more easily opt for the choice of future profession. Results of the show the following: physical education (17.4%), TIO (22.9%), biology (12.6%), foreign languages (9.7%) and so on. Interestingly, the chemistry and physics of the very small percentage (about 1.5%) students approaching future careers. Based on the obtained data it can be concluded that, after the sport as a future profession most interesting technical field, 22.9% said it allows them to cross-curricular fabulous object TIO.

Figure 1. Item 1

Figure 2. *Item 6*

In the following two statements of the students have chosen favorite subject, and declared themselves why they are so identified (Figure 3 and Figure 4). Offered are all compulsory subjects in the elementary school and informatics, which is an optional subject. Placement course is the same as in the previous analysis with a smaller margin percent. Almost half of the children pleaded their favorite subject is the one who prefer to study.

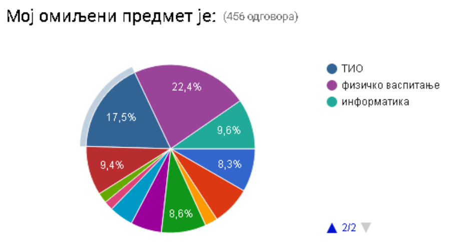

Figure 5. *Item 2*

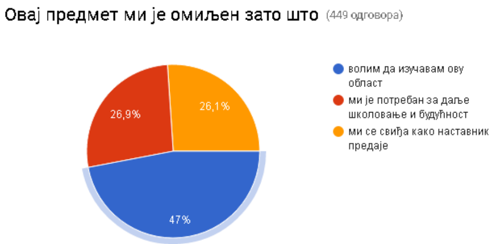

Figure 4. *Item 3*

The fourth and fifth testimony given answers to the questions of application of knowledge that students acquire in school (Figure 5 and Figure 6). The majority of students (83.3%) is very important to know the significance of what they teach or explain the possibilities of applying the knowledge acquired in the primary school does not receive nearly a third of students.

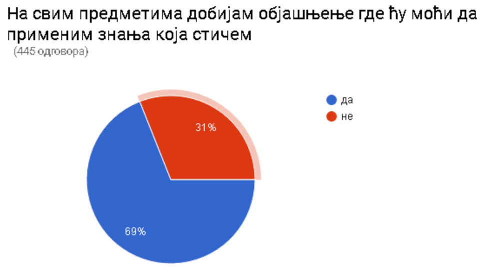

Figure 5. *Item 4*

Figure 6. *Item 5*

Other statements relate to the learning process and the amount of acquired knowledge (sl.7,8, 9 and 10). 81.8% think it is important to be educated and that they need to know in life, about 77% of students successfully, easily and with a lot of work, coping with school work and their 15.4% that does not succeed, no matter how try. The biggest problem for effective learning for 49.3% of the students is extensive material to get a high score is required of them understanding (49%) and implementation (19.1%) and even 28.1% for the same result must learn much information from memory.

Figure 7. *Item 7*

Figure 8. *Item 8*

Figure 9. *Item 9*

Figure 10. *Item 10*

Item 11 is: "In order to be motivated to be more bother and achieve better success in school, you should introduce the following changes (write what would you change in teaching)." Objections students mostly were related to: reducing materials, reducing the number of hours, better relationship between teachers and students, discipline in the classroom, presenting interesting materials, more hours of physical education and practical application of knowledge (camps, nature trips, etc.).

3.3. Analysis of the survey

Based on the analysis part of the survey, which contains all the items, it can be concluded that the TIO favorite subject at school after physical education, a reason, a majority, for that is what they like to study this field of education. TIO almost the highest percentage in relation to other objects, the students closer to the possibility of future profession. Students were izjsnili that it's very important to know where to apply the acquired knowledge and to them 83.3% to dobijaja in school. Acquiring knowledge is one of the most important goals of education and students is very important to be educated (81.8%). Teachers of students require an understanding of teaching material and application as the biggest problem is the extensive material but also boring lectures.

The students were in part surveys in which they share their suggestions, declared that they want more hours where they were physically active and i stayed in the countryside or real environment. The way of presentation of educational content in teaching TIO is such that the theoretical accompanied by practical work, through the development of appropriate models, models, devices, etc. The use of different software, visit production sites, museums, exhibitions and the like.

“Technical education is essential part of the general education, which integrates knowledge of different fields and gives to pupils technics-technological competence important for the life and personal and professional development.” (Purković & Bezjak, 2015).

4. CONCLUSION

Taking all this into account TIO is a very important subject in primary schools. It is fully in line with the objectives and outcomes of education. The technique is the application of skills and overall knowledge of the natural sciences and mathematics, which is used to produce a variety of devices necessary for the life of modern man. TIO is designed so that the benefits of ICT in the presentation of educational content and independent or group work of students. Teaching TIO can work place in classrooms, workshops, plants, nature, etc. but online, which provides for the education development plan by 2020. The theoretical teaching is imbued with the practical application of acquired knowledge, which is acquired knowledge but also the sustainability of the basis for the proper selection of suitable future profession.

TIO is the subject, which have the fastest changing, thanks to the enormously rapid development techniques and technologies. Thanks to an easier and more affordable use of ICT and enormous knowledge base relatively easy this development can be traced in the teaching TIO. However, like every science proceeds from its earliest beginnings, so the techniques and technologies of primary school students must present from the base to the bottom of their students understand the basic principles but also that the current level of technological development, in which enjoys the benefits of mankind, created thanks to discoveries of great scientists and inventors as well as ordinary people who have sought to facilitate the work of people's lives.

Technical drawing is the universal language of the world, who understand all people with basic technical literacy. Experts in the field of technology, each level, crafts and engineers, are appreciated and sought after all over the world and can easily come to work in the profession. Developing an affinity towards work and create impact on the development of entrepreneurial competencies, so it is an excellent basis for serious engagement technique, later working in industry or start their own business by opening small and medium-sized enterprises.

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Technical and IT education challenges, fears and hopes

Zoran D. Lapčević[1]
[1]OŠ „Dositej Obradović“, Belgrade, Serbia
e-mail lapcevic@vektor.net

Abstract*: Technical and IT education is a subject with different names so far, but with a long tradition. This is the only subject of theoretical and practical character where students acquire functional knowledge at the class applied in practice through practical work, knowledge which is applicable at different levels outside the school in real life. The century in which we live is the century of inexhaustible and spiraling development of techniques and new technologies, which is the basis of development in all fields, and the society as a whole. Without knowing the techniques and technologythere is no development of ICT and their efficient use. IT facilities in the TIE in the function of computer applications in technique. Possible separation of informatic techniques by subtracting one class of TIE and the impossibility of practical application of acquired knowledge to students wouid deny the application of ICT in education, skills development and mobility (sensorimotorics, psychomotor, fine motor skills), the development of technical creativity, creativity, the subject would lose its multidisciplinary nature .*

Keywords: *techniques; functional knowledge; informatics*

1. INTRODUCTION

Technique is responsible for the development of any society,and dealing with technique is everyday need of people, who are surrounded by various technical means. Modern technologies, production automation, information technology, robotics, use of new energy sources, the development of telecommunications, fundamentally change the structure of society and our way of life. The intensive development of science, technology and production targets in the world brings a need for even greater implementation of content and technology in our educational system from the earliest days of schooling.

Technical literacy has always been, especially in today's modern technical and technological time, one of the most successful segments of the educational process of youth education, development and promotion of each individual and the prosperity of modern society in general. Therefore, the technique within the subject technical and IT education (TIE) should be viewed as a science rather than a skill.

A variety of programs within the framework of technical and IT education, from the fifth to the eighth grade, introduce students to the world of technigue and modern technology in an interesting and attractive way, encouraging their interest for technical creativity.

Program at technical and IT education relies on previous experiences in the classroom and in the current reality, and aims addition to the modernization and rationalization of object classes and relieving students, so the program is of evolutionary nature.

The lessons are taught through lectures (theory) and practice (practical training) primarily using methods of visual and practical presentation with the algorithmic approach to teaching, using modern teaching aids. Practical work allows students to express their own creative abilities, seek and find their own technical solutions and prove it in practical work. This approach allows the individualization of teaching, according to the talents, abilities, motives and interests of students. Selection of exercises in program content according to each student achieves personal commitment. The realization of exercises can include more students if the project is more complicated, or if it is justified, rational in relation to the objective, tasks and, if the application of this form of work has social, psychological, pedagogical and didactic justification [6].

Connecting theory and practice is achieved through the unity of theoretical content and exercises in implementation which should be intertwined and complementary. Program content provides a functional correlation with similar content in the teaching of physics, mathematics, biology, chemistry and others.

1.1. GOOD BASIS FOR DUAL TRAINING

It's largely spoken about of the introduction of dual education in Serbia. It can not be realized only by the reform of secondary education. Students in elementary school must be prepared for this kind of education, and it's the most natural thing within the context of the subject technical and IT education, because its programs already represent a good basis for the dual education.

This is demonstrated by the practice in the countries vhat we want to look up, and whose experience we want to implement. For example, in Austria, the students after the fourth grade, based on the observations and recommendations of teachers, opt for one of the forms of continuing education, with the aim of gradual introduction of the dual model of vocational education [1].

In the process of preparing students for a dual system of education the role of technical and IT education is particularly important in terms of professional orientation of students. Through practical work in this subject teachers, identify vulnerabilities and capabilities among students during their education expressed by a particular branch of technique which is taught in this course and guide them in that direction to get to know, i and easily choose their future profession.

The fact that about 75% of those who enter secondary school, enroll in our professional schools, gives more importance to the study of such subjects in elementary school [2].

The dual model of vocational education means that students enrolling at vocational schools provide a position for themselves in the companies that, along with the school for a particular profession and give them, trained knowledge and skills needed for practical work. In this way, after graduation they are fully trained to operate. An important fact is that a large number of young people leaving school establish permanent employment at the company where they gained practice in education in Germany more than 80% of pupils from the three-year dual education find a job at the employer where they had practice [3].

All in all, technical and IT education represent a very important segment of the cycle of dual education announced in our country.

1.2. MODERN CLASSROOM OF FOR MODERN EDUCATIONAL

In order to enable students to express their creative abilities and creativity through practical work, and to enable them to prepare for further aspect of dual education in secondary school, they must be provided with favorable conditions for work, which means that they have a modern classroom for technical and IT education. This century is the century of inexhaustible and spiraling development techniques and new technologies, especially information and communication technologies. This is the reason for modern teaching TIE in functional classrooms using modern teaching equipment.

Unfortunately, many TIE classrooms are now just typical classroom with desks, chairs and a blackboard.

The reasons for this situation are, above all, lack of space and material resources for the provision of equipment, as well as the lack of interest of teachers and school principals to change this.

The Ministry of Education should as soon as possible, bring the long awaited new standard of equipment at school laboratories which must be accompanied by the adequate financial support, otherwise modern teaching and dual education won't happen.

1.3. ENCOURAGE THE CONSTRUCTION OF FUNCTIONAL SKILLS

Today it is considered that the main outcome of education should be the acquisition of functional, applicable knowledge.

Functional skills must be developed from early childhood. In the context of education, functional skills are developed by guiding learning process forwards students and his activities, as well as putting emphasis on their educational achievements including the development of linguistic, mathematical, technical, IT, scientific, artistic literacy, necessary for life and work in modern society [2].

Being functionally literate means to interpret context in which some information is given, understanding and bringing things into a particular connection and using aguired knowledge in different situations.

Reproductive knowledge of our students is high, but functional is very low, and functional knowledge of the applicability and productivity depends on the individual. Reproductive knowledge involves constant repetition of lessons, and what is learned in such way, without practical application, is forgotten after some time.

When assessing student achievement in the framework of international programs, such as the PISA (Programme for International Assessment), students are not required to reproduce the contents of the various curricula, but to apply them in relevant situations outside school.

The mere fact that in recent years we share the last places in the PISA program, and that last year we did not even appear on such a prestigious assess of student achievement, emphasizes even more the importance of acquisition of functional knowledge of TIO [4].

The program of technical and IT education encourages functional knowledge with the student and provides the ability to verify the practical application of knowledge, whereby they have greater durability and are a better basis for further learning. In addition, the acquired knowledge and skills from this course students can apply outside of school, solving problems in real life, in satisfying their own desires and goals, encouraging their motivation and activity.

1.4. TECHNOLOGY AND INFORMATICS

We live at the age of automation and robotics, the time in which an increasing number of technical devices contain in its name the attribute "smart / i". The level of overall development has already reached the point where the technology / technologies and infarciono and communication technologies (ICT's) have become inextricably interdependent. There is no technical device in which is not installed, an information technology. Therefore, IT facilities are in the program of technical and computer education. Without knowing the techniques and technology there is no development of ICT and their efficient use.

Therefore it is hard folunderstand the effort of informatics teachers which recently culminated with reference initiative to the Ministry of Education, the National Education Council to separate techiguefrom the informatics technology. Particularly disturbing is the way how to do that without acquiring an opinion frau vocational colleges, the Society of teachers of technical culture, teachers TIO and informatics, and professional public in general.

Separation of informatics from techniques could have unforeseeable consequences on the creation and development of technical and technological competences of young generations. ICT is not just a technique, nor IT education can be a substitute for the technical and technological. On the contrary, they are inseparable and complementary. The only correct approach is inevitable technical education with specific application of information technology in various fields of the techniques that are taught in this course.

Development of the curriculum for technique without computer science technology would mean a return to the first half of the last century. Information Technology in our school program is represented in the first grade, and the technique in the fifth grade of primary school. In teaching technical and information education we have 62 hours of informatics from the fifth to the eighth grade, and information technology with specialized software for using in the context of certain techniques that are taught in this course (construction, mechanical, electrical, electronics, robotics, transport technology, etc.). That should be the real goal for studying and application of information technology in all subjects in primary school. IT facilities in the TIE are in the function of computer applications in technique, and there is no reason that such activities spill over into any other subject, not even in IT.

TIE makes the basis of teaching concept that is built on the achievements of psychological-pedagogical science and technological development, as well as the experience of other countries [3]. Because of this, the primary commitment is to keep the concept of TIE developing skills and mobility (sensorimotorics, psychomotor, fine motor skills), developing technical creativity, creativity, learning about technical materials and technology of their processing, traffic education, energy, ecology, construction engineering, mechanical engineering, architecture, electrical engineering and electronics, agricultural techniques and technologies, telekomunications, informatics, robotics, interface technology, mechatronics, etc.

Bu the reconciliation of classes of TIE to one hour per week, the most important practical part of this subject would have been completely lost, and everything would be reduced to a theory without practical work and it makes no sense.

If this hoppened, reduction at number of hours at this subject would create incalculable consequences for the technical literacy of young people, their creativity and creativity, making it impossible to acquire new knowledge of modern technologies and the right choice of professional orientation. Doing this we mould move in the opposite direction to the demands of the economy, society in general and from the announced introduction of dual education. Each flat-rate reduction of curricula to meet the form, would be disastrous for future generations of young people. It would also be contrary to the Bonn Declaration (UNESCO, 2004), which defines the "five new skills" among which, in addition to information and communication skills is technical culture on the second place [5]. The subject of the technical IT education as part of its program significantly contributes to the development of these skills and therefore belongs to the graupot modern subjects that contribute to the universal development of personality and occupies an important position in the school curriculum.

2. CONCLUSION

Technical and IT education is a subject full at challenges. Every day, having learned something new from the world of technique students you have a new challenge in to deal with, eager to learn and prove themselves. Teachers are there to direct them, encourage and train to successfully navigate the modern technical environment.

Unfortunately many years of anxiety, of the teachers of this subject, who struggle for years dedicated to work, finding examples of modern technical and technological achievements, modern pedagogic practice, the needs of the modern market economy, and, in this way trying to prove that technical and IT education has a very important role in the education of young people who will one day be the leaders of the economic development of our country.

Hopes for greater representation of modern techniques and technologies in the programs of our schools are in all of us: teachers, students, parents, teachers at vocational schools and technical colleges, business men and all those who know that modern technology pillar of development of any society. We sincerely hope that those who make the key decisions within the school system of Serbia are aw are of this fact.

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The global perspective of technics in education

Veljko Aleksić[1] and Željko M. Papić[1]
[1] Faculty of Technical Sciences Čačak, University of Kragujevac, Čačak, Serbia
e-mail veljko.aleksic@ftn.kg.ac.rs

Abstract: *A characteristic of production-oriented economies of the developed countries is that they demand technology literate students from their educational system. The paper presents key characteristics of technics in education with reference to the international standards and subject development perspectives. Modern education involves multidisciplinary knowledge and the production in digital environment, so the student skills and competencies make a complex kaleidoscope.*

Keywords: *technics; education; perspective*

1. INTRODUCTION

Technics and technology are important factors in any modern society, whether we use them in private or professional life. The introduction of technology in economics, culture, healthcare, and society, ensures the sustainable development, encourage innovations, change our habits, lifestyle and professional performance. Technical education enables the acquisition of fundamental technology knowledge base and the ability to adapt the use of technology to private, social and professional needs. Technologies gave us mobility and communication as the fundamental social changes and defined the way how we see ourselves in modern society. Having in mind the perspective and the importance of technics and technology, it should be expected that technics education is a key element of the curriculum. Developed countries, such as Germany, United Kingdom, Netherlands, Australia, USA, etc. are explicatory in having technics/technology education in compulsory education framework [4] [7] [8].

Many researchers have studied the legitimacy and the emancipation of technics education [10], and they stated four basic characteristics:

- Educational theory – based on two key elements: (1) students must be prepared for society and life; (2) technology makes the integral part of the culture. The educational potential of technics is reflected through understanding, construction, evaluation and technology design. Having in mind the technology-oriented environment, the educational theory perspective implies that everyday use of technology is active participation in society. Social participation is the key educational goal of technology literacy in creating ITEA standards [6];
- Epistemological stance – technology science is considered to be a separate interdisciplinary science. Its interdisciplinarity is reflected in close cooperation with

the science and engineering, philosophy, sociology, and economy;
- Sociological impact – new technologies (e.g. Internet) can become the important factor in social changes [4];
- Practical professional importance – it is assumed that technical skills in combination with intelligence will induce the success in education [2].

The examples of international standards and the basic characteristics of technical/technology education are further presented.

2. INTERNATIONAL STANDARDS FOR TECHNICAL/TECHNOLOGY EDUCATION

The introduction of educational standards is aimed at providing the results of education and improving the teaching quality. Specific subject goals are formulated through skills that Weinert [15] defined as the cognitive abilities and skills that individuals possess or can learn aimed at solving specific problems in various situation. Skills should be modelled in accordance to the subject specifics. Unlike traditional science subjects, such as physics, chemistry or biology, educational standards for technical education does not exist in cross-countries unique framework. This consequence is due to the fact that standards for technical/technology education were usually created by interested groups (e.g. ITEA – International Technology Education Association, AAAS – American Association for the Advancement of Science, VDI – Verein Deutscher Ingenieure) based on the curriculum of different countries. It should be noted that there are cases that technical education does not exist as a subject in formal education.

A selection of relevant international educational standards and curricula for technical education is further presented:

- Delphi-study [11] presented the results of technical education key goals analysis. The study was prepared and participated by the 32 internationally recognized experts in the fields of education, philosophy, history and communication. Resulting five concepts that technical education must meet were: designing (optimization, specification), systems (structures, functions), modelling, resources (materials, energy, information) and values (sustainability, innovation, social interaction).
- ITEA International standards for technological literacy [6] included the proposed educational programmes from pre-school to secondary level of education. They are based on the concept of literacy and are not in the form of binding curriculum, but serve as a basis for creating educational standards by state institutions. The pragmatic literacy concept is based on PISA assessments and is oriented on practical knowledge. Technological literacy is defined as the ability to use, manage, assess and understand technology. The standard is divided into five clusters: properties of technical products and processes, technology and society correlation, design and construction of technical products, necessary skills for living in a world of technology, and technology world.
- AAAS standards [1] are formulated for 12 areas of subjects from kindergarten to secondary education. The areas are connected by mathematical, scientific, and technological perspective. The “Nature of technology” subject is defined by three clusters: technology and science, design and systems, and problems in technology.
- Educational standards of the German engineering association for the Technology subject [12] are created for five skill areas: understanding technology (goal, function,

concepts, structure), design and production (planning, optimization, technical solution testing), using (selecting technical solution, application), technology evaluation, and communication (relevant information exchange). According to the concept, teaching should be based on the development of components that are needed for solving technology-oriented real-life situations and the preparation for using technology in private and professional life.

Based on the analysis of various approaches for technical education, we specified some general subject characteristics:

- Subject area and/or clusters of technical education are based on modern contexts and activities;
- Technical contents are only implicitly described;
- The concept of technology literacy is clearly focused. The subject goals are generalized and oriented towards practical knowledge;
- The subject areas are closely related to engineering domains;
- Skill areas (cognitive, action, communicative, and evaluative) are largely identical to the structure of skills in natural sciences (biology, chemistry, physics);
- Conceptualization is focused on problem solving approach and action-oriented implementation.

3. PERSPECTIVES OF TECHNICAL/TECHNOLOGY EDUCATION

Papers related to the issue of technical/technology education are mainly conceptual and descriptive in nature [3] [5] [9]. A rare empirical studies [13] [14] may offer a starting point for defining perspectives for future research that should be directed to the development of technical/technological literacy. The key development perspectives are further emphasized.

3.1. Methodics improvement

So far we have mainly relied on the use of results of researching secondary education needs to define the subject content and create the basis for further development. However, this approach has its limitations because it has shown that it is not practical to focus neither on gymnasium or vocational education. In the first case, often there is no vertical relationship with the gymnasium subjects, which is an obvious lack of secondary level of education. In the second case, studied areas and the level of knowledge and skills gained in primary education are not suited to the needs of vocational schools, so they are often forced to repeat the contents that should already be adopted.

Given the wide range of areas of technical education, it would make sense to empirically study the way in which educational practice theoretical approaches could contribute to the desired skills development and the promotion of technics and technology.

3.2. Skills development

The question is whether the structure of adopted skills can be applied to the integrative concepts of teaching technology. There is a risk that the technological perspectives, characteristics and methods are inadequately considered, and that teaching technology is limited to its application. The analysis of student interests should examine the relation between adopted technical/technological skills and the selected educational direction or future profession.

3.3. Skills evaluation

Educational standards for technical education can be effective in quality assurance if the appropriate skill assessment instruments can be developed. It is necessary to clarify whether normative educational standards can be empirically tested by skills demonstration.

3.4. Digitalization

Technological development and innovations has digitalized virtually all technics and technology modalities in modern industry. Technical/technology education must be more flexible in adjusting to constant rapid changes to retain expediency. The demands placed upon future workers are increasingly stringent, as processes become more interrelated and complex, especially in the industry. Lifelong learning, development of IT competencies and interdisciplinary thinking skills will become the basic requirements of specialized workers.

3.5. Teacher education

Professional knowledge, values and motivation are the proven factors for shaping teacher skills. Given the wide range of disciplines associated with technical education (biology, chemistry, physics, civil engineering, electrical engineering, mechanical engineering, IT, sociology, etc.) raises the question of teacher scientific skills and professional methodic profile. The extent of knowledge expected from future teachers is extremely large and complex, while the timeframe of their training is limited. This fact indicates a potential structural problem of developing only basic technical knowledge and skills in accordance only to the needs that are defined by the subject programme. It is necessary to establish and acquire the key skills and competencies that teachers must possess in order to meet the scientific and professional requirements.

3.6. Serbian perspective

Technical education is taught in Serbian primary education for several decades, first as sole subject, and later in the form of Technics and informatics education subject. Unfortunately, we have witnessed the current uncoordinated signals from the Serbian educational policy makers, where on one side the introduction of dual education is represented as the effective example of incorporating education and the economy mainly by educating personnel in various areas of production-oriented technics/technologies, and on the other hand an ad hoc splitting of the Technics and informatics subject, with the aim of directly reducing the number of hours of technical education and the creation of a new, this time a service-oriented subject named Informatics. It should be noted that this process is not under the control of the professional and academic community, but is led through adopting decrees without clearly defined educational standards, outcomes, projections, and ultimately, accountability.

This kind of “reforms” are not unknown to the Serbian educational system, and often have proven to be failures, so the generations of students were deprived of the opportunity to acquire a variety of competencies, skills, and knowledge. The efficiency and effectiveness of the Serbian educational system is clearly reflected in the PISA and TIMSS assessment results, which is something that should first need to direct resources at.

4. CONCLUSION

Teaching technical education is a major challenge due to the complex spectrum of areas taught and the relations with other disciplines. Attempts on international standardization of the subject did not achieve satisfactory results, primarily because the operationalization on the level of individual countries inevitably highlighted the diversity of socio-economic environments which lead to the limitations.

Technical/technology education is not traditionally considered as the fundamental science, although it directly affects the acquisition of knowledge and skills necessary for future professional performance. Developed countries with the production-oriented economies are making great efforts on the subject development and modernization, and it is often taught in secondary education, also. Industry trend projections show the decrease in the need for academic knowledge, and correspondingly higher demand for skilled, technical/technological literate and IT-competent workforce, which is a clear indicator of importance that technics and technology will take in the future educational settings.

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Control Input/Output interface with the program for control of robotic production line segment models

Milan Sanader[1] and Gordana Sanader[1]
[1] M&G Dakta, Belgrade, Serbia
e-mail migdakta@sbb.rs

Abstract: *This paper is based on modernization of teaching the school subject Technical and Information Education by introducing an interface with 8 digital inputs and 16 relay outputs as a new teaching aid in the final grades of elementary school. The basic interface parts, their role and mode of operation are presented. In order to better understand the function of this teaching aid this paper presents a program through which executions are ordered to the interface by the computer. The program is presented on the operating cycle of four models from the living and work environment which are together making a production line.*

Key words: *control; input/output; interface; program; production line*

1. INTRODUCTION

The teaching program for the school subject Technical and Informatics Education for the seventh grade of the elementary school envisages, inter alia, the following teaching units: Machines and Mechanisms, Robotics, Structural Modelling…, and for the eighth grade Information Technologies, Digital Electronics. Computer with adequate programs is used to control modern devices and machines. Electronic assembly (Bartolić et.al. 1990) for connection between computer and a device is called interface. Fulfilment of goals and standards of achievement in above said fields is impossible without this device.

Control input/output interface (Filipović, 1997) with 8 digital inputs and 16 relay outputs has been designed and made as a teaching aid for the needs of teaching the school subject Technical and Informatics Education in the seventh and eighth grade. Its aim is to control the models of devices, machines and systems from the living and work environment by use of a computer. It enables open and closed control interface. For the open interface only inputs are used, and for the closed interface both inputs and outputs are used. To control the models in such a way it is also necessary to introduce serial USB interface.

The program is intended for movement control of 10 actuators, out of which 9 are micro motors and 1 is electromagnet. For 3 micro motors one rotation direction is envisaged, and for the remaining 6 micro motors two directions are envisaged.

A segment of the robotic production line (Sanader, Sanader, 2009) is made of the models of two conveyors. One is intended for transport of the blank, and the other one for transport of the workpiece. The robotic arm is intended for workpiece handling and CNC machine is intended for making the groove in the workpiece.

1.1. Serial USB interface

The role of the serial USB interface is to achieve connection between personal computer (PC) and control input/output interface. It is based on the last generation FT234X integrated circuit which enables serial communication with control inputs and outputs through USB port. Via this interface the PC program controls the model by sending turning on or turning off commands to the control outputs which may be an electro motor or electromagnet. Serial USB interface is used exclusively for communication between PC and the control input/output interface. By USB cable it is connected with one end to the PC's USB port, and with the other end through 25-pin DSUB connector to the control input/output interface. Power supply for this interface is provided through the PC's USB port and there is no need for any additional power supply.

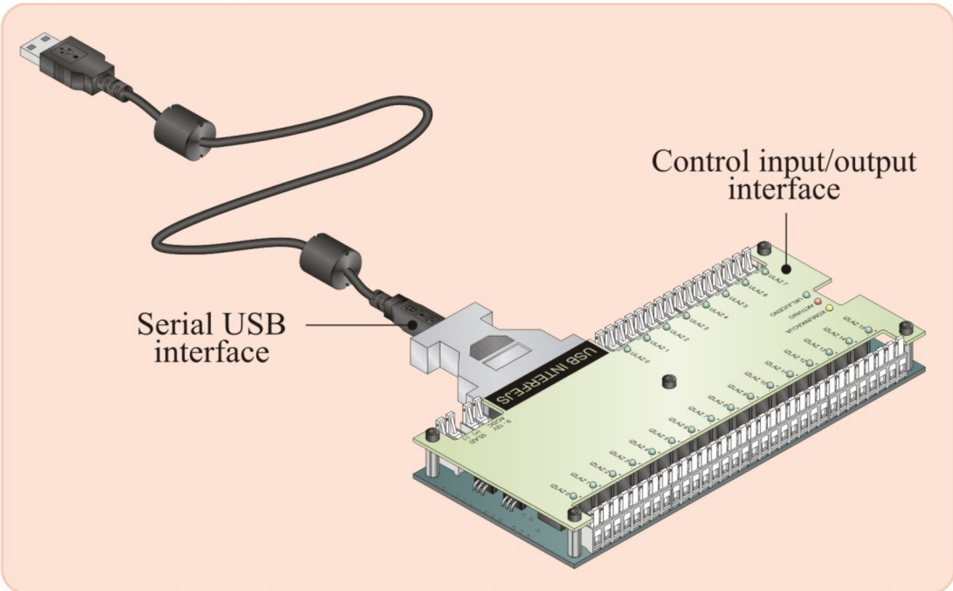

Figure 1. *Serial USB interface and control input/output interface*

1.2. Control input/output interface

The commands arriving from PC program through serial USB converter are executed by the control input/output interface. This device has 8 input lines to which switches can be connected, and 16 relay outputs to which electro motors and electromagnets can be connected. Connection with serial USB interface is made by use of 25-pin DSUB connector (Sanader, Sanader, 2009) and to ensure proper operation it is necessary to provide 9V direct current voltage. Connection between serial USB interface and control interface is galvanically separated by optocouplers, having insulation 3.75kV. In this way PC protection is achieved against any potential disturbances which may occur during turning on of electro motor or electromagnet. Additional protection is provided by separate power supply of electro motor and electromagnet. Consumption of this device is in the range of 400mA. All inputs and outputs are clearly marked and each of them has LED as an indicator of active state. The control input/output interface is based on Atmel AVR microcontroller Atmega 16 whose role is to transform the command serially received from PC into a signal which turns on the outputs, or to return the state of input lines to PC. Connection of electro motors, electromagnets, switches and power supply of the control interface is achieved by micro connectors with lever which enables fast and simple use.

2. PROGRAM FOR CONTROL OF PRODUCTION LINE SEGMENT MODEL

Automated production process for manufacturing the products includes transport of the blank, handling thereof, automatic processing and dispatch of the workpiece. Model of the production line segment is presented in Figure 2. Conveyor 1 transports the blank. The robotic arm (manipulator) (Sanader et.al. 2011) takes over the blank from the belt and transfers it to the worktable of coordinate milling machine. Upon completion of milling the manipulator transports the workpiece from the worktable to Conveyor 2. The workpiece is dispatched by Conveyor 2 to the machine for the following production operation.

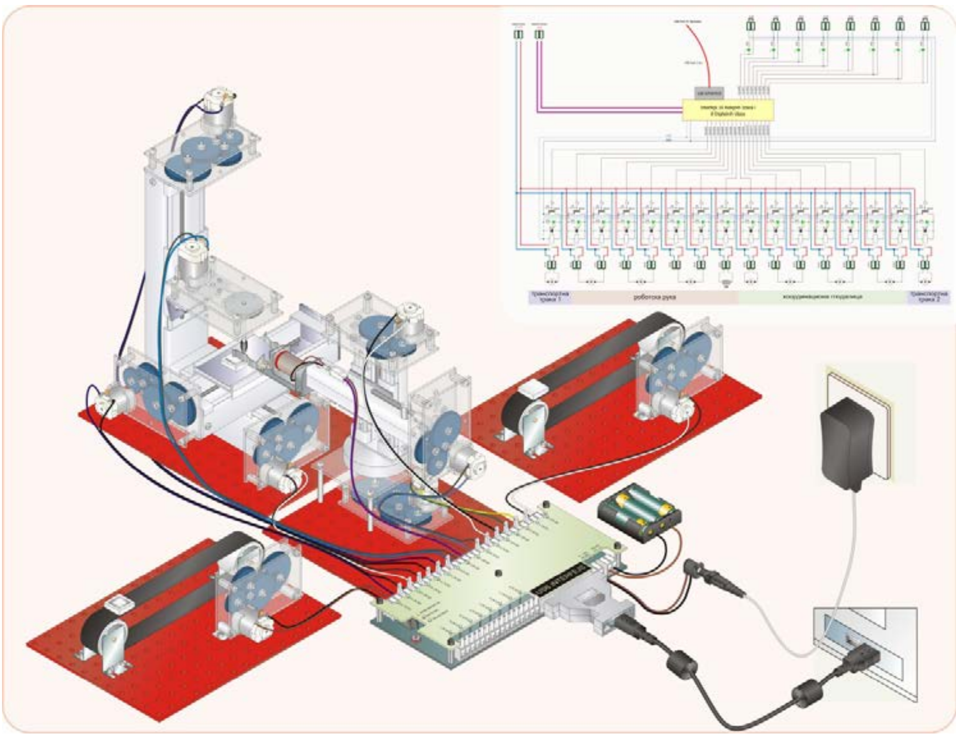

Figure 2. *Model of production line segment with a diagram of executive bodies*

2.1. Program – Production Line

This program is intended for control of the production line segment model. By controlling the model connected are the activities by which making of a square-shaped channel is demonstrated. The sequence of activities is defined by the program. To present the entire cycle it is necessary to adjust motor operation times for each machine based on movement parameters.

Once the program is started, there appears a window with the image of the model of the production line segment next to which there are fields showing operation times of some electro motors, Figure 4.

machine	conveyor 1	robotic arm (manipulator)			coordinate milling machine				conveyor 2
motor	T1M1	RM2	RM3	RM4	GM5	GM6	GM7	GM8	T2M9
movement	translation	rotacion	translation	rotacion	enables operation of milling cutter	translation	translation	translation	translation
movement direction	←	↻ ↺	↓ ↑	⇄		↓ ↑	↙ ↗	↘ ↖	←
time in s / in $x10^{-1}$ms	2,5 / 250	0,66 / 66; 0,70 / 70	12 / 1200	10 / 1000		15 / 1500	20 / 2000	20 / 2000	2,5 / 250

Figure 3. *Motor operation times*

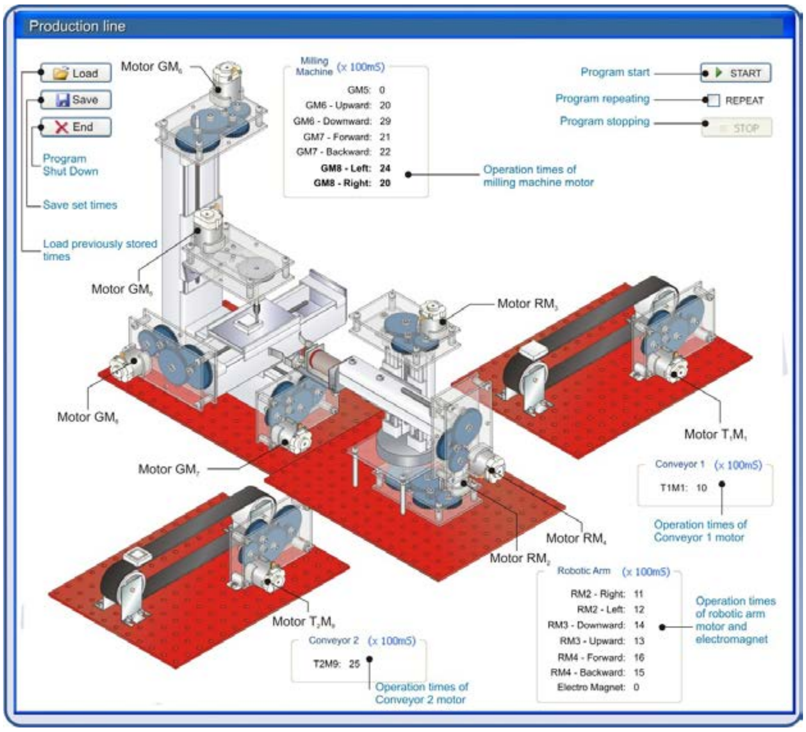

Figure 4. *View of the production line program*

3. CONCLUSION

Modern teaching of the school subject Technical and Informatics Education imposes a need for the use of modern teaching aids. It can be surely said that the interface presented in this paper is a modern teaching aid. It enables control of both simple and complex models and systems. Control of the model of the robotic production line segment is enabled by open control interface. Eight digital inputs provide possibility to upgrade the models with sensors and to apply control feedback. The models of the robotic production line segments provide an opportunity for pupils to have a better insight into the production process of material goods without participation of a human worker. To many pupils they can represent motivation to create the same or similar models. It should be borne in mind that this can also have an impact on professional orientation of pupils.

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UDK: 371.333:004.4 Professional review paper

Tehnical resources in the construction indystry, educational software

Aleksandar Đurčilov[1]
[1]OŠ „Petar Petrović Njegoš", Beograd, Serbia
e-mail diplingrud@gmail.com

Abstract: *"Technical resources in the construction industry" is an educational software for the same teaching unit in the sixth grade of elementary school for technical and IT education. Educational software consists of a Windows Form and relational database. Relational database Technical resources in the construction industry consists of two tables and is a relational database with files picture. The basic mask as a Windows Form is connected to the database via SQL (Structured Query Language) queries that result in view of the database, a single value attribute view for each record (the record order) destined awarded (in three TextBox, in one RichTextBox, in one PictureBox) Windows Form. In the PictureBox in the images are stored. Record navigation is done with the help of a four-Button (button) on the Windows Forms. The software is programmed in Visual Basic MS Visual Studio 2012, a database in Access 2007.*

Keywords: *Technical and IT education, technical resources in the construction industry, educational software, relational database with pictures, Visual Basic*

1. INTRODUCTION

In the sixth grade of elementary school teaching Technical resources in the construction industry should be treated primarily a demonstration of images and brief explanations to the divisions and the purpose of technical resources in the construction industry. This approach is possible with the help of the educational software that was developed for this purpose and that is displayed with the help of a video projector. The current results of the application software are great because students interested in teaching and easily adopt new material when they see pictures of technical resources in construction and accompanying text. The software consists of a Windows Form and relational database with images. Relational databases can always be modernized by inserting pictures of new models of tools and construction machines.

2. MAKING THE EDUCATIONAL SOFTWARE

2.1. Design Database

Technical resources in the construction industry is a relational database with files image that is through SQL (Structured Query Language [5]) queries associated with Visual Basic Form1 (mask) and is part of the educational software. The software is programmed in Visual Basic MS Visual Studio 2012 [6, 8], a database in Access 2007. Pictures and technical resources in the construction industry are downloaded from the Internet [1, 2, 9, 11, 12]. Database [5] consists of two relational tables *Overview of technical resources in the construction industry* (Fig. 2) and the *Types of technical resources in the construction industry* (Fig. 3). Table *Overview of technical resources in the construction industry* (OTRICI) has the following attributes (ordinal number (on), name of the technical resource, purpose of technical resource, image file (imf), ordinal number of the type of technical resource (ontotr)). The primary key of the table is ordinal number (on). Table *Types of technical resources in the construction industry* (TTRICI) has the following attributes (ordinal number of the type of technical resource (ontotr), the type of technical resource). The primary key of this table is the ordinal number of the type of technical resource (ontotr). Table *Types of technical resources in construction* and *Overview of technical resources in the construction industry* are in relation one to more. At the logical level was performed database normalization. In a physical database referential integrity is applied. The tables are designed in Access 2007 (Fig. 1). Table *Types of technical resources in the construction industry* under the attribute *Type of technical resource* enumerated the simple division into a construction tool, construction earthmoving machines, construction machines lifting and cargo transport, construction mixer, a means of protection at work in the construction industry. This division is similar in technical literature [7] and is less detailed with respect to the division of construction machinery in the technical literature [10].

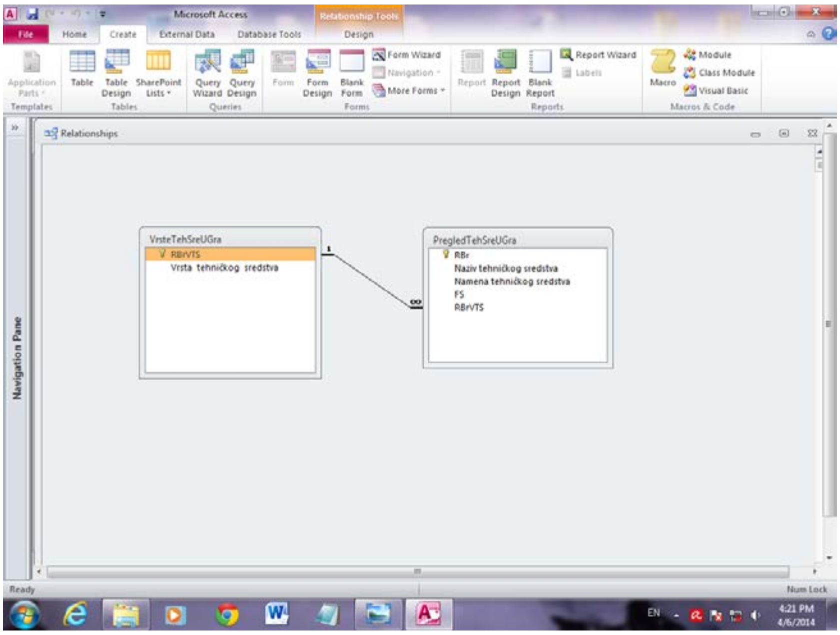

Figure 1. Relationships

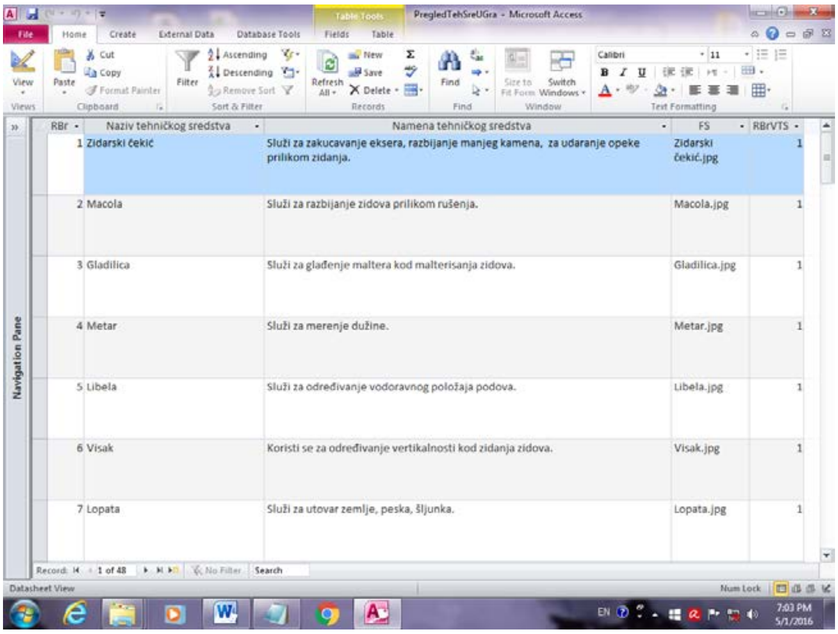

Figure 2. Table *Overview of technical resources in the construction industry*

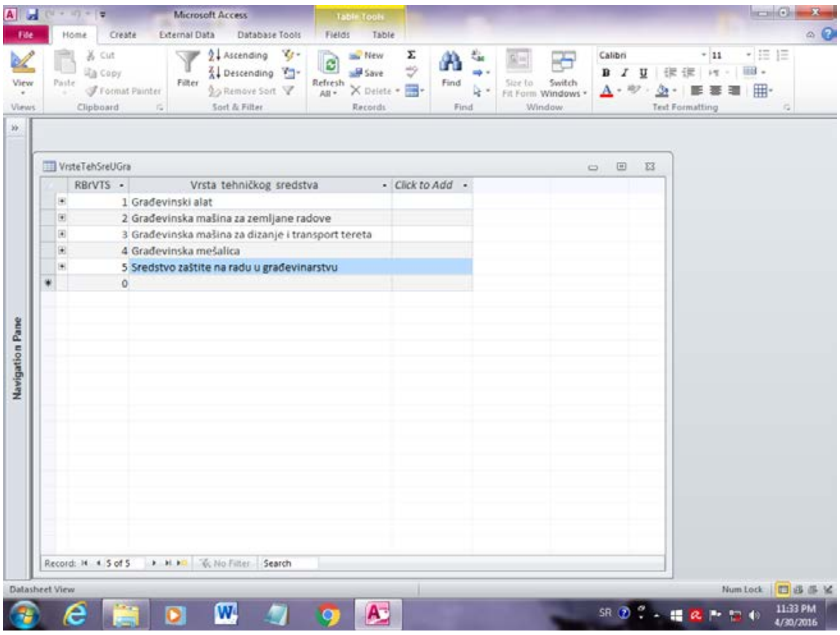

Figure 3. Table *Types of technical resources in the construction industry*

2.2. Designing and programming software

The basic mask as a Windows Form is connected to the database via SQL (Structured Query Language) queries that result in view of the database, a single value attribute view for each record (the record order) destined awarded (in three TextBox, in one RichTextBox, in one PictureBox) Windows Form. In the PictureBox in the images are stored, a record navigation is done using the buttons on Windows Forms. The software is programmed in the programming language Visul Basic MS Visual Studio 2012 [8]. Which is the Windows Form1 base class consists of four Label, three TextBox, one RichTextBox, four Button (button) and one PictureBox. Buttons are used to navigate the record (the record table rows): return to the first record, left, right, and coming to the last record. Visual Basic Form1 mask is connected to the database via SQL (Structured Query Language) queries that read: „SELECT OTRICI.on, OTRICI. [name of the technical resource], OTRICI. [purpose of technical resource], OTRICI.imf, TTRICI. [the type of technical resource] FROM TTRICI INNER JOIN OTRICI ON TTRICI.ontotr = OTRICI.ontotr;“. This request results in the view of the database and obtained by the merger of two tables. View is a virtual table obtained SQL (Structured Query Language) query that can not be updated in the database and used only for the purposes of the program. To connect to a database used Microsoft.Jet.OLEDB.4.0 provider that runs only on 32-bit software, so it is in MS Visual Studio 2012 that can be converted to run on 64-bit [3]. Reverse engineering with the help of UML (The Unified Modeling Language) tool Enterprise Architect 11 (UML Modeling Tool) company Sparx Systems [4], the source code (Visual Basic) is read out and appeared UML image basic class Form1 (Fig. 4).

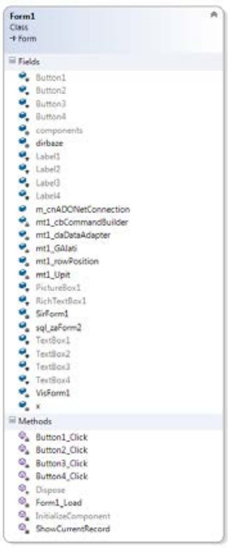

Figure 4. Class Form1 (Fields & Methods)

In Fig. 4 in class Form1 under Fields is a list of associated controls and variables declared, under the Methods list of related functions that have been implemented. Appearance Form1 work can be seen in Fig. 5. By creating this educational software produced is more convenient and clearer user interface Windows Form that represents two connected tables of relational database instead of working individually with each of the two tables of relational databases.

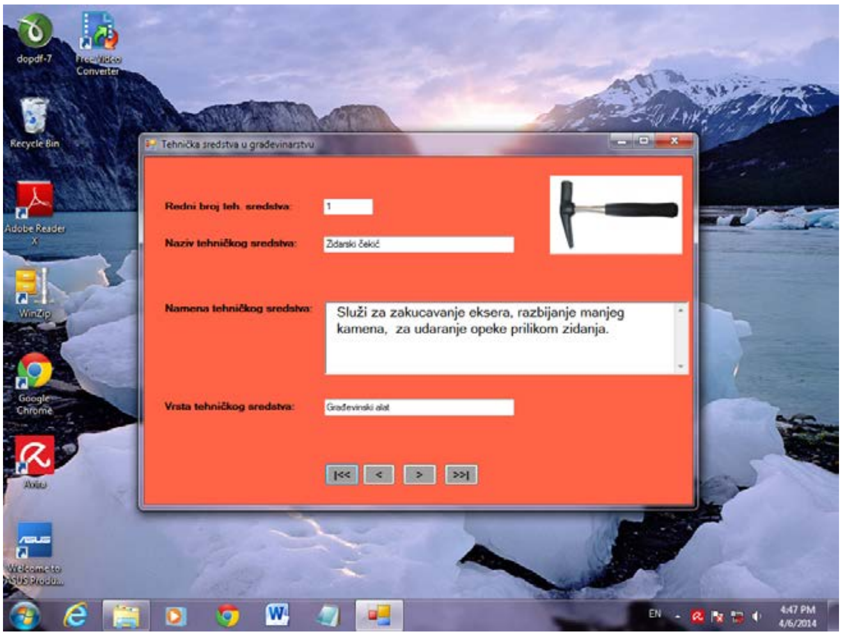

Figure 5. Form1 work

3. CONCLUSION

"Technical resources in the construction industry" is an educational software for the same teaching unit in the sixth grade of elementary school for technical and IT education. Educational software consists of a Windows Form and relational database. Relational database *Technical resources in the construction industry* consists of two tables and is a relational database with files picture. The basic mask as a Windows Form is connected to the database via SQL (Structured Query Language) queries that result in view of the database, a single value attribute view for each record (the record order) destined awarded (in three TextBox, in one RichTextBox, in one PictureBox) Windows Form. In the PictureBox the images are stored, a record navigation is done with the help of a four Button on the Windows Forms. The software is programmed in Visual Basic MS Visual Studio 2012, and the database in Access 2007. By creating this educational software produced is more convenient and clearer user interface Windows Form that represents two connected tables of relational database instead of working individually with each of the two tables of relational databases. The current results of the application software are great because students interested in teaching and easily adopt new material when you clearly see the text and images and technical resources in the construction industry.

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Simple electrical circuit to light up a gas discharge lamp

Milentije Luković[1], Sanja Antić[1] and Vanja Luković[1]
[1]Faculty of Technical Sciences Cacak, University of Kragujevac, Cacak, Serbia
e-mail milentije.lukovic@ftn.kg.ac.rs, sanja.antic@ftn.kg.ac.rs, vanja.lukovic@ftn.kg.ac.rs

Abstract: *In order to successfully monitor achievements of scientific and technology revolution, modern society invests growing efforts in popularizing technical sciences. In order to motivate pupils and students to realize the importance that their knowledge has in everyday life, teachers often use experiments and laboratory methods in the schooling. This paper is devoted to a simple construction of Tesla coil with electrical circuit where transistor is used as amplifier and switch too. Tesla coil can be used as a teaching tool to demonstrate the high frequency currents, i.e. for causing electrical discharge in the gas discharge lamps. Also, some problems that can occur during the preparation of this experimental set up as well as on laboratory excersises with participants of the Regional Centre for talents in Cacak, are explained.*

Keywords: *Tesla coil; electrical circuit; transistor*

1. INTRODUCTION

This year marks 160-th anniversary from the birth of Nikola Tesla, Serbian the most famous scientists who had more than 700 protected patents and innovations. His contribution to science is so great that eight US states (New York, New Jersey, Pennsylvania, Colorado, Nevada, Minnesota, Arizona and Indiana) declared Tesla's birthday as their national holiday [1]. In the field of wireless transmission of energy, Tesla has invested considerable time and effort, but his research has been left unfinished.

Tesla coil, which is supposed to be the basis of wireless energy transfer, can be made in different ways, while as a power source both alternating and direct current can be used. This paper is devoted to a simple construction of Tesla coil, using direct current power source, which is also safe, and involves the use of electronic parts that are in electronic kit for the subject Technical and informatics education, in the eighth grade of primary school. The realization of Tesla coil was demonstrated to the participants of the Regional Centre for talents in Cacak, after which they were given the task to realize the same. Therefore, this paper also discusses the problems that they encountered during its preparation. In this way designed Tesla coil, can also be applied for the various teaching subjects: physics, technical and informatics education, basis of electrical engineering, etc., in order to acquaint students with Tesla's work in the field of high frequency currents.

The original design of the Tesla transformer for the first time appears in US Patent No. 454.622 from 1891, and was planned to be used for, at that time new and efficient lighting

[2]. It consisted of medium or a high voltage AC power source, one or more high-voltage capacitors and a sparker, connected in the primary circuit of the transformer (Fig. 1).

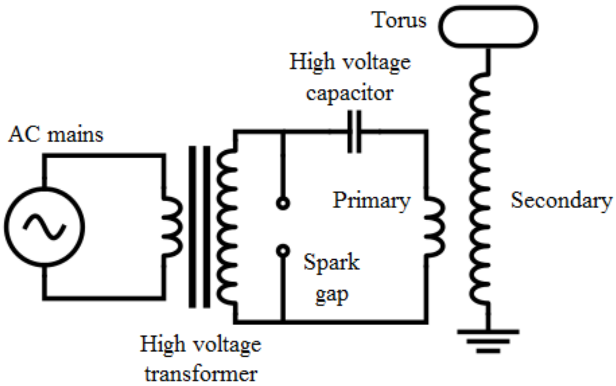


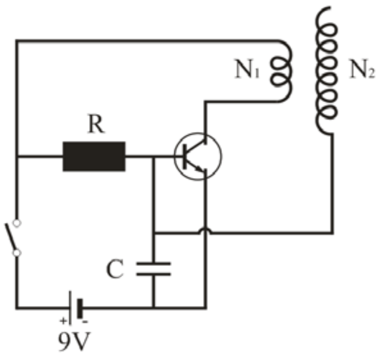
Figure 1. *Construction scheme of Tesla transformer*

Sparker consists of two electrodes, between which, there is a small gap which optionally can be decreased or increased, thus affecting the frequency of the current in the primary coil. In this way, the primary winding is excited with periodic pulses of high frequency currents.

At the secondary winding, there is a large number of turns (hundreds or thousands), in which voltage is induced by electromagnetic induction from the primary. Primary and secondary are resonant circuits, so the voltage increase is also achieved with resonance, and not only with the increasing of the number of turns in the secondary winding. The resonant frequency of Tesla's transformer is typically between 25 KHz and 2 MHz.

2. TESLA COIL FOR TEACHING PURPOSES

In this paper, for the purpose of implementation in the teaching process, construction of Tesla transformer, which is shown in Fig. 2 - left is proposed. The development of electronics has contributed to the construction of Tesla coil, so that the sparker gap can effectively be replaced with the transistors of different types, which did not exist in Tesla's time. The advantage of such a coil is that a transistor can be used as a switch and the amplifier at the same time.



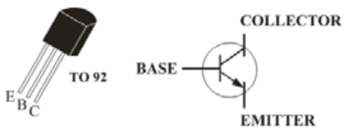


Figure 2. *Scheme of Tesla coil with bipolar NPN type of transistor*

For this purpose, different NPN transistors may be used, although the characteristics of individual transistors constitute some of them more suitable for the application than the others. The basic parameters of the coil are: *diameter of the frame D, wire diameter d, wire diameter with isolation k, the length of the coil l, the length of the wires without leads a, the number of primary windings N_1, the number of secondary windings N_2, the inductance L, the self-capacitance C_S, and self-resonant coil frequency f* (Fig. 3).

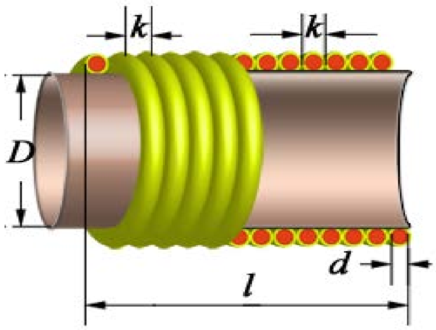


Figure 3. *One-layer coil with close winding*

Inductance of the secondary winding can be calculated from Wheeler's equation (1) [3]:

$$L = \frac{N^2 \mu_0 \pi \left(\frac{D}{2}\right)^2}{l}. \tag{1}$$

Self-capacitance of the coil can be determined from equation (2), where the value of the diameter D is given in centimeters and the value of the capacitance in picofarads [4].

$$C_S = \frac{\varepsilon_0 \pi^2 D}{(N-1)\ln\left((\frac{p}{d}) + \sqrt{(\frac{p}{d})^2 - 1}\right)}, \tag{2}$$

where: ε_0 is dielectric constant, N is the number of windings, p is the distance between the centers of neighboring turns. Using the equation for calculating oscillation of LC circuit (3), one can approximately calculate the frequency of oscillation of the secondary.

$$f = \frac{1}{2\pi\sqrt{LC_s}}. \tag{3}$$

3. EXPERIMENTAL RESULTS

In the paper the use of bipolar NPN transistor 2N2222A, with housing TO-92 (Fig. 2 - right) is proposed [5]. The reason for this selection is the simplicity of application in the teaching process, since it requires the use of a low voltage DC source (up to 40 V) with low current (up to 0.6 A at the input). In our case, 9 V battery was used as the power source.

Besides the issue of safeness for pupils or students, the reason why this type of transistor is commonly used, is that for the realization of the electrical circuit in Fig. 2, the use of capacitor is superfluous [6]. The use of a capacitor may cause overheating and even burning of a transistor. Applying the circuit in Fig. 2 without the capacitor, there is a higher frequency range in which the frequency of circuit oscillation can be harmonized. For this type of coil is characteristic that it does not produce sparks, or they are very small since it works with low power at very high frequencies (> 10^6 Hz). This represents a limitation of the Tesla coil made in this way. On the other hand, it produces a high enough voltage to light and neon bulb which has power up to 36 W. Fig. 5 shows a graphical representation of the oscillation frequency of the coil, obtained with OriginPro softer [7], on the base of oscilloscope measurement.

Figure 4. *Oscilloscope display of the oscillation frequency, of the small Tesla coil*

Fig. 4 shows the Tesla coil made with aforementioned transistor. The number of turns in the primary winding is $N_1 = 3$, and in the secondary winding $N_2 \approx 350$ (Table 1). The ratio of the coil height H and the coil diameter D needs to be in the range 4 < *H/D* < 6. For the secondary windings it is necessary to use lacquered copper wire of diameter 0.2 – 0.4 mm (AWG 32-26). In the electronic kit for the subject Technical and informatics education for the eighth grade of primary school, there is the wire *d* = 0.25 mm, which can also be used. At the primary it is necessary to use the insulated copper wire of larger diameter (AWG 19 <), whereby there is no influence whether wire is solid-core or stranded. The value of the resistor is not crucial since it has a role to take the current when it is not flowing through the transistor. Its value can be taken in the wide range. In the electronic kit for the eighth grade there are three resistors that can be used for this purpose: 6.8 KΩ, 38 KΩ and 82 KΩ. In the realization of the coil in Fig. 4, 22 KΩ (metafilm, power ¼ W, 1% tolerance) resistor value was used. The parameters of a one-layer coil (close winding) were obtained using *coil32* software [8] (Table 1).

The value of the self-resonant frequency of the secondary, obtained with *coil32* software is f = 6.882 MHz and quite well corresponds to the lowest measured value of the oscillation frequency of the coil f = 6.849 MHz, experimentally obtained with the oscilloscope.

In addition to the mentioned type of transistor, construction of Tesla coil in Fig. 2 was also tested with bipolar NPN transistor MJE3055, with housing TO-220. On this transistor, it is necessary to set a cooler of the type HL SK35-51 or a cooler with similar characteristics whose thermal resistance is ≤ 9 K/W. Transistor with a cooler need to be moved away from the primary and secondary coils, to prevent interference with their electromagnetic field.

Table 1. *The parameters of one-layer coil (with close winding) obtained with coil32 softver*

Entered data	Obtained data
Diameter of the frame D: 18.2 mm *Wire diameter d: 0.2 mm* *Wire diameter with isolation k: 0.22 mm*	*Winding length l: 78.075 mm* *Length of wire without leads a: 20.47 9m* *Number of turns of coil* N_2*: 353.545* *Inductance L: 474.924 μH* *Self-capacitance* C_S*: 1.13 pF* *Coil self- resonant frequency f: 6.882 MHz*

This transistor in the contrast to the previously described has a lower coefficient of the current gain β (20-100), and to achieve the same or better performance of the circuit, it is necessary to use the equivalent capacitance C ≥ 300 nF. Using capacitors, there is much narrower frequency range in which harmonization of the frequency of circuit oscillation can be achieved. However, after the circuit achieved the optimal frequency of oscillation, this type of coil will give sparks on the secondary coli with the size up to several millimeters.

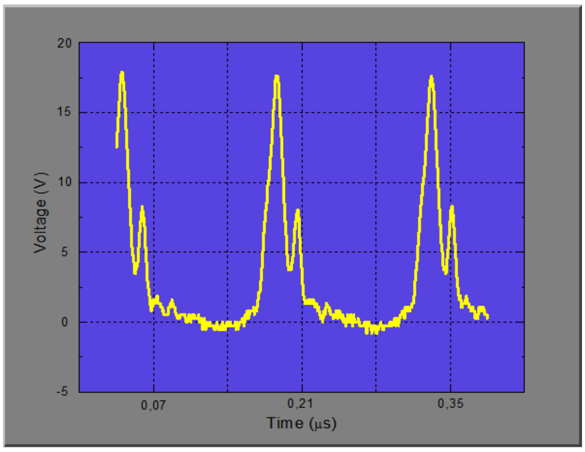


Figure 5. *Graphical display of established frequency oscillation of the circuit, measured on the oscilloscope*

Described realizations of Tesla coil were experimentally performed by the participants of the Regional Centre for talents in Cacak. During construction, they encountered with various problems, due to which the coil did not work, so here are allocated the basic items that need special attention during the experimental realization:

- The direction of the winding of the secondary should be opposite to the direction of the winding of the primary coil.
- One of the most common mistakes for which the coil will not work is when the

connection ends of the primary coil with the rest of the circuit are permuted.

As noted above, described type of Tesla coil does not produce sparks, or they are very small. Considering that small sparks leave less impressive impression on the viewer, to obtain coil that will make larger visual sparks it is necessary:

- Reduce the frequency of oscillation of the coil with introduction of additional electronic components in the electrical circuit. This further complicates the circuit, since it is no longer such easy for construction (especially for pupils and students), and also it is not cheap.
- To increase the dimensions of the coil, by increasing the diameter and the number of the windings turns. This will reduce resonant frequencies of the secondary and primary.
- Use of a larger DC voltage source, which is the easiest and the simplest solution.

It should be noted an interesting fact, which is that complete of electronic kits for the subject Technical and informatics education in eight grades of primary school, has two transistors 546B and BC327, with which is possible to create a small Tesla coil. However, they are not the best choice due to the small value of the input current of 0.1 A.

4. CONCLUSION

This paper describes the experimental realization of Tesla coil which is demonstrated to the participants of the Regional Centre for talents in Cacak. The most important characteristic of the construction of Tesla coil is it is safe, since the circuit produces current frequencies above 20 KHz, which are completely harmless because they do not cause muscle contraction and are transmitted through the skin. On the other hand, this Tesla coil does not produce sparks because it has low power (powered by a 9 V battery), but it is powerful enough to light up any gas discharge lamp. Another important characteristic of the demonstrated Tesla coil is that its technical realization is very economical and convenient. Because of this, electrical circuit made in this way, can be used as a teaching tool in order to introduce students with Tesla's work in the field of high frequency currents, as well as encouraging their experimental and practical work.

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Modeling, simulation and control of electronic circuits in the application electronics lab

Siniša Minić[1], Dragan Kreculj[2] and Goran Manojlović[3]
[1] University of Priština-K.Mitrovica,Teacher Faculty in Prizren-Leposavić, Serbia
[2] Primary School „Jovan S. Popović"/External Associate Min. ESTD, Beograd, Serbia
[3] Primary School "Ljubica Radosavljevic Nada", Zaječar, Serbia
e-mail sinisa.minic@pr.ac.rs, kreculj7@gmail.com, manojlovicg@yahoo.com

Abstract: *In the paper are present description, properties and use of application Electronics Lab/from Autodesk 123D CIRCUITS environment, for the modeling and simulation of electrical/electronic circuits in technical systems. This application can be used as an efficient tool in the realization of teaching themes from Electrical installations and Digital electronics. It is available through the Internet, contains a number of components, and also is gratuitous. Characterized by a simple interface on the desktop/protoboard with placing of electrical/electronic components/devices and with the ability to change certain characteristics the same. Quickly, clearly and in a visually interesting way in the application are simulated circuits in installations of appliances, machines and buildings. The application integrates the Arduino microcontroller platform, contains sensors, relays and measuring devices. It is especially important that Electronics Lab allows the entry code for the programming and consequently control of the created models; as shown in paper for LED, traffic light and display, in real time.*

Keywords: *teaching electrical engineering, control, Arduino, programming*

1. INTRODUCTION

Modern teaching requires a new approach to the implementation of the teaching techniques. Application Electronics Lab for modeling/simulation of electrical/electronic circuits is certainly an example of good practice for the use of modern ICT considerable simplicity, quality graphic/environment and accessibility (does not require the installation of special software and it's free). It is part of Autodesk 123D Circuits environment and can be used in the realization teaching materials Electrotechnical Installations and Digital Electronics.

Electronics Lab contains a number of components: batteries, resistors, lamps, LED, Arduino boards, sensors, relays, etc. The created models are stored in the database, and can be easily modified/Edit. There are also specific measuring devices for performing electrical measurements in the car.

In addition it allows the write program code, that is programming with the Code Editor to control models of technical systems in real time.

It is assumed that for students it will be interesting, interactive and allow the expression of creativity. At the same time the application allows the acquisition of knowledge, skills and competencies of engineering/electrical engineering and computer science, which are developing in an intensive and very promising for the selection of future interest in the field of technics.

2. CHARACTERISTICS OF THE APPLICATION ELECTRONICS LAB

Electronics Lab is part of Autodesk 123d D Circuits environment (https://123d.circuits.io). This is a quality online tool, ie. web service for project development in electrical engineering/electronics. With Arduino platform it has implementation and in programming. Thereby it is used quite simple functions void setup and void loop.

Electronics Lab applications is relatively easy to use, free and suitable for the simulation of electrical circuits. It may serve to explain programming to students in a simple way and how to connect electronic components in more or less complex circuits, especially if there is not real Arduino microcontroller [1].

In options there are a lot of components and a library, which is quite enough to work in this environment, even at the higher levels/secondary technical school.

Operating environment/parts:

- ProtoBoard
- Components
- Start/Stop Simulation
- Code Editor
- Edit
- Lab View/View Schematics/PCB View [1].

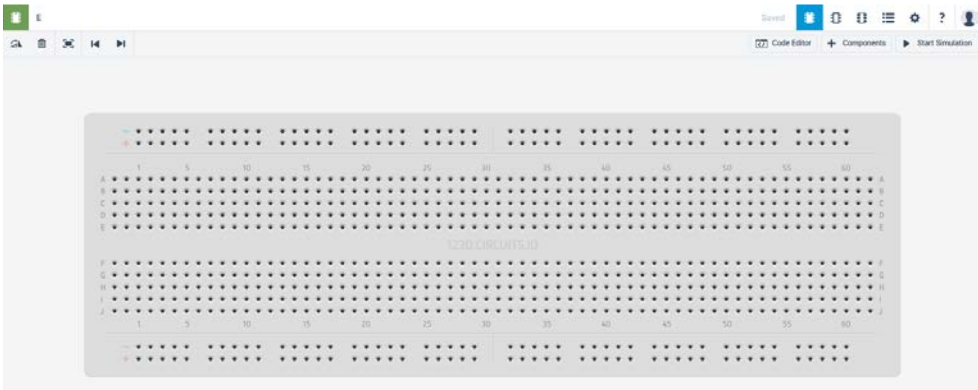


Figure 1. *ProtoBoard*

In the section Components of the application there are a large number of components for the representation of the electrical/electronic circuits, machines, devices. In addition to active and passive electronic components, batteries, several types of Arduino boards, there are sensors, relays, measuring devices/multimeter [1].

Functionality of models is created and checked by the command Start/Stop Simulation. Only certain components from the Electronics Lab applications is shown in Figure 2. Formed models are automatically assigned names and simultaneously stored in the database, a possible quick and easy shift characteristics of the components, as well as the existing models/Edit. Marked components are deleted with Delete and rotated with Rotate. Options for graphical views of the model are: LabView, View Schematics, PCB View [1].

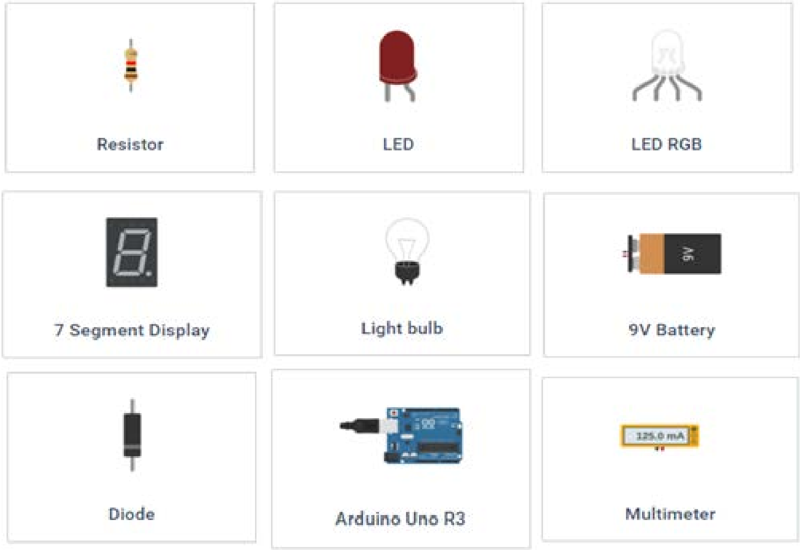


Figure 2. *Components*

3. MODELS PROGRAMMING AND CONTROL

Electronics Lab applications other than creating a model of electrical circuits and allows the development of software codes in the Arduino environment. Command Code/Editor, below the graphic display models, opens space for entering codes [2]. The codes are directly written in the lines or can be copied from other editors. At the end of the command Upload/Run the code is implemented, a Start Simulation command executed. Thus, in real time allows testing of code and control made models.

A simple model of an electronic circuit, made of LED and resistors (with Arduino-powered) is shown in Figure 3 [3], a corresponding code to turn on/1s and turn off/1s for LEDs in Figure 4 [3].

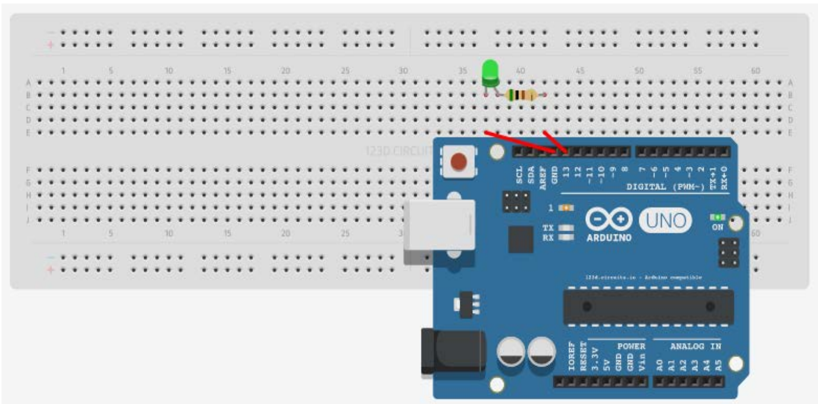
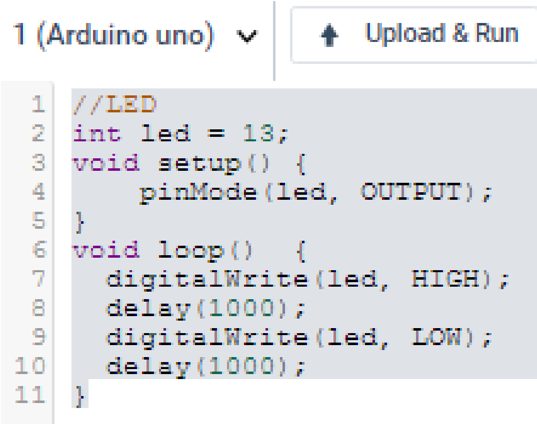


Figure 3. *Model of an electronic circuit with LED, resistor (Arduino supply)*




```
//LED
int led = 13;
void setup() {
    pinMode(led, OUTPUT);
}
void loop()  {
  digitalWrite(led, HIGH);
  delay(1000);
  digitalWrite(led, LOW);
  delay(1000);
}
```

Figure 4. *Code for turn on/off (after 1s) LED*

Example for modeling traffic light is shown in Figure 5.
Code for same model is presented in Figure 6. On the traffic light model/determining the time regime turned on/off lights (red, yellow, green) by the parameters of the traffic light signaling (Code/Editor) and receive direct appropriate responses.
Details of writing codes in Arduino are given in [4].

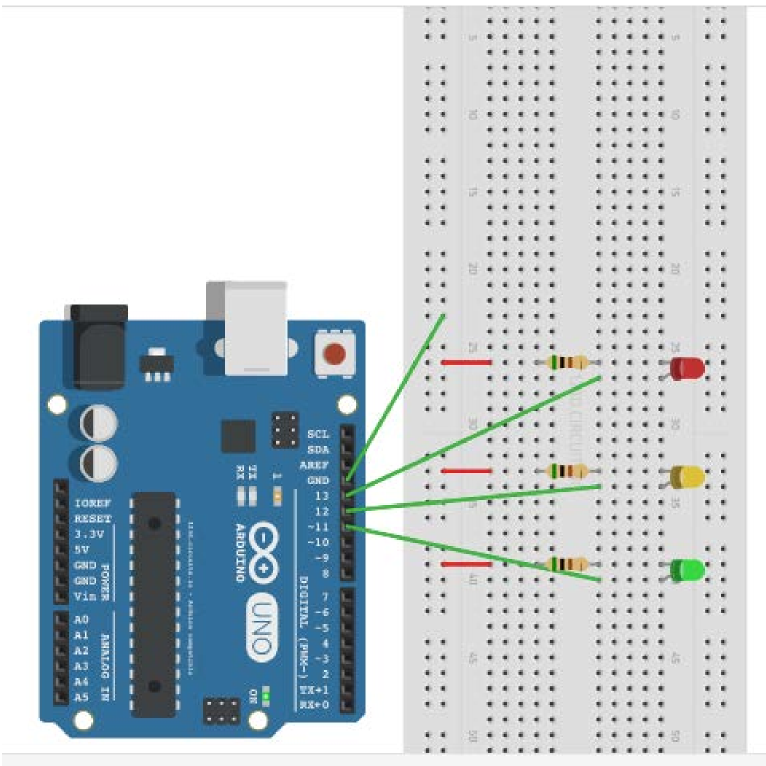


Figure 5. *Traffic Light Model*

1 (Arduino uno) Upload & Run

```

void setup() {
  pinMode(11, OUTPUT);
  pinMode(12, OUTPUT);
  pinMode(13, OUTPUT);
}
void loop() {
  digitalWrite(13, 1);
  digitalWrite(12, 0);
  digitalWrite(11, 0);
  delay(3000);
  digitalWrite(12, 1);
  delay(1000);
  digitalWrite(13, 0);
  digitalWrite(11, 1);
  delay(3000);
  digitalWrite(12, 1);
  digitalWrite(11, 0);
  delay(1000);
}

```

Figure 6. *Code for model control traffic light*

In the Electronics Lab is possible to create traffic light model/with determination time regime turned on and off lights (red, yellow, green). Certainly parameters/when light traffic signs easy to change (Code/Editor) and receive direct appropriate responses.
Figure 7 gives the 7-segment LED display model, which allows the display of numbers from 0 to 9. The complete code for the control of regime occurrence numbers (1s interval) is shown in Figure 8.

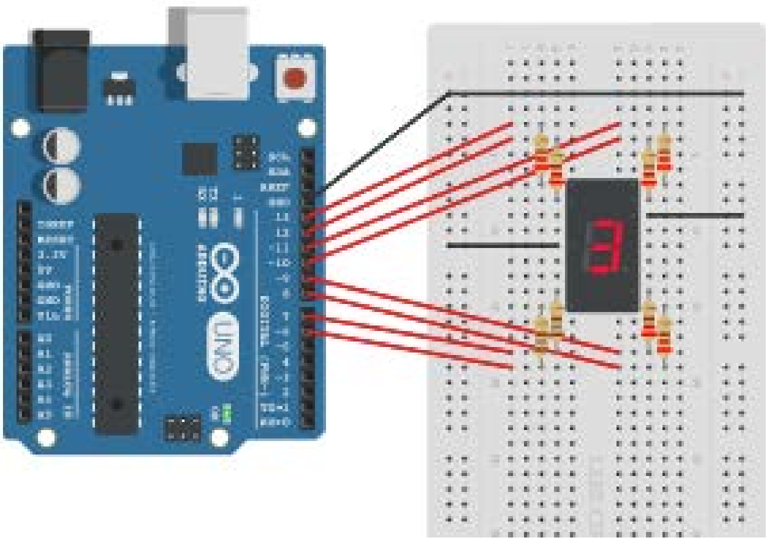


Figure 7. *Model LED Display (7-Segment, Digit 0-9)*

1 (Arduino UNO) Upload & Run

```
int ports[]={11,10,8,6,7,13,12};
int mat[10][7]={
                    {1,1,1,1,1,1,0},// Digit 0
                    {0,1,1,0,0,0,0},// Digit 1
                    {1,1,0,1,1,0,1},// Digit 2
                    {1,1,1,1,0,0,1},// Digit 3
                    {0,1,1,0,0,1,1},// Digit 4
                    {1,0,1,1,0,1,1},// Digit 5
                    {1,0,1,1,1,1,1},// Digit 6
                    {1,1,1,0,0,0,0},// Digit 7
                    {1,1,1,1,1,1,1},// Digit 8
                    {1,1,1,1,0,1,1},// Digit 9
                   };
void setup() {
  for(int i=0; i<7; i++) {
    pinMode(ports[i], OUTPUT);
  }
}

void loop()     {
  for(int i=0; i<10;i++) {
    Display(i);// Diplay number 0-9
    delay(1000);
  }
}
void Display(int number) {
  for(int i=0; i<7; i++) {
    digitalWrite(ports[i], mat[number][i]);
  }
}
```

Figure 8. *Code for control of the LED display*

4. CONCLUSION

Application Electronics Lab/123D CIRCUITS in teaching technics materials has multiple significance. Content and features it provides access to continue with innovative computing technologies necessary for education. The advantage of this so to speak electronic lab is that it is easier and faster to connect electrical circuits with virtual instead od real components. Available online or with a small necessary resources, the application becomes a tool for high-quality processing of lessons from Electrical installations and Digital electronics. The examples of the model electronic circuits clearly indicate the views of control and simulation models of typical LED, traffic lights and displays. At the same time the combination of development and simulation models, control and testing software codes in real-time proved to be a very significant and innovative research.

It is expected that motivation and interest of students to work in the Electronics Lab with all specifications indubitably would be at a high level. The application provides interactive and relevant cooperative relationship individual/in team for more complex projects, and is in the line with the learning outcomes in order to obtain relevant and necessary knowledge, skills and competences for further education at higher levels.

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UDK: 37.031:656.1 Professional review paper

Preventive work of driving schools and the local community on eliminating the causes of young people suffering in traffic

Željko Petrić[1]
[1] Car Traffic, Brčko, BiH

***Abstract**: This paper indicates the importance of the cooperation of driving schools and the local community while planning and realizing preventive activities on eliminating the causes of young people getting hurt in traffic. The traffic behavior, that is to say, the level of traffic behavior, was identified as the immediate cause. The family is presented as the most powerful factor of the traffic education. Systematic approach, as well as adequate engagement of all holders of prevention in the implementation of prevention programs and the strong influence of the implementation of measures in the education of parents as well as children, is expected to help the proposed solution become accepted in the community as the standard of behavior.*

***Keywords**: Family, upbringing, traffic culture*

1. INTRODUCTION

Traffic safety is one of the biggest issues in all communities, in every country in the world. Statistical data and analyses of traffic accidents (a large number of the dead, seriously injured people, as well as huge material damage), require carefully designed measures that will contribute to increased traffic safety. The importance and urgency of solving this problem is even greater, having in mind the negative trend of growing involvement of young people in traffic accidents. Each traffic situation has two components: - the objective component (the content of that which the traffic participant observes and registers as relevant and the factual material beyond his immediate observation) and – a subjective component (which is the response of the participant on the objective reality in a given traffic situation[2].

The logical sum of the responses of traffic participants as individuals represents the traffic behavior. Statistics on accidents, penalties imposed in misdemeanor proceedings and on the spot by the police officers of the traffic police, speak very clearly of the level of lack of traffic discipline[4]..

Behavior, in general, as well as traffic behavior is learned from early childhood. A child adapts to the family environment, and then it goes beyond up to its range between the minimum which is necessary for the survival of the individual in the local community. For these reason, family is the most powerful factor.

2. FAMILY AS THE FACTOR OF TRAFFIC EDUCATION

Statistical data on the structure of the participation of children in traffic accidents does not provide a satisfactory picture of the successful completion of the educational role of our average family in the area of traffic. Before going to school, many children already know letters and sometimesread fluently, while in the traffic area, they do not know the basic concepts. It is worth noting that the traffic literacy of children is not influenced by those hundreds of thousands of father and mother drivers, which essentially represent a significant force of implementation of traffic education. The thing which can be accepted as the problem is the system of prohibition and intimidation by the family, not the system of education and practice on the traffic surfaces. Our children step into traffic reality much too late. [1].

The question is where is the place to create the contemporary citizen aware of traffic? First of all, the place is in the family. Education in the family should be the first step in creating a citizen well aware and well disciplined in traffic. Hundreds of thousands of parents who are amateurs and professionals in driving live in families. Traffic safety is not just about the education of children but also it is about educating the adults. While highlighting the obligation of parents as educators of children in traffic, at the same time we emphasize the education of adults in the same way as parents during the first years of primary school re-learn the materials while working with children or even learn subjects of their children in order for them to be more successful. When and how to provide basic elements of traffic culture? First of all, the mothers or parents through a story, a game, a walk that provide the ability for traffic practice with the help of parents, schools, of health, environment.

3. THE ROLE OF DRIVING SCHOOLS ON PREVENTIVE WORK TO ELIMINATE THE CAUSES OF YOUTH SUFFERING IN TRAFFIC

Following the experience of foreign driving schools, especially those that have been long developing and implementing partnership while working with the local community, the application of this model in the task of prevention work of driving schools and local communities to resolve the suffering of young people in traffic is one of the steps to make citizens trust driving school.

Bearing in mind that the main key of this concept is working together, in other words partnership, prevention and problem-oriented work, the bottom line is that the citizens define security problems and to target and jointly come up with a solution. In this work concept driving schools should be interested in the following elements: - educating citizens - planning the program of preventive work - the work efficiency, - a systematic solution for the problem - creating a model of the project implementation and education - the consistent realization of the set targets. [1].

While realizing this, citizens should not think of driving schools as they did before. They must be partners in eliminating the presented problems and in realization of the project of education.

A large number of headlines and publications on the subject of safety of young people were undoubtedly significant, even though they treat the place and role of the individual and his awareness in addressing these issues in general.

Various campaigns carried out by the traffic police, have also contributed to some improvements, but it is considered that the results of the measures do not have the necessary continuity.

Driving schools should continually:
- Indicate the possibility of influencing citizens or their concrete actions to address the identified traffic problems,
- Indicate the need for connecting and interesting in the problems faced by schools in the field of traffic safety,
- Interest them in an organized work in the partnership on traffic education of adults.

Working with adults is the most complex and the most difficult to implement for many reasons, because there are no psychological groups that are already involved in the educational process.

Thus, it is necessary to establish educational groups which will have an educational approach effect on:

1. Parents, and help them enter into a correct relationship with the children,
2. Class teachers and inform them about the groups' activities and harmonize the program content and encourage them to research on the effectiveness of teaching in traffic education and upbringing of young people.
3. Mental health workers, indicate the importance of the work in traffic prevention, and the importance of counseling patients who have been noticed experiencing changes that could directly affect the safe participation in traffic,
4. Local Media, with the aim of informing about traffic problems and the realization of the concept of encouraging the involvement of individuals or groups of citizens to get to know about and solve specific traffic problems.

4. PREVENTION PROGRAMS

The prerequisite for the success of prevention activities, in specific setting, is that these activities, after detailed analysis and the introduction of conditions under which it should be exercised, are shaped and balanced wholes, along with programs, whose consistent implementation will be included in all the target groups should be influenced. The elaboration of the program of prevention activities is given a lot of attention in the practice of some countries that make more serious efforts to take steps that would lead to change and improve the security situation of young people in traffic. This is the case with Sweden, Norway, and can be seen in England and America. It is obvious that any preventive measures that are carried out outside of the program as a whole and without enough systematic work and determination do not seem to lead to the ultimate success. [4].

Another significant point is that all prevention programs are developed in a way that is mutually equally linked, or to derive one from the other.

Prevention programs also include legal measures and sanctions as an inseparable part of every system of prevention. Those most responsible for preventive activities could be divided into several groups depending on the way in which they implement their actions and areas on which they operate:

- The Police
- Family,
- Schools and other educational institutions,
- Driving-school centres
- The media,
- Health and technical services, etc.

Prevention program must include measures which will eventually affect the improvement of the key factor of traffic education – the family.
So there is no doubt that the level of security can be achieved by taking the following measures:

- measures in the process of education of parents and their obligations for hereditary upbringing of children, and
- measures in the education of children.

a) Measures in Educating the Parents

At preschool age, the parental influence is intense and very significant, but the actions in their upbringing and schooling are difficult to conduct in an organized manner, unless those activities do not focus on the work of educational groups of citizens and the police, as well as other stakeholders of prevention. Compared to all other measures, we can say that this set of measures has not been given full attention. It is known that children in one of their phase of development often imitate their parents and very well perceive their behavior in the street and traffic. [1].
At the time children start school, it is necessary to point out to the parents the importance of their behavior on the street, especially when accompanying children to school. Parents should be involved in the creation and development of safe corridors (painting, folder) and treatment of children in specific situations, because in this way the children can acquire the necessary experience in movement. [1].

b) Measures in Educating the Children

Measures in educating children can be carried out in the pre-school and school age. It must be admitted that the measures in the upbringing and education of children in preschool age, or very little applied or not applied at all. Children’s toys and games with the means of transport have a very large purpose, if the child learns something on its own, something that it will be useful in its life. In addition to empty stories of parents of special vehicle models in the world of children we are designing our dreams not bearing in mind that a child learns first, and then the applies its knowledge in the traffic behavior.
Traffic signs as toys and games for children are almost non-existent, and games in parks that can be called a small traffic world are very rare: these spaces for play in our area do not exist. In short, the traffic education provided by listed bearers of prevention has failed.

5. CONCLUSION

It is known that a problem is solved only when a solution is accepted in the community as the standard of behavior. Elementary education of the children and youth as the standard of behavior starts in the family, which will later continue in school. The education in the family should be the first step in creating the traffic culture.
This issue needs a programmatic approach. A personal computer as an inevitable means of learning today offers great opportunities for learning through play. By creating games on the theme of basic skills in traffic, a child through play unconsciously meets the program content.
How much time is needed to create one game which will become conventional with the rules of the game that will remind you of the way from home to school, and the dangers that occur in the real world (at the pedestrian crossing, on the road, etc.). Let's leave the place and time for the competition between parents and children in the traffic.

Family competition will encourage and give collective stimulation. All this presented in this paper is an attempt to realize the vision for which it is expected that in the coming period will have its realization.

Assuming that a holder of preventing the establishment of strong ties of mutual and lasting co-operation, so that the activities of each of them gets the effect that fits into a single unit, in due course there could be significant improvements in the field of traffic safety.

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UDK: 656.1:629.118.6/.68 Professional paper

The development of motorcycles in terms of passive safety in traffic[1]

Senad Sinanović[2]
[2] Driving School "Green Wave" Srebrenik, BiH

***Abstract**: This paper points to the importance of the application of passive safety elements in series production of modern motorcycles. Nowadays, the need for further development of safety motorcycle is increasingly emphasized, because of the motorcyclists. Factual situation is evident from the analyses and statistics on traffic accidents involving motorcyclists.*

***Keywords**: passive safety, development, safety*

1. INTRODUCTION

Offers and constructive solutionsof safety elements of motorcycles should find their own application in practice with a wider number of producers of motorcycles. It is important that these new safety solutions be esthetically acceptable of very finicky young customers, owners and drivers of motorcycle. The point of this paper is to launch a new debate, which would generate new initiatives for the producers of motorcycles and
equipment for modern development in this neglected area. It is necessary to introduce elements of passive safety for motorcycles, and equipment for motorcycle riders, as well as it is necessary to introduce legal norms of their implementation on the roads.Nowadays civilization is unimaginable without modern transport, this extreme characteristics of our time. Traffic affects our lives and it is closely linked with the human psyche, and a vehicle has been given the status, a member of family".
Nowadays, motorcycles have become one of the most massive and interesting participants in everyday traffic. There are a lot of reasons of this use, for example, traffic jams on the roads, as well as economy, and ecological aspects. Motorcycle is subject of the satisfaction in the hands of young people, who do not have experience at all. Because of this, motorcycles often cause accidents.
Today's motorcycleshave high constructive and technical characteristics of dynamic capabilities. Because of that, this means of transportattracts young people, and a lot of people considered it the first means of transport, because it is still the cheapest.[1].

[1] *Work was developed in the framework of the doctoral thesis " The impact of passive safety of drivers and passengers using the vehicle - Disabled in traffic "*

1.1. Motorcycle Development Directions

Today's motorcycle is set to manage the city traffic and it is practical for longer and shorter trips, it is fast and economical, and because of this, it has become a favorite means of transport, and every day it has more and more supporters in those countries where so far only ruled cars. The problem of parking vehicles in urban areas should be added to this. It is believed that in the future, the motorbike will provide more pleasure to the man in his needs in the fields of movement, recreation, sports and tourism.
Therefore, world motorcycle industry obviously has set its future development of the motorcycle. However, today there are many types of motorcycle which are produced as a function of their utilization. Motorcycle with a driver could be mild and relatively harmless to the traffic, in the case of the bicycle with an auxiliary motor, or fast and aggressive when it comes to motorcycles that are driven by powerful engines working volume over 1000 (ccm), which have over 100 power (kW) with a mass of about 500 (kg) including the driver. It's all led by the world industry of motorcycle, to do more engagement to increase active and passive safety, which include big capital in those countries, which have developed the technical world.
The main reason of this is the fact motorcycles killing mostly young people, who seldom become disabled people for life time, which is a huge burden on society.

2. CONSTRUCTION OF MOTORCYCLE BASED ON ASPECTS OF PASSIVE SAFETY

Increased safety of motorcyclists in traffic is based on quality constructions of motorcycles and good roads on which they drive, to the versatile education and training.
This includes basic vocational training and exploring the possibilities and dangers of riding on two wheels it carries and what she hides followed by many and frequent traffic hazards of other participants and traffic traps.The same feel the legislators and producers, many of them are already fully or partially realized, and some new laws were foreshadowed.
At the same time the automotive industry much earlier responded to the increase in the number of accidents in traffic, by undertaking intensive efforts and costs in the development of vehicles using modern structures in order to achieve the greatest possible passive safety[2]. Exactly the same situation exists today in the construction of the motorcycle. The enormous technical and optical - designed solutions with attractive production models are directed against number of traffic accidents, which are somewhat stagnant, but are still at a certain level unacceptable. Now it should be as well as in the field of automotive, considered fundamental for safety and with the further development of the motorcycle. This applies particularly to the area of passive safety in accidents that do not yet take into account and do not handle many motorcycle manufacturers. Reasons should be found in the fact, that in this area, only occasional information on the potential improvements of passive safety at the motorcycle have been achieved , but it lacks a comprehensive research and complete treatment of this complex issue.

2.1. Proposals for motorcycle safety

In order to complete such a research project set up and processed,the special development groups and institutes for the safety of two-wheelers have been established in Germany, Japan, Italy. In this very complex and responsible task, apart from technicians, designers, medical doctors, psychologists and other professions have also been involved. The focus of this preliminary development work is based on the following areas:

- There were taken into account and examined all categories of statistics on motorcycle accidents
- Individual accidentwere analyzed and processed
- The causes of and collision flows between personal vehicles and motorcycles were analyzed
- Encounters of motorcycle on pedestrians were analyzed
- Collisions between a motorcycle and other stronger traffic participants: trucks, buses, tractors, trams etc have been investigated.
- We analyzed mutual collisionstwo motorcycles.

Based on the above and executed tests, we made a detailed expert analysis of individual cases and all the results are systematized and largely disclosed in professional journals and books. The data obtained by testing on the basis of the analysis are constructively worked out, but on the basis of them, we made drawings and models of constructive project motorcycle safety. In doing so, the authors' main task was to cooperate with designers preparing the project (sketch - model), which will integrate safety equipment motorcycle and central security clothes of its driver. Therefore, the design of most commercially attractive motorcycle with a basic concept design and craftsmanship of real motorcycle safety should have been accepted.

2.2. Examples of the kind of injuries

Based on the kind of injury that happens on motorcycles, according to the data fromthe investigations and analysis of accidents in which motorcycles take part, it was established that two types of injuries happen mostly:

1. Injuries of the bottom limbs, because for majorityof motorcycles, the feet of the driver are the most vulnerable spot of the system driver-motorcycle. Namely, it is found that all of the lateral contact and collision between the legs of the driver and passenger get the most damage and receive the primary injury.

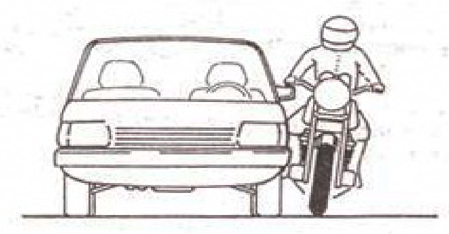

Illustration 1. [7]

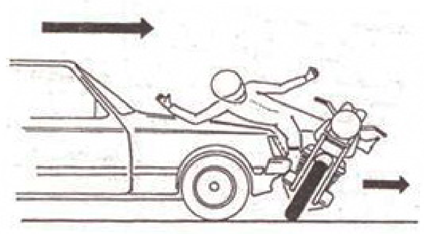

Illustration 2. [7]

Figures no. 1 and 2 show cases of lateral contact of motorcycles and cars. In both cases the side exposed to the injuries of the motorcycle is the lateral side in relation to thecar in the picture no. 1 has a lateral contact with the motorcycle. Figure no .2 shows contact of the car again with the lateral side of the motorcycle.Lateral side of themotorcycle is more vulnerable and exposed to contact, because it is dimensionally longer and has a larger contact area. In general, it can be added that almost any form of accident threatens every motorcycle driver, as well as compression of the body between a car and a motorcycle. If the motorcycle driver fails to separate and free himself from the motorcycle during a collision, a rule will be another leg that does not move, trapped or pinched between the motorcycle and the medium on which it fell. The consequences are first, that will get your foot in the true sense of word peel or scrape, and second, the driver will go through such a critical situation and violations, seized from every opportunity to actively influence the process of further uncontrolled glideon the surface or the environment.

2. **Injuries of the upper extremities and the body of driver** are shown in the cases of the Figure no. 3 and 4. [7].

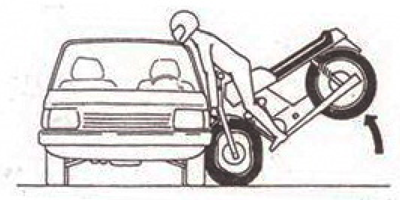

Illustration 3. [7]

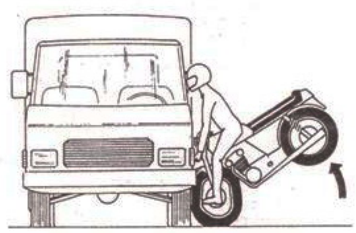

Illustration 4.

Figure no. 3 shows an example of a collision between a motorcycle and a passenger car, and the picture no. 4 collision with a freight car. The main cause for very frequent cases of frontal collisions, the driver of the motorcycle causing injury is a separation of body and motorcyclists collision with a higher hurdle: personal vehicle, truck, bus, tractor or a stationary obstacle. Figure no. 3 is an example of ways to crash on the side of the passenger compartment with personal vehicles, and in the event of collision with a motor or the tailgate is part of the vehicle body kinematics clash is even more complex due to the flight of the body through the vehicle body.
According to these examples, the most common motorcycle crash to conclude that the passive safety system motorbike-driver should not be limited to a motorcycle, but must be and collision-collision opponents (traffic participants) included in this sense should be field shaping and construction. In particular, attention should be paid to passenger cars as the most massive traffic participants.This is shown in current tests and analyses of case studies, as well as analyses of typical collision zone on vehicles which should be constructive and implemented and made from such materials to absorb as much energy collision.
Certainly, the quality of the road surface, as well as protective clothing and footwear, the motorcycle riders influence the outcome of motorcycling injuries.

3. NEW MOTORCYCLE MODELS

Based on past practices and analysis of traffic safety of motorcyclists, and achieved constructive and technological solutions, a model of motorcycle safety has been builttoday. The model of such a motorcycle is shown in figure no. 5. As you can see in the figure following safety elements of a motorcycle are represented:

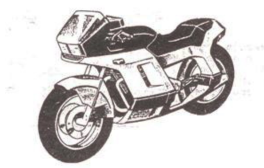

Illustration 5. *Proposal model motorcycle safety*

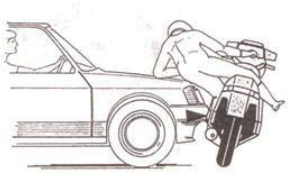

Illustration 6. Collision position of the front bumper of a car and motorcycle side reinforcements to protect the driver's leg

1. Double-front full of light, for better lighting times for night driving, because they are at the same time during their development cars the intense halogen lightsare already secured. That is why during the night driving a motorcycle, the driver in traffic is handicapped. In order to monitor the footprint of small motorcycle traffic in some European countries adopted a law that that during the day, the driversturn onthe long or beam light. As is well known, light motorcycles sold in a wide retail network from various manufacturers, are of different quality and lifetime. Light is often used for better visibility at night, and is subjected to the intense action of the vibration of the vehicle and the ground on which the motorcycle is moving. Therefore, it happens that at nighttime driving the motorcycle, sometimes a sudden and unexpected failures or cracking incandescent lamps, which can lead to serious accidents, as this in practice by examining was found. This danger can be eliminated by installing double headlights or spare beacon, which would automatically beintegrated with burnout light bulbs in the main beacon - travel light. On this basis, today more and more motorcycles on the roads meet the double road lights, and included one beacon per day. [6].
2. Second side rails are installed for the driver and passenger legs in order to protect the clash. Older types of motorcycles need to specially install these protective elements of the motorcycle, in order to protect the lower limbs. For new construction of modern motorcycle these protective bumpers are more constructively built and integrated together with the frame, i.e. motorcycle frame. In fact, in about half of all accidents in which motorcycles participate, or are going to participate, contractures and is not damaged the side of the motorcycle. Therefore, based on the study because of higher safety, built a strong, stable and tightly framed side bumpers should be built in. Because of almost the same height all the front bumper above the road, on personal cars was determined and constructive position and height of a lateral bumper protection on a motorcycle. Its width is so designed that the driver and passenger pass a safe space for their feet, which should be protected, as shown in figure no. 6. In order to such collision situations experienced by motorcyclists need to side with reinforced bumpers to predict a motorcycle and side armor. Side armor has multiple purposes, ranging from the protection of the rain, aesthetic design, streamlined shape and reduce drag, and to protection from side impacts. Side armor belongs to one of the elements of safety equipment motorcycle, which is taken from the racing motorcycle, because the racetracks in cases of falls drivers proved their quality. Appearance model motorcycle safety with side armor and the side guard is shown in Figure no. 7. In order to protect your hand motorcycle driver in the area of control, it is intended lining the front of the motorcycle as part of the shield or as a separatist protection arm. The shield is designed so wide that, looking from the front, the whole driver is protected. Regarding the

protection of the leg motorcyclists, performed side protective frame smooth surface, which is aimed to remove and prevent dangerous cuts in side contact with the motorcycle obstacle[6].

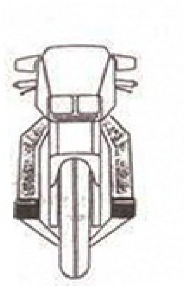

Illustration 7. Model security motorcycle equipped with side guard (metalbumper) to protect the lower limbs [6]

If the motorcycle is viewed from above, as seen in figure no. 8, we can see the V- shape, because in this way avoid the collision by cut at an angle, as in the frontal and side impacts

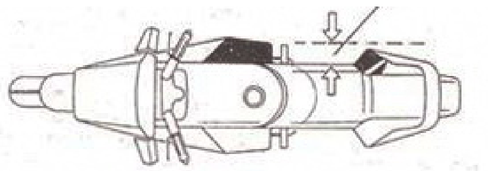

Illustration 8. Model security motorcycle seen from above

3. Antidive system is one of the elements according to the improvement of passive safety of modern motorcycle, which is built into the front wheel fork. The task of this system is to prevent the immersion of the very front of the motorcycle when braking. In particular, it distorts and disrupts the dynamic stability of the system driver-motorcycle in cases of stronger or extreme braking as it comes to the appearance of up and down driver's seating position and center of gravity system disorders. The front of the new security motorcycle is meant to be made of easily deformable plastic, especially in the area of the lining of road lights (headlights). This is sufficiently absorbing plastic material thatin deformation does not break, does not create debris such as glass, plastic or a classic sharp cutting edges as is the case with metal surface collisions of vehicles. Modern plastic materials allow the rear of the motorcycle to rise during a collision.
   In addition to this,such a softer front of the motorcycle to be in a collision with a pedestrian reduces injuries.
4. Discharge pipe, with the silencer while driving, can be heated up to 600 ° C, and is intended to be covered with a protective sheet, which acts as a thermal insulator in the event of contact of body parts of the motorcyclists with these hot parts of the motorcycle, creating burns they touch. Risk of burns, which are quite frequent in individual accidents and motorcycle collisions with pedestrians in this way is significantly reduced.
5. In various studies, the optimal passive safety of modern motorcycle is today proposing a constructive combination of safety elements and one of those is also a possibility to

move in a collision combined with an airbag and driver's seat. In this way direct contact between the driver's body to the surface on which slides is avoided. Fig. 9 shows the effect of one such motorcycle safety equipment collision with a car in the stages of "A" to "D ".

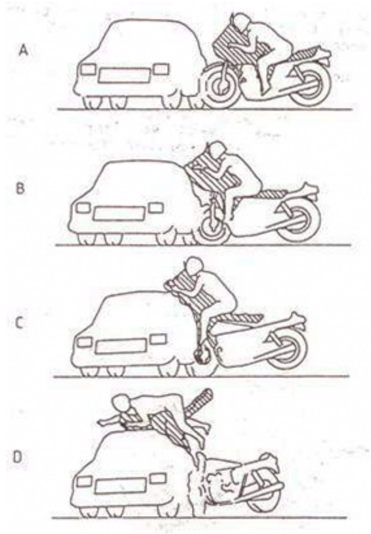

Illustration 9.

6. Finally it is necessary to mention the fact that today many serial motorcycles are equipped with "ABS" braking system. Some manufacturers of motorcycles installed at the customer's request "ABS" braking system as an option that is paid specially. The world market offers colorful serial motorcycles when buying a motorcycle, automatic transmission can be ordered separately as an option. The electric motor that drives the study C1-E is designed for exploitation in urban conditions and is based on components developed by Vetrix. Because of the higher performance, all in order to reduce the mass of the vehicle, BMW has incorporated lithium-ion batteries that are easier with a conventional metal hydride units. In addition to electric plants, the company BMW leaves the possibility of a petrol engine with low emissions. Outrank transportation on two wheels it goes without saying - both in terms of traffic flow, and in terms of the quantity of exhaust gas. However, 80 percent of road accidents occur in cities, which are the cities of Paris, Rome, Barcelona and London launched Esum project. This is one of the main reasons why the BMW put emphasis on safety. Otherwise, the BMW in the middle of last year produced the millionth motorcycle equipped with ABS system. This means of transport has arisen as a result of the BMW and the contribution of the European project for the security of which is called Esum. People in the BMW claim that the C1-E provides excellent protection to the driver. Unlike motorcycles and scooters this model despite the large windscreen has a safety cell or the roll-over bar and two bands - similar to a car. Also, the front and rear elements are "body" that absorb the forces resulting from a collision or contact. In addition to improving the active and passive safety of drivers, C1-E has better protection from inclement weather, and this model can be proud of the fact that this is the only two-wheeler driver where in most European countries is not required to wear a helmet.

Illustration 10. *Model of a safe motorcycle with elements of passive safety*

4. CONCLUSION

Central member of the family of motorcycles "the motorcycle" today, after a century of existence and development, study designed and guided by the idea of simple standby motorcycle became a model with somewhat "phantom appearance". New safety model of the motorcycle shows new elements constructively different from the previous execution of serial motorcycles. Finally, we attach a realistic model of a modern motorcycle with elements of passive safety, which is now installed at the serial motorcycles, as seen in the figure no. 10

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UDK: 374.7+37.018.48]:004.9 Review paper

Educational standards for the subject Digital literacy in the functional primary adult education

Dragana Stanojević[1] and Branislav Ranđelović[1]
[1]*Institute for Education Quality and Evaluation, Belgrade, Serbia*
e-mail dstanojevic@ceo.gov.rs, brandjelovic@ceo.gov.rs

Abstract: *One of the key factors in adult education is the acquisition and improvement of digital competences. Therefore, the subject Digital Literacy is integral part of the program for adult education as a compulsory subject. This paper presents the educational standards for the subject Digital Literacy. Also, in this paper, the results of analysis domeins and educational standards obtained by empirical research, during the process of preparation of educational standards, are presented. In the process of preparing standards, teachers of appropriate subject, andragogist and experts involved in adult education were included. Based on the analysis results, conclusions and appropriate suggestions are provided.*

Keywords: *adult education; educational standards; functional education; digital literacy*

1. UVOD / INTRODUCTION

The Institute for Education Quality and Evaluation has, during 2012 and 2013, prepared General standards of achievement for the end of a functional primary adult education (FPAE) for school subjects: Serbian language, English language, Digital Literacy, Mathematics, Physics, Chemistry, Biology, Applied Science, History, Geography, Entrepreneurship and Responsible life in a civil society. Functional primary adult education lasts for three years and is carried out in three cycles each lasting one year. In the first cycle the basics of functional literacy is acquired and in the second and third, bases of general education and professional competence. Educational standards were prepared for the first and third cycle FPAE.

One of the starting points in defining standards were the basics of computer literacy, which are necessary for each individual to improve his ability to work and to facilitate daily life. Subject Digital Literacy allows each participant elementary digital literacy, because it is the basic prerequisite for the development of society in the era of new technologies. The aim of this subject is for each participant to master the techniques of computer skills, thereby becoming more productive at work and at home. Acquired skills are here to improve his business and private life. Adult education is often described as ‘second chance’, offering adults a chance to reaccess educational systems or to re-train in new educational skills and knowledge. (Grummell, 2007)

Educational standards for the subject Digital literacy are divided into three domains:

- OPERATING SYSTEM - includes the basics of using the operating system, efficient use of software and hardware, the application of knowledge in other operating systems ie. other versions of a particular operating system.
- COMMUNICATION - encompasses the basics of using the global network and e-mail.
- CREATING DATA - includes the basics of word processing.

Standards for the third cycle define competence to use information and communication devices independently and safely in order to find, save, create, display and exchange information and communicate in the context of satisfying private, community and work needs. Independently use of IT usually involves the use of a personal computer, and in particular for the reason that an increasing part of the information is transferred to the virtual sphere of the Internet. Most of the business, public and private services are most easily implemented in this sphere and commonly accessed from a personal computer / tablet / phone. Therefore, despite the fact that the context of digital literacy is slightly wider, educational standards are designed precisely to satisfy basic use of personal computers.

In each of these domains standards are sorted on both basic and advanced levels. Basic level of standards are related to the competencies that are necessary for the participant basic computer use in simple situations. Advanced level include standards comprising the skills of using advanced software tools.

The standards also verify how the student is trained to practically apply acquired knowledge, but it is expected that the user will be be able to use other forms of digital communication such as ATMs, mobile phones, cameras, electronic desks and others.

As opposed to the other subjects, participants in digital literacy classes acquire skills that they will complement and update as soon as possible, and competences acquired as part of this area students will use to find information, solve problems, communicate and develop skills to strengthen the social interactions.

2. RESEARCH

The survey was conducted in May 2012, on a sample of 455 respondents from 69 schools from all over Serbia. At the beginning of the study, within each domain, the knowledge and skills that students need to demonstrate at basic and advanced levels were first identified. Then proposal of the standards were defined that describe identified knowledge and skills. On the basis of this proposal assignments that have been tested were prepared. The goal of the testing was to check the level of standards, and quality control of tasks that have been designed for this purpose.

2.1. Testing

On the pilot testing during the data collection, there was a total of 16 tasks for the subject of Digital Literacy, which were divided into 2 clusters. Clusters of different items were made into notebooks which were solved by the participants of the third cycle functional primary education of adults. Total of 45 participants were solving both clusters and had the opportunity to solve sixteen tasks each. Table 1 shows the layout of clusters in notebooks and number of participants solving tests.

Table 1. *Notebooks overview, clusters layout and the number of participants*

Notebook	Claster 1	Claster 2	*Number of participants*
Notebook 1	Mathematics1	Mathematics2	28
Notebook 2	Mathematics2	Mathematics1	29
Notebook 3	Serbian language1	Serbian language2	27
Notebook 4	Serbian language2	Serbian language1	27
Notebook 5	Digital Literacy1	Digital Literacy2	24
Notebook 6	Digital Literacy2	Digital Literacy1	21
Notebook 7	Applied sciences1	Applied sciences2	23
Notebook 8	Applied sciences2	Applied sciences1	20
Notebook 9	English language1	English language2	24
Notebook 10	English language2	English language1	24
Notebook 11	Physics1	Physics2	23
Notebook 12	Physics2	Physics1	27
Notebook 13	History	Geography	26
Notebook 14	Geography	History	26
Notebook 15	Responsible life in a civil	Entrepreneurship	26
Notebook 16	Entrepreneurship	Responsible life in a civil	27
Notebook 17	Biology	Chemistry	27
Notebook 18	Chemistry	Biology	26
Total			**455**

Table 2 presents taks data: the name of the field, the name of the task, standard to whom task belongs, as well as the percentage of success in solving the problem - pvalue (P) and discrimination (D). Data were analysed using the Statistical Package for Social Sciences (SPSS).

Table 2. *Results of the research*

Domain	Task	Standard	P	D
Communication	**DP101**	O3.DP.1.2.1. Finds information based on keywords.	0,33	0,58
	DP102	O3.DP.1.2.2. Access to the Internet web pages based on address.	0,58	0,42
	DP103	O3.DP.1.2.3. Access to own e-mail account, reads and sends a message, opens the associated document.	0,60	0,37
	DP104	O3.DP.2.2.2. Attach document to an e-mail.	0,20	0,27
Creating data	**DP106**	O3.DP.1.3.1. Selects the language for the text, moving the text and simply regulates (cut, copy, paste).	0,18	0,16
	DP107	O3.DP.1.3.2. Sets the size, color and shape and use tool for text alignment.	0,42	0,20
	DP108	O3.DP.2.3.4. Inserts the picture in the document and adjusts the image position and size.	0,27	0,34
Operating system	**DP201**	O3.DP.1.1.1. Know how to turn on a computer, log into the system, log off, restart the computer and turn it off safely.	0,64	0,21
	DP202	O3.DP.1.1.2. Uses tools to display and close the window and resizes windows.	0,69	0,15
	DP203	O3.DP.1.1.3. Exchange data between the computer and external memory (flash) and transmits data to optical media to the computer.	0,93	0,17

	DP204	O3.DP.1.1.4. Starts the application; opens, creates and preserves folders and documents in the default location.	0,62	0,21
	DP205		0,87	0,32
	DP105	O3.DP.1.1.5. Print the document. O3.DP.2.1.1. Performs basic settings work environment.	0,78	0,51
	DP206	O3.DP.2.1.2. Downloads data from the computer to the optical media and exchange data between the computer and external devices (eg, camera, mobile phone).	0,87	0,20
	DP207	O3.DP.1.1.1. Know how to turn on a computer, log into the system, log off, restart the computer and turn it off safely.	0,82	0,24
	DP208	O3.DP.1.1.2. Uses tools to display and close the window and resizes windows.	0,44	0,52

2.2. Results and observations

In the field of communication, participants were most successful in the task DP103, where they should determine the exact sequence of actions that are performed when sending e-mail. Although the task solved 60% of participants, there are grounds to believe that the participants would be even more successful if they were put in realistic situation. The task DP104 was solved by lowest number of participants. In this multiple-choice task and participants were chosing a keyword that describes the document assignment to the electronic message. Answers that were offered were *document* (31.1% of students chose this answer), *attach* (20%), *send* (37.8%) and *forward* (6.7%).

In the area of Creating data participants were the most successful in the task DP107, where it was expected of them to link the tool icon to align the text with his description. Although they were the most successful at this task, less than 50% of participants knew how to format text. A task in which participants were least successful, is the task in which it was necessary to choose the right combination of commands to move text. Though the task had only three offered answers, most participants chose the answer copy + paste, 64,4% of them, from which the conclusion derives that the partricipants did not differ from moving or copying certain content in MS Word. For them those terms are seen equally.

Domen Operating systems contained half of the total number of tasks that were tested. The most successful solved task is DP203 and is also the most successfully solved task in testing. In this task it is expected of participants to connect illustrated parts of a computer and a CD with their names. Such high achievement indicates that the participants clearly differ computer components such as a keyboard, casing, monitor, mouse, speakers and printer. It is also interesting to analyze the task DP201A that had three questions, a double answer every. Each question solved more than 80% of participants but all three together exactly solved 64% of participants. This is the task for testing knowledge of the procedure loging into the system, turning power off and reboot the computer. The most complex task for the participants was the DP208, solved by only 44% of them, where they were expected to determine the exact sequence of actions to be carried out in order to exchange data between the computer and camera.

If we analyze the frequency of answers on the test, the percentage of the participants who answered each task was greater than 95%. The lowest discrimination has the task DP202, in where participants linked symbolically display of a button for the window manipulation and its function that button performs. A task that had the highest discrimination was the task DP101 (Figure 1).

By writing the numbers 1, 2, 3 and 4 in the squares determine the exact sequence actions you will be doing in order to find the desired information on the Internet.

☐ You will press the Search button or Enter.

☐ In the search field, you will enter the desired word.

☐ You will select and click one of the links obtained.

☐ Launch an internet browser.

Figure 1. *Task DP101*

2.3. Educational Standards

The final standards for the subject of digital literacy for the third cycle FPAE, revised based on the results of this research were created in parallel with the educational standards for Digital Literacy for the first cycle FPAE. The importance of the development of digital competences in adults is of immeasurable importance, and for that reason this subject is in all three cycles of compulsory education. The final list of educational standards in the subject Digital Literacy was created based on the expert opinions of experts who are engaged in adult education and on the basis of the empirical research, which is implemented during the process of preparing the standards.

3. CONCLUSIONS

The role of educational standards is to improve the teaching process. On one side, teachers highlight the key outcomes and competencies that learners should realize, and also to define more precisely what is needed to achieve progress. In this way it helps teachers when they evaluate. On the other hand, students are helped to distinguish the important from the less important, so that they can focus their efforts on learning what is necessary in order to move to the next level of the educational process.

Using educational standards in the planning of the teaching process the teacher formes teaching blocks oriented towards specific life activities and actions: download photos from your phone to a computer and send them via email, locate and download the administrative form from local government, filling it and printing and so on. Improving the knowledge and skills that reach the educational standards is achieved by planning the teaching blocks, which are oriented towards the interests, and previous knowledge and experience of participants. An important aspect of information literacy is that of independent learning. (Williams, 2006)

Digital literacy is a basic life skill, and it is essential that every individual has these skills in order to take part on an equal footing (basis) in all aspects of private and social life. Possession of these competencies allows each citizen to significantly improve his life.

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Education as prevention of cyberbullying

Andrijana Pešić[1] and Živadin Micić[2]
[1] Student at Faculty of Technical Sciences, Čačak, University of Kragujevac, Serbia
[2] Faculty of Technical Sciences, Čačak, University of Kragujevac, Serbia
e-mail andrijana90pesic@gmail.com

Abstract: *The number of IT users is rapidly increasing, and most of them belong to the young population. In addition to numerous possibilities, modern technology also brings many risks. The aim of this work is to determine how much and for what purposes young people use digital devices and the Internet, how they expose themselves to the risks of digital communication and to what extent young people are involved in various forms of, as well as how to react in case they are victims of cyberbullying. In this paper we used descriptive statistic methods. The sample consisted of 98 pupils from two primary schools. The results showed that most pupils who use the Internet, are aware of the measure of protection, but do not use them enough, and as a result, they are most often exposed to the harassment on social networks. In the case of violence, pupils are rarely asking for help, and teachers mostly warn them of possible danger.*

Keywords: *cyberbullying; education; prevention.*

1. INTRODUCTION

In recent years, the Internet and modern achievements of information technology (IT) are talked about more than all other media combined. The number of users each year grows, and contents are becoming richer and more diverse. The development of global computer network opened new possibillities that lead to a series of irregularities and abuse of the use of technical achievements.

Due to the lack of education regarding the dangers to which they are exposed on social networks, inexperienced users thoughtlessly leave information and multimedia content on their profiles that can be abused by variously motivated Internet users. Thus opening the way for the expansion of different forms of violence. Defining the parameters of cyberbullying (for example, which communication technologies are involved, how they can be abused, or on whom, and with what effect) are somewhat proven difficult, partly because the methods used by cyber bullies are diverse. The violence includes many different types of behavior. However, in its essence cyberbullying includes bullying through the use of technologies such as the Internet and mobile phones.

Cyberbullying can include any form of multi-messages sent over the Internet or mobile phone, which aim to injure, disturb or otherwise damage the child, youth or adults who cannot protect itself against such procedures. It may be in the form of a text or a video messages, photos or calls, and violence increasingly expands to several forms of communication, including sounds, images, animations and photos, [1].

For years, the literature has shown us examples of many types of this type of violence [2, 3]:

- Electronic messages that contain vulgarity and insults (flaming);
- Sending threatening messages;
- Defamation and accusing the other sending rumors and lies to destroy someone's reputation or ruining relations with others;
- Under false pretenses, bullies present themselves as another person (using his/her nickname or password, etc.), therefore, doing the things that are destroying the reputation of another person, or placing it into conflict with others;
- Indiscretion - revealing one's secrets, information and images that are not intended for others;
- Turn off - eject someone from a forum, mailing list, etc.;
- Sending inappropriate sexual material (sexting).

2. ORGANIZATION OF RESEARCH

This research was conducted in order to provide information on how much and how pupils use digital technology and how much they are exposed to the risks, as well as which factors of exposure to risk and violence through the Internet, are connected. The results of this research should serve as a basis for prevention of abuse on digital media and to raise awareness among pupils, teachers and parents about the role of digital media in modern life.

The focus of the research were the following forms of digital violence:

- Harassment through emails (insults, threats, bad jokes and similar);
- Harassment on social networks;
- Harassment on the websites: concealing identity, taking the identity, impersonation, using other people's accounts, uploading photos and videos of others without their approval, setting up false and offensive content, sending viruses.

Method of research: The research is of a questionnaire type. For the purposes of this research a questionnaire for pupils of the eighth grade was made. The questionnaire was developed starting from the questionnaires from the research that is part of the project "Stop Digital Violence", [4].

Data processing techniques: Methods of descriptive statistics - frequencies and percentages has been used. For data processing I SPSS statistical software was used.

Sample: The survey was conducted on a sample of 98 primary school pupils, of which 46,9% of the pupils were boys and 53,1% of the pupils were girls. Examinees are consisted of four eighth grade classes from two primary schools in Cacak. *The variables*: gender and frequency of using a computer.

Flow examination: Testing pupils was conducted at the beginning of the October, the school year of 2013/2014. Estimated time to complete the questionnaire was 20 minutes.

3. RESULTS AND DISCUSSION

3.1. Possession of digital devices and Internet access

Among eight grade pupils who use the Internet, more than half use the Internet every day (49%) or almost daily (37,8%), while a very small percentage of them use once or twice a month, only 1%.

Most parents use the Internet (90,8%).

Pupils find that 52% of parents know how to use the computer and internet worse than them, one third (32,7) knows how to use the Internet as well as their parents, while the rest of the pupils considered that parents know how to use a computer better than them.

When pupils were asked at what age they first entered the Internet, 32,7% of pupils first had access to the Internet at age of ten, half the pupils (15,3%) have joined the Internet at age of seven. Most pupils first joined the Internet from 7 to 11 years of age.

3.2. Activities of pupils on the Internet

Pupils most often use the Internet to visit a social network daily (72,4%), watch videos, series or movies on the Internet (45,9%), also to browse Web pages (42,9%); 37,8% of pupils plays games every day and talks via chats. Pupils rarely visit the forums and read or write blogs. Once or twice a week, pupils use the Internet for learning for school (40,8%).

Pupils accept friendship request from people they do not know in 57,1%. Leaving the personal information on profiles/blogs are 30,6% of pupils. 27,5% of pupils responds to the stranger's messages, and 30,6% corresponded with strangers actively.

Pupils know to apply protective measures on the Internet in a high percentage (like blocking people on social networks, privacy settings, finding information on the Internet, and how to safely use the internet), while 53,1% of pupils do not know how to block the person from whom they do not want to receive an e-mail.

According to obtained data, in most cases (93,9% of children who have a profile), personal information can only be seen by people who are their friends on social networks.

E-mail and exchanging e-mails is the least popular form of communication among pupils. Therefore, there is no disturbance of e-mails as a common form of cyberbullying.

To the harassment on the social networks are exposed up to 16,3% of the pupils. Frequency of exposure is not a decisive factor, because one photo can be enough to jeopardize pupils.

In the case of harassment, most of the pupils did nothing. They tried to talk or have tried to return the same way, as responded to 2% of pupils. Only 1% told their parents, and 3% told his/her friend. None of the pupils has never contacted a teacher or a school psychologist, suggesting that schools should be involved more in this problem.

3.3. Helping children by adults in case of cyberbullying

Parents are trying to find out what their children are doing on the Internet (50,1%), and equal per cent know how to determine which sites they visited. Only 27,6% of parents are applying technical measures of protection. Parents warn children about possible dangers (80,6%), and provide advice for the protection on the Internet (64,3%). Teachers warn pupils about possible risk (90,8%), while parents give advice for the protection on the Internet in a slightly smaller percentage (87,8%).

3.4. The frequency of using computer by gender

The girls, compared with boys, are visiting more social networks. Attendance for girls was 80,8% and 63% for boys. Girls also talk more via chats.

Boys are more concerned with technical measures to protect computer and updating programs and applications (30,4%), as well as activating firewall (13%).

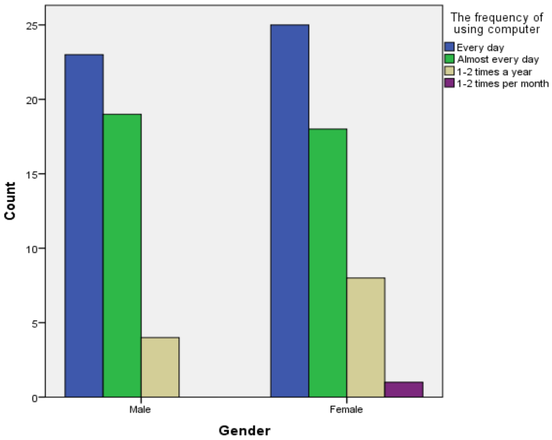

Figure 1. *The frequency of using computer by gender*

Fig. 1 shows the differences between boys and girls at the frequency of Internet use.

From the perspective of pupil's parents, they have sought to find out what the girls are doing on the Internet (61,5%), and those parents would warn them of possible dangers (96,2%), also give them an advice on how to protect themselves on the Internet (78,8%), while parents of boys do less monitoring and warning them of possible danger.

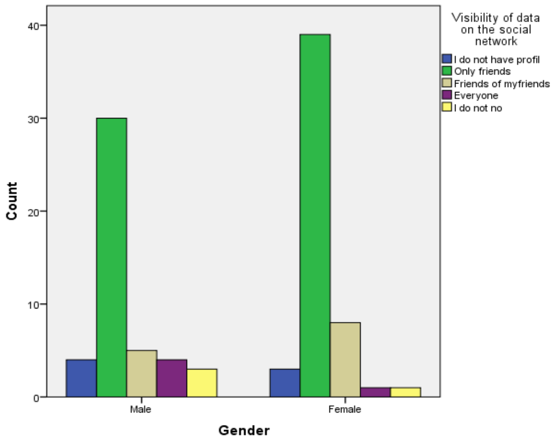

Figure 2. *Visibility of data on the social network by gender*

According to the analyzed results, (Fig. 2), the largest number of respondents (98% of children with profile) say that information about themselves can be seen only by people who are their friends on social networks. However, girls (15,4%) slightly less boys (10,9%) while having a profile and sharing private data with others.

3.5. Acceptance of friendship from unknown persons through frequency of using of the Internet

Pupils who go online daily, often accept a request for a friendship from unknown people, while those who use the internet once or twice a month are not exposed to such a risk, [5].

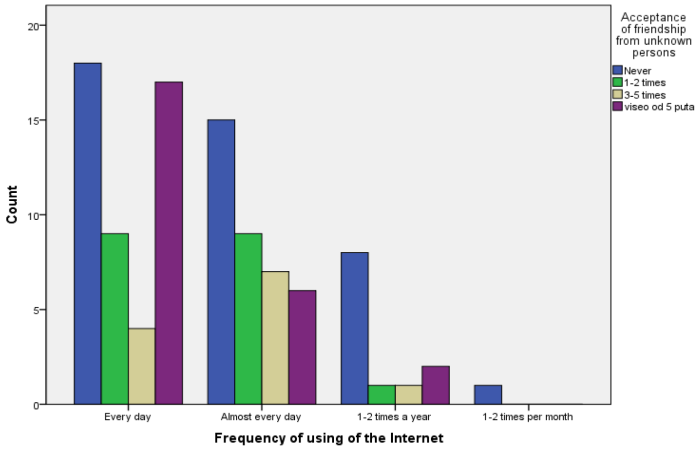

Figure 3. *Acceptance of friendship from unknown people through frequency of using of the Internet*

4. PEDAGOGICAL IMPLICATIONS AND RECOMMENDATIONS

Children need to develop a trustworthy relationship with some of the adults worth trusting (teacher, parent, or someone else reliable), so that they can talk about problems that they have experienced on the Internet. They should use the privacy settings on accounts that they use. This will certainly reduce the risk of violence through internet, [6].

Parents need to educate their children about the rules of behavior on the Internet. They also need to monitor children's activities while online, especially in the initial phase of the researching the Internet. Parents must give their children freedom, privacy and accountability. They will not be able to monitor their children constantly, so it is essential to maintain communication with children, so that they would be willing to say if they encountered unpleasant or disturbing experiences, [7].

There are many preventive steps that teachers can take to help reduce the number of incidents of cyberbullying that occur at school and outside of school. Key components of an effective program of prevention of violence can easily adapt to include the segments of cyberbullying prevention. An important step towards the implementation of effective violence prevention programs is through systematic approach, [2].

Pupils may be required to create posters against violence that will be shown in the school. Older pupils can make a short presentation for the younger pupils about the importance of using technology. The point is to condemn the behavior (without a conviction of the perpetrator!), sending a clear message to the rest of the school community that violence in any form is not acceptable, [7].

5. FINAL CONSIDERATIONS

The research results allow us to conclude several aspects of prevention, and above all: informing children, parents and teachers. Safety education of young people is a very important factor in the prevention of cyberbullying. Preventative solutions should include the education of parents, teachers/school children, as well as enhanced system of control and punishment measures.

Parents' education plays an important role in the prevention of solving this problem. Parents must be aware of the problem of cyberbullying as well as with preventive measures, using specialized programs to control and block unwanted sites.

Children need to learn about and be educate about the threats on the Internet, to recognize when the situation can be classified as risk and to respect the rules of behavior on the Internet. In addition to the indispensable support of parents in the prevention of electronic violence, it is also important and necessary to support the teachers and schools, and the entire community throughout the media and educational campaign to raise awareness of the abuse over the Internet, of safe Internet usage, the preventive measures.

Only combined education of parents, teachers/schools and children leads to solving the problem of cyberbullying, because it will consequently increase the safety on the Internet.

It is said that a chain is only as strong as its weakest link, and the weakest link in any system is usually human. The most important thing is applying constantly education for all users, especially the young population, as well as setting the boundaries to access and use the Internet, each year moving towards younger generations, as they are the most vulnerable to electronic violence.

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Google classrooms and its application in teaching

Biljana Vučković[1]
[1] OŠ „Dositej Obradović", Ćićevac, Srbija
e-mail biljanavuckovic74@gmail.com

Abstract: *This paper will be presented to the Google Labs and means that the classroom can be applied in the classroom. The vast majority of teachers applying innovative in their teaching methods, although few of them to work across Google Drive. This will be explained to the Google Labs, you can set the material in the classroom and work with this material, methods of assigning the role of students and how a specific classroom for a certain student. In this study, a procedure for obtaining a school task, and complete administration, as both teacher and student accounts, making individual classrooms, installation of all materials within the classroom, as well as ways of evaluating and providing feedback to students.*

Keywords *: Google; Teaching in the cloud; Internet; tests; tasks; classroom*

1. INTRODUCTION

Google has free and linguistically localized system for educational institutions. Google Apps for Education (Google Apps for Education) can meet the needs of each school. With one account have access to all of Google's apps. Every school can get a warrant if an authorized person from the school register domains Google-school and connect it to the existing domain school. All Google services are accessed by creating a single order. Google Apps for Education (Google Apps for Education) constitute an integrated solution for the communication at the level of a school or educational institution. Just Google the solution allows you to connect mail accounts, calendars, Google Drive and other applications for communication. Google classroom instruction is an innovative solution in the cloud. Several years ago our school uses the Google system for educational institutions .

2. THE ADMINISTRATION GOOGLE SYSTEM OF EDUCATION

2.1. Login to the system

Google itself classrooms can be set up without prior administration (Fig. 1). Therefore it could possibly be working on the classroom requires some preparatory activities.

Google education is completely free and the only prerequisite for obtaining a Google system for education is that the school has its own domain. After checking domain by Google to give the specific number of orders for teachers and students. This is part of the work should be done by the school administrator, or a person in charge of administration.

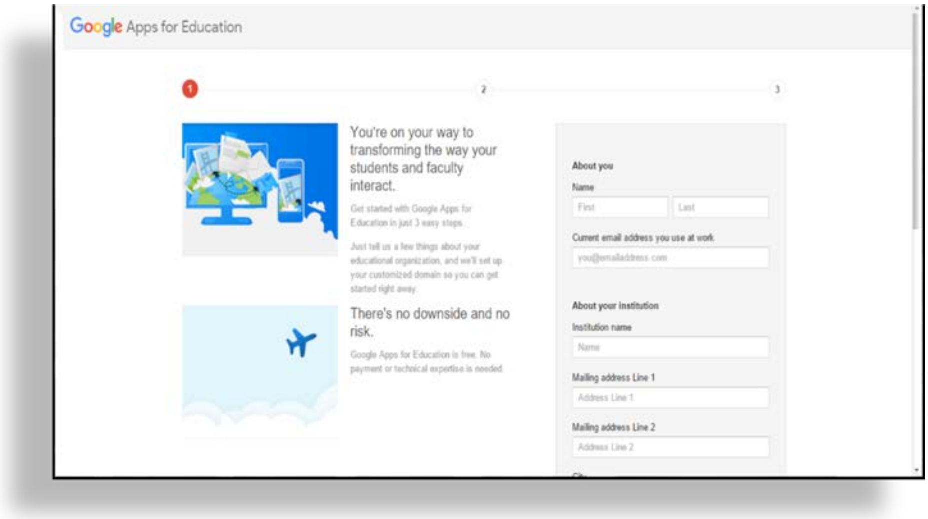


Figure 1. *Log in to Google system*

Forming a task is performed for each student and each teacher. Any account of the established order is exactly the same as the orders established by the user. Difference Between one free user accounts and accounts established in this manner for educational purposes is the possibility of assigning roles orders. In addition to the role can be assigned to different applications and different accounts. This is very important for reasons of control students' accounts. Student accounts are in the case of forming this platform are safe and controlled.

Classroom is available to anyone using Google Apps for Education. The classroom teacher is assigned to be able to be edited. Just edit the classroom starts from its personalization through the creation of materials, issues, tasks, and simple setting of fasting.

The teacher may create more classrooms, each of which has its own specific code (Fig. 2). This is good to a teacher who teaches more subjects or taught in several classes could form a compact continent related to the subject, grade or class.

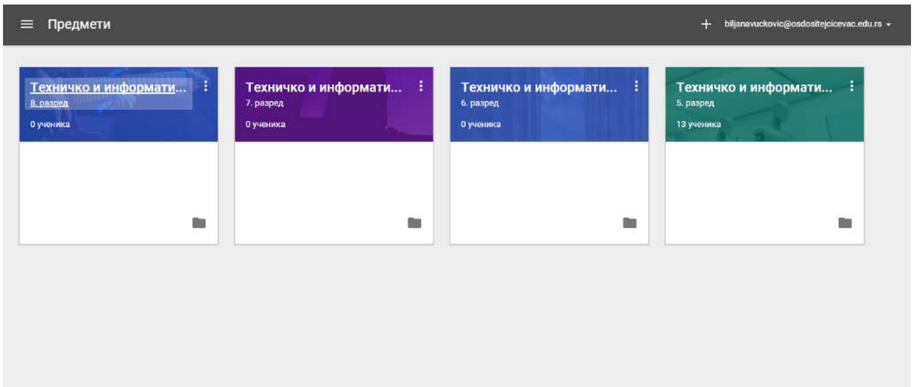


Figure 2. *Only classrooms within the system*

After the formation of the classroom is necessary to set the students at certain classrooms. Adding accounts of students in a particular classroom students to mail call comes in with a code classrooms and registration. In this way, the student is informed that the work can be connected in a particular classroom.

The student can only be in that classroom that receives the call from the teacher while the other locked classrooms for students .

In the classroom we can post materials from classes, presentations, lessons and additional material, we can do the task or ask a specific question students (Fig. 3) .

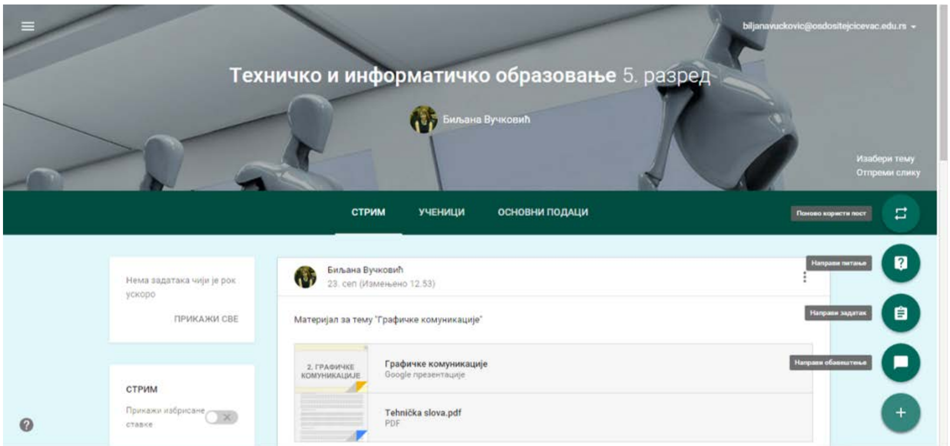


Figure 3. *Only the classroom*

Just set the notification is simple and in the notification next to the text we can add a specific file, Document your Drive, YouTube clip or a particular link (Fig. 4). The document that we can add dispatched from our computer or add a document that we have already set up on Google Drive. Such notice immediately available to students. As far as our classrooms, in addition to the notice which set lessons, additional material and presentations on topics often asked and information related to the course of instruction. The suitability of these notices is that it provides the possibility of setting more classrooms or in all classrooms.

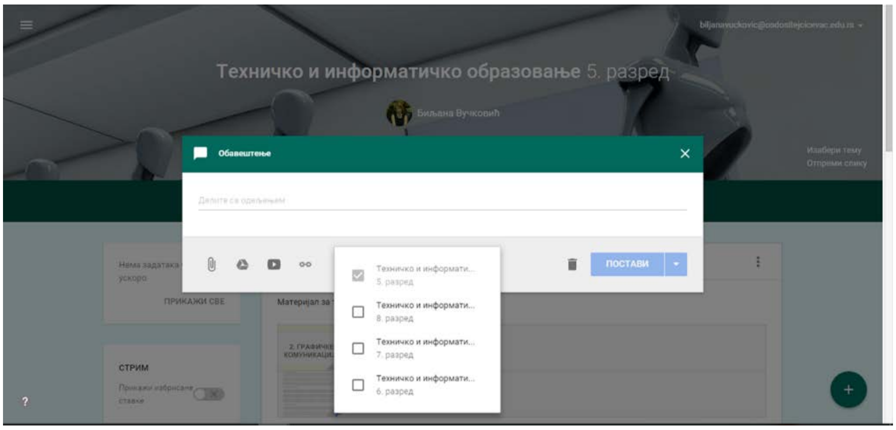


Figure 4. *Adding announcements*

An important segment of the classroom and assign students the task (Fig. 5). In making assignments in addition to the instructions for the task and adding documents, we can add the date of completion of work. The deadline for its completion is determined by the date and exact time which allows us to limit the time of making the task. After setting up the task students can access making the task only by the deadline set in the task , and the current development task teacher can keep track of your account.

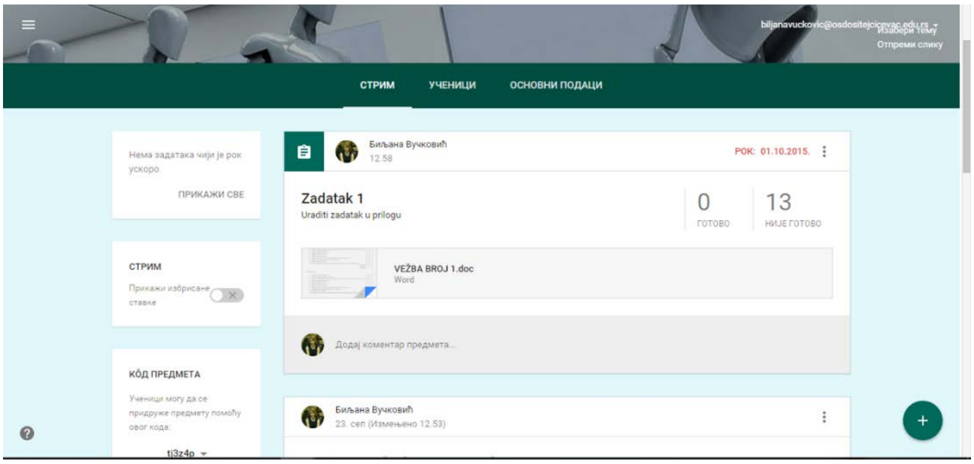


Figure 5. *Layout task*

The teacher can see the number of students who did or did not do the task and to the task, check that the students do a specific task and to assess students (Fig. 6). In addition to evaluating the essential thing for these tasks is that all estimates can be copied to Google tables and can be executed analysis which is made (Fig. 7). Tutors may be returned to the tasks that have not been created.

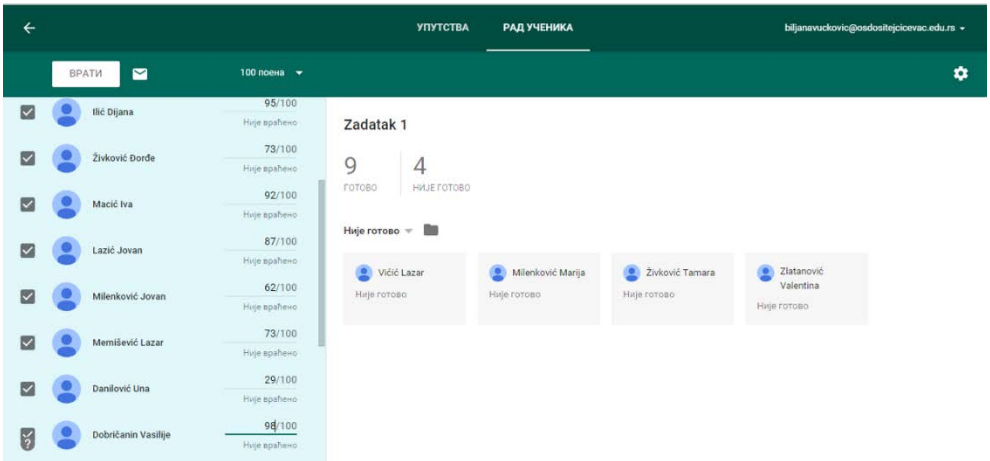
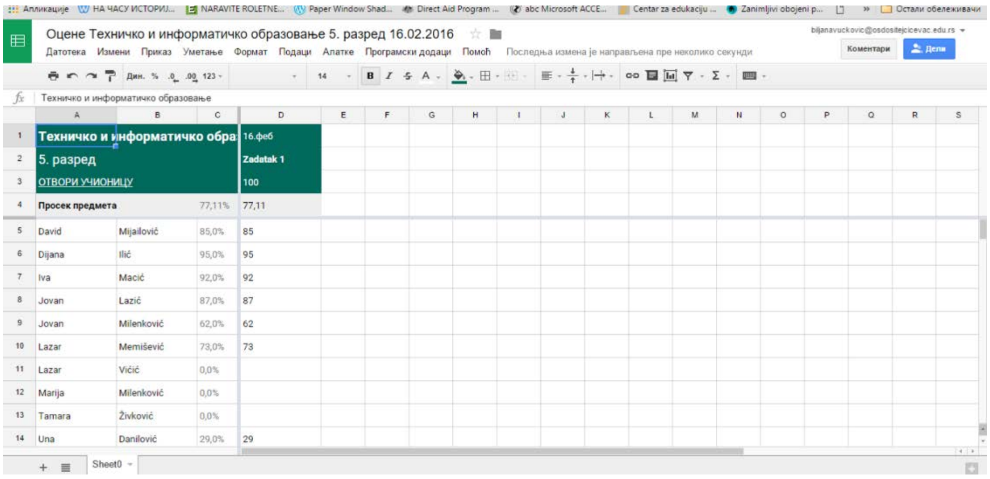


Figure 6. *Overview of tasks*


Оцене Техничко и информатичко образовање 5. разред 16.02.2016

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1	Техничко и информатичко обра			16.феб
2	5. разред			Zadatak 1
3	ОТВОРИ УЧИОНИЦУ			100
4	Просек предмета		77,11%	77,11
5	David	Mijailović	85,0%	85
6	Dijana	Ilić	95,0%	95
7	Iva	Macić	92,0%	92
8	Jovan	Lazić	87,0%	87
9	Jovan	Milenković	62,0%	62
10	Lazar	Memišević	73,0%	73
11	Lazar	Vičić	0,0%	
12	Marija	Milenković	0,0%	
13	Tamara	Živković	0,0%	
14	Una	Danilović	29,0%	29

Figure 7. *Analysis rating*

In addition to the option of adding a task, there is also the option to add questions and answers quick check. And after the tasks, there is a possibility of checking the accuracy of the answers to the questions and the analysis of these answers.

Google classroom is designed to help teachers create and collect assignments. The advantage of this classroom is that there is no paper tasks and assignments alone at home, I can work on single classes. Students can access the classroom and through their mobile devices which also significantly increases the use of classrooms. Documents can be automatically copied to all students, which significantly saves time. A very important fact is that all the material that students surrender, be remembered in the Google Drive are in a separate folder for students. Students can follow the sides of the classroom all incoming tasks and after making it read their reviews and feedback related to the tasks done.

3. CONCLUSION

Benefits of classrooms reflected a slight adjustment. Teachers very easily can add students to the classroom or to a particular class award at the classroom. All this can be completed in minutes. Tasks can easily set up and allow the paperless office. View tasks, evaluation and overall analysis of the findings in one place and can be accessed from anywhere. Google Drive files are formed for each student which allows the teacher to monitor the work of individual students over time.

Google classroom allows teachers to send announcements and start discussions within a department, allows students and teachers to and share resources, allows teachers to leave comments on the work of students and thus provide them with feedback.

Google classroom is an innovative tool in which multiple sets can facilitate the work of teachers and students, and provided security at a high level.

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The use of computers and the Internet for learning elementary school pupils

Snežana. D. Mijailović[1]
[1]Student Faculty of Technical Sciences in Čačak, University of Kragujevac, Serbia
e-mail sneza90ca@gmail.com

Abstract: *The progress of information and communication technology requires considerable changes in the organization and implementation of the teaching process. The aim of this study is to determine the extent in which pupils use computers, how many are available to them, how often they use the Internet to learn, but also how the frequent use of certain teaching aids. Survey was conducted, and sample consisted of 94 pupils from elementary school. The results indicate that students generally have conditions for learning via computers and the Internet, as well as to pupils relatively often used the computer and outside of class.*

Keywords: *computer; Internet; education*

1. INTRODUCTION

The digital age in which pupils work now and learn, requires implementation of modern technologies in the teaching process. In order to increase the efficiency of teaching and pupils' motivation for learning and facilitate the acquisition of content, it is essential that teachers use the potential of modern information and communication technologies. The survey on attitudes towards the use of ICT both teachers and pupils, indicated a positive attitude towards the use of new technologies, with instant access to information and simple way of sharing the same stand as the benefits of using ICT (Džigurski, Simić, Markovic and Scepanovic, 2013). The same survey noted the opinion of teachers that pupils use ICT more efficiently and with greater attention following classes are more active and acquire functional knowledge. Another study showed that teachers largely (up 80%) use the Internet in the classroom, with emphasis on viewing video clips, as well as the use of a blog (Andevski, Vidakovic and Arsenijevic, 2014). The same survey, which covered the examination to evaluate the effectiveness of learning by using Web 2.0 tools indicates that teachers and pupils believe that the application of web technology leads development and IT competence. (Milenkovic, 2012). Research on the use of computers and the Internet, indicates that 96% of pupils have a computer, and that about the same percentage of pupils have Internet access from home (Vučeljić Šćepanović, 2012).
These pupils express to use computerfor several hours a day outside of school. And other studies (Milenkovic, 2012) show that a large number of pupils have access to computers at home, and 65% of the pupils use daily.

Accordingly increasing necessity to innovate teaching and learning approach due to the expansion of new technologies, there is also an increasing need for the development of digital competence of teachers and pupils.

2. ORGANIZATION OF RESEARCH

The subject of research

Object of the research is to investigate the frequency of use of computers and the Internet for learning elementary school pupils.

Research goal

Research goals are gaining of the image on the use of computers and the Internet in order to learn pupils in primary school.

Assignment of this research was to determine how to use teaching aids in primary schools The basic hypothesis: Students use the Internet and your computer for educational purposes.

Methodology and Framework Research

To examine the use of computers and Internet in schools conducted a survey closed questionnaire prepared for this research. The survey was anonymous.

In the study participated eighth-grade pupils from two primary schools in Cacak.

Examination of students was conducted at the end of December 2015. The testing was conducted in classes.

3. RESULTS AND DISCUSSION

One of the questions in the survey investigated whether the pupils have a computer, Internet access, etc. (Table 1).

Table 1. *The possibility of access to the Internet from a home computer*

Survey Question: Whether at home, you can access the Internet from a computer?	***Number of respondents***	***% reply***
I do not have a computer at home	1	1,1%
I have a computer that does not have Internet access	9	9,6%
I have my computer with Internet access	53	56,4%
I can access the Internet only from a computer that I share with some other family members	31	33%
Total	94	100
* Note: the table shows the number (percentage) of students who answered YES		

The fact that even 89% of pupils have a computer home with access to the Internet, whether it be your own computer or shared with family members.

This study investigated how often pupils use the Internet. (Table 2).

Table 2. *The frequency of internet use*

Survey Question: How often do you use the Internet?	*Number of respondents*	*% reply*
Daily	45	47,9
Almost every day	22	23,4
Once or twice a week	20	21,3
Once or twice a month	3	3,2
Less than once a month	4	4,2
Total	94	100

Among eight grade pupils who use the Internet, nearly half (48%) use the internet every day, 23% use the internet almost daily.

It was investigated how often pupils use the Internet for various learning activities (Table 3).

Table 3. *Use of the Internet for learning purposes*

Survey Question: How often do you use the Internet for the following activities for the purpose of learning?	*Everyday*	*1-2 times a week*	*1-2 times a month*	*Rarely*	*No*	*Total*
You use the Internet for learning	*27*	*36*	*12*	*15*	*4*	*94*
Search for an website	*52*	*20*	*3*	*8*	*11*	*94*
Are you looking for ready-made tasks	*9*	*14*	*18*	*17*	*35*	*94*
Your visit forums	*11*	*15*	*19*	*6*	*43*	*94*
You use the system for e-learning	*8*	*16*	*6*	*14*	*50*	*94*
Interchange e-mails	*21*	*13*	*14*	*17*	*29*	*94*
You read and write blogs	*17*	*6*	*5*	*4*	*62*	*94*
Your visit social networks	*60*	*12*	*6*	*4*	*12*	*94*
You talk in chat	*42*	*12*	*10*	*10*	*20*	*94*
You learn with the help of tutorials	*11*	*18*	*9*	*13*	*43*	*94*

Pupils visit social networks on a daily base (60%), a slightly smaller percentage (48%) browsing Web sites, at least visit the forums and rarely read and write blogs. Internet for learning, the greatest number of pupils used once or twice a week.

Comparing (Percentage) of responses with answers (and percentage) of frequencies to the internet, deriving a conclusion about the insufficient use of the Internet for educational purposes.

In addition to determining the frequency of use of the Internet for learning and access to the Internet for students, examined the frequency of use of different teaching aids during classes.

Table 4 shows the use of the teaching resources.

The results showed that:

a) the computer is the most used in teaching lessons;

b) use the projector as a teaching tool is slightly smaller, but no less represented by using a computer;

v) interactive board is an innovative teaching tool, but its use is somewhat smaller;

g) the use of tablets is very small, as well as the use of a mobile phone;

Table 4. *The use of teaching resources*

Medium	*Every day*	*%*	*1-2 times a week*	*%*	*1-2 times a mounth*	*%*	*Rarely*	*%*	*No*	*%*	*Total*	*%*
Computer	*30*	*31,9*	*40*	*42,6*	*13*	*13,8*	*5*	*5,3*	*6*	*6,4*	*94*	*100*
Projector	*14*	*14,9*	*45*	*47,9*	*24*	*25,5*	*1*	*1,1*	*10*	*10,6*	*94*	*100*
Interactive board	*4*	*4,3*	*13*	*13,8*	*7*	*7,4*	*10*	*10,6*	*60*	*63,8*	*94*	*100*
Tablet	*6*	*6,4*	*2*	*2,1*	*2*	*2,1*	*1*	*1,1*	*83*	*88,3*	*94*	*100*
Mobile phone	*19*	*20,2*	*6*	*6,4*	*1*	*1,1*	*3*	*2*	*65*	*69,1*	*94*	*100*

Research results confirmed the basic hypothesis of this study, and it is for pupils to use computers and the Internet for educational purposes.
Also was compared how often boys and girls use the computer.

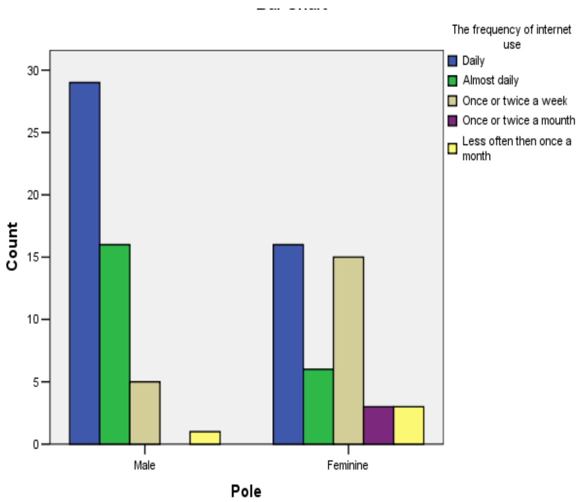

Figure 1. *Frequency of using the Internet*

By frequency of Internet usage boys use it on a daily basis, unlike the girls.

4. CONCLUSION

The results of this study show that among pupils use of the Internet and digital devices is widespread.

Implications or recommendations to further research was to determine the motivation of pupils to use the Internet, as well as their assessment of efficiency as their assessmen of the internet use in teaching.

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Application of modern educational technology in teaching technical and IT education

Dragan Grujić[1]
[1]Elementary School "Sveti Sava", Požarevac, Serbia
e-mail gruji.dragan7@gmail.com

***Abstract**: This paper presents examples of application of modern educational technology computer assisted, in the implementation of the contents of teaching technical and information education, from the fifth to the eighth grade. This methodical approach in teaching technical and IT education, aims to develop the students' interest in the use of modern information - communication technology for learning. The paper presents the finished software tools which, as part of modern information - communication technologies, we successfully applied in the actualization of content of technical and computer education. Teaching enriched ready software tools and the Internet provides an opportunity for students to acquire teaching content in an interesting and entertaining way, and can positively influence the motivation to learn.*

***Keywords:** multimedia, internet, e-learning*

1. INTRODUCTION

Classical teaching technical and information education in which the teacher presents frontal teaching unit is obsolete forms of labor, dysfunctional and does not correspond to the requirements of the digital environment in which we live. Application of new information - communication technologies, a new way to access and process information with the help of ready-made software tools and the Internet, directly changing the position and the role of teachers, students and teaching content, so now we have a triangle rather than didactic didactic rectangle, with the obligatory presence of new educational technologies. Modern demands to improve the teaching of technical and computer education are focused on methodological innovation supported by information and communication technologies. New methods relate primarily to the use of user software and the Internet, which will significantly improve the traditional system of teaching. Use of computers, educational software and the Internet enables a completely different content actualization of technical and IT education and teaching is adapted to the abilities and interests of students, to acquire new knowledge with personal experience in an interesting and entertaining way. The curriculum of the Technical and IT education is realized in the form of lectures and exercises. It is essential that the teaching of this subject in the future increasingly implemented using methods of visual and practical presentation, using modern teaching aids (computers, projectors, interactive boards ...) and interesting software solutions that the fabric of this case make learning more interesting and easier for adoption.

2. MULTIMEDIA IN TEACHING TECHNICAL AND IT EDUCATION

Multimedia term comes from the Latin multus (many) and medium (media or agent). Multimedia is a combination of text, image (movable and immovable), sound, animation, video content, integrated with a computer and related mainly to the media, which are by their nature non-text. Multimedia is a concept that is a combination of software and technical dimensions. The main objective of the introduction of multimedia as a modern information technology in teaching technical and information education is primarily to facilitate students to acquire new knowledge and that this knowledge can be applied in everyday life situations. Using multimedia enriches the learning process by providing multipercepciju. It represents the integration of more than one media - text, audio, video, image, animation, etc. (Fig. 1), which complement each other and enrich the information transfer.

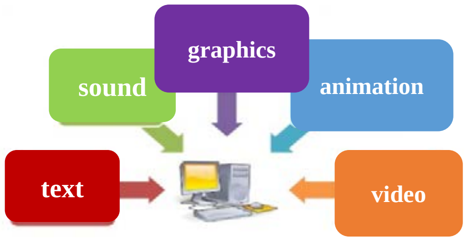

Figure 1. The basic elements of multimedia to be applied in the classroom

- ✓ Using multimedia software in teaching technical and inf. education, it is possible to prepare and implement the teaching according to individual abilities and previous knowledge of students (Krneta, 2007). Also, teaching becomes apparent, dynamic, increasing internal and external motivation of students, a knowledge of the students are becoming more permanent (Kljakić, 2003). Multimedia presentation as one of the segments of multimedia, contributes to easier maintenance of discipline in the classroom and the creation of teaching situations in which will increase the activity of students and thought to come to the fore their responsibility for the success of learning (Mandić, 2003). Multimedia in teaching technical and IT education can be applied during the implementation of the course content as follows:
- ✓ The analysis of lessons through multimedia presentations,
- ✓ Creating and displaying animation and simulation of various machines, tools and equipment,
- ✓ Creating and using interactive content for students,
- ✓ Creating and using video and audio tracks,
- ✓ Using interactive whiteboards.

2.1 Benefits of multimedia in teaching technical and IT educationednosti

There are many advantages of using multimedia in teaching, and these are just some of the positive effects of multimedia teaching:

- ✓ positive effect on academic achievement because it allows the use of various sources of knowledge base information;
- ✓ students acquire new knowledge in an interesting and entertaining way;

- ✓ multimedia allows engaging multiple senses of perception in students, which contributes to easier and simpler acquisition of knowledge;
- ✓ provides individualization of instruction;

3. APPLICATION OF INTERNET IN TEACHING TECHNICAL AND IT EDUCATIONINTERNETA

The time in which we live is characterized by rapid technological progress and the digitization of society as a whole. At the present time the information - communication technology on the rise, the Internet has become the general needs of the people. Keeping this fact in mind we are aware that the use of the Internet - technologies in education has become commonplace, and the need to gain new knowledge and to help you come up with new information. Children in early childhood encounter with computers and the Internet, and is in line with their interests and the times in which we live is required for students to form and develop awareness that computers and the Internet is not used exclusively for fun and recreation, but can be very powerful and a useful tool in the learning of the content of technical and computer education. New knowledge in the application of these technologies is the result of students' activities, reconstruction of existing and construction of new knowledge based on what he already knows from the social environment, especially from peers (Mandic, 2010). Contemporary teacher scientific and technical progress require a search for new sources of knowledge, effective methods and forms of work, as well as modern teaching aids to improve and update teaching (Budimir - Ninkovic, 2005). One of the current a very powerful teaching tools, which provides great opportunities for learning, the internet. Internet is a global computer network that is available to most of today's students. One of the most widely used service on the Internet is the WWW (World Wide Web - World Wide Web), which represents an enormous database (texts, images, audio and video, animation ...) that students can use for independent learning and acquiring knowledge. Teaching and learning with the help of the Internet favor the development of abstract thinking, planning guidance and allow individual progression in the acquisition of knowledge (Blagdanić, 2007). Communication students and computers is direct and simple. The use of computers and the Internet in the classroom allows the development of memory, imagination, independence in learning, raising educational levels, builds sensitivity to the problems of flexibility and independence. Such knowledge can work successfully put into operation the development of human capabilities. Table No. 1 above are examples of educational sites and links that students from fifth to eighth grade, can be used to learn the content of technical and IT education.

Table 1. *Examples of links on the Internet that students can use to acquire knowledge in technical and IT education*

Red. num.	Teaching subjects:	Education link on the Internet:
1.	energetics	http://www.cnti.info/energija/page2.html
2.	Technical drawing	http://www.tehnicka.edu.rs/cesta-pitanja/strucne-obuke/89-blog/opstestrucno-podrucje/495--sp-1569984462
3.	Architecture &	https://sites.google.com/site/petarblagojevictehobrazovanje

	Construction	/sesti-razred/uvod-u-arhitekturu-i-gradevinarstvo/1-1-arhitektura-i-gradevinarstvo
4.	Tech materials	https://sites.google.com/site/petarblagojevictehobrazovanje/peti-razred/tehnologija-materijala
5.	Traffic	https://www.youtube.com/watch?v=dIB8h1ryFiQ https://www.youtube.com/watch?v=pTwDcFipzQE
6.	Information technology	https://sites.google.com/site/virtualnicas/racunarski-sistem https://www.youtube.com/watch?v=E4qUNM2JOE4
7.	Construction materials	http://digis.edu.rs/mod/book/view.php?id=1824
8.	Technical means in construction	http://digis.edu.rs/mod/book/view.php?id=1824
9.	Culture housing	http://digis.edu.rs/mod/book/view.php?id=1857
10.	Machines and mechanisms	http://natalijadikovic.weebly.com/105210721096108010851077-1080-108410771093107210851080107910841080---1079108510721095107711141077.html
11.	Digital electronics	http://natalijadikovic.weebly.com/105410891085108610741080-10721085107210831086107510851077-1080-107610801075108010901072108310851077-10901077109310851086108310861075108011121077.html

4. APPLICATION OF ELECTRONIC LEARNING IN TEACHING OF TECHNICAL EDUCATION AND INFORMATICS

One of the most important attributes of modern teaching is e-learning. It is an area that is slowly but surely becoming more and more an integral part of our system of education. E-learning can be defined as a way of learning with the help of information - communication technologies, as well as the performance of the educational process with the help of electronic technology - the most common ICT. In other words, the electronic learning (e-learning part, eng. "E-learning") is a very broad term that actually encompasses all the methods and techniques for computer-assisted learning. According to constructivist theory, teaching e-learning is a teaching system ,, Keeping students in the process of constructing their own knowledge and increase awareness of the context of learning " (Schertler, 2006: 223) using modern information and communication technologies. In teaching, technical and IT education successfully can be applied e-learning system through various activities of students. The main objective of introducing e-learning in the process of education is teaching innovation, raising the quality of teaching and the achievement of the best possible learning outcomes. E-learning can be especially useful tool in working with gifted students in teaching technical and inf. education. For the purposes of e-learning can be used free of charge software package Moodle. It is safe to operate, adaptable to different needs of students, flexible, and allows for the possibility of expanding and improving existing functions.

4.1 Resources Moodle platform for e-learning

Moodle application allows teachers complete modular support in organization and realization of electronic teaching. Teachers of technical and computer education who want to use Moodle platform for the realization of on-line classes, among others, are also available the following resources and applications designed for e-learning:

- ✓ Planning dynamics of e-learning,
- ✓ managing user accounts,
- ✓ work with existing files and educational content,
- ✓ fully monitor the activities of students,
- ✓ tools for synchronous and asynchronous communication and teamwork,
- ✓ forums: allow discussions, ask questions, notices,
- ✓ Tests: This module allows the teacher to create a database of questions, based on which they can create a knowledge assessment tests with different types of questions,
- ✓ Dictionaries: This activity allows students to create a list of lesser-known concepts in the form of a dictionary,
- ✓ chat: allows users synchronous discussion in real time. It is especially useful for teamwork and the exchange of ideas and opinions on a particular topic,
- ✓ wiki pages: represent an activity that is suitable primarily for teamwork, for the exhibition of works of students.dinamike realizacije e-nastave

Figure 2. *An example of using the system for e-learning in teaching technical and IT education*

5. CONCLUSION

The general conclusion of the paper is that it is the realization of the content of technical and IT education, may apply different educational technologies, such as multimedia, internet and e-learning. The paper gives examples of applying these methods. Their common goal is to teaching technical and information education and modernize the students, the easier and more interesting way, developing research skills, acquire new knowledge of computer use.

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UDK: 004.382.73:373.5 Professional paper

The use of tablet devices and Google Drive service in teaching in the case of information technology high school - ITHS

Nikola Dragović[1], Svetlana Anđelić[2], Bojan Ristić[2] and Mirjana Žilović[1]
[1] High School of Information Technology - ITHS , Belgrade, Serbiabija
[2] College of Professional Studies for Information Technology - ITS , Belgrade, Serbia
e-mail nikola.dragovic@iths.edu.rs

Abstract: *Within this work is emphasized the importance of the form of communication between teachers and students, the transmission of information, data, exchange of materials in the modern educational process and gives a brief description of the application Google Drive service using a tablet as a teaching tool in the Information Technology High School - ITHS .It is the school that fully supports the new modern information - communication technologies (ICT) that are used in the modern educational process.*

Keywords: *Education, tablet device, Google Drive, ICT, learner – centered paradigm*

1. INTRODUCTION

In the High School of Information Technology (ITHS), as well as contribute to the improvement of teaching, motivating students, raising the quality of teaching and learning in the process of realization of regular classes in their daily work with students are used tablet devices. New didactic - given to organize technical resources, which are based on the use of tablets in the classroom, allows classes to be designed as an integrated cognitive system that feedback is monitored through every step of the student`s activities.

The processes of scientific - technical revolution with all the rapid application of scientific knowledge, in practice, trying to improve the way we communicate in teaching using modern communication tools such as tablet devices [1].

In ITHS in tablets and Google Drive service are the modern communication tools and technologies aimed achieving interactive communication between students, students and teachers, and between teachers and professional associates, regardless of their physical location, and with the use of infrastructure and resources of the Internet.

2. A NEW EDUCATIONAL PARADIGM BY USING TABLET DEVICE

The role of teachers in traditional teaching is mainly confined to lectures (disclosure of information), and the occasional control of students' knowledge, although it should be permanent and far richer and more diverse. In this system, the teacher was the main subject of the teaching process, and the student belonged to the object-function.

The teacher should indicate students how to learn, how to be independent, to advise them and helps to the faster progress, that enables them to self-education and lifelong learning.

The new educational paradigm is oriented towards students (eng. Learner - centered paradigm).The student is "stored" in the center, while in the environment are learning resources both in terms of time and place and ways of learning. Furthermore, the student is all oriented - and everything is covered by an original resource, tablet device and an Internet connection.

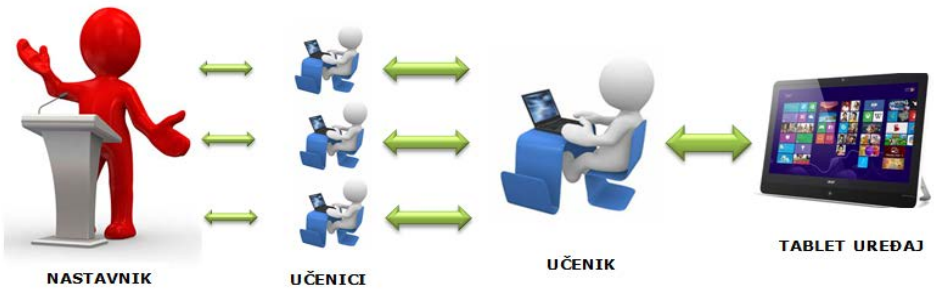

Figure 1. *Modern teaching methods with the use of tablet device*

All you need to organize such a process of communication between teachers and students are: mail, stable, reliable and fast WiFi connection and tablet.

3. THE USE OF GOOGLE DRIVE SERVICE IN TEACHIN

The tablet itself is not sufficient unless there are adequate resources for learning that could be used on it.The Internet is a rich variety of learning resources, but they are not always suitable or adapted curricula and / or age of the students.

The best solution is that a teacher puts the teaching material at one “place“ that students can see and, if necessary, they can update it too. Such possibilities are provided by Google Drive service. Google Drive is a user friendly suite of online collaborative tools that come with tremendous potential for use in the classroom. [3]

3.1. The process of organazing and creating work environment

Every teacher creates folder for the subject that he teaches ,picture 2. After creating a new folder using the Create option opens a dialog box New Folder where you can enter a folder name, or the name of the Subject which the folder is created for .When you create a new folder, access to his sharing Share.The process of sharing is extremely simple.Select the folder that should be granted to students who study the subjects and then click on the icon Share, which confirm the award.

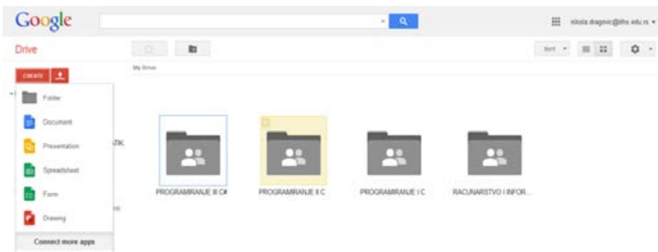

Figure 2. *Create a new folder within the Google Drive service*

When you create a new folder, access to his sharing Share. The process of sharing is extremely simple.Select the folder that should be granted to students who study the subjects and then click on the icon Share, which confirm the award, Figure 3.

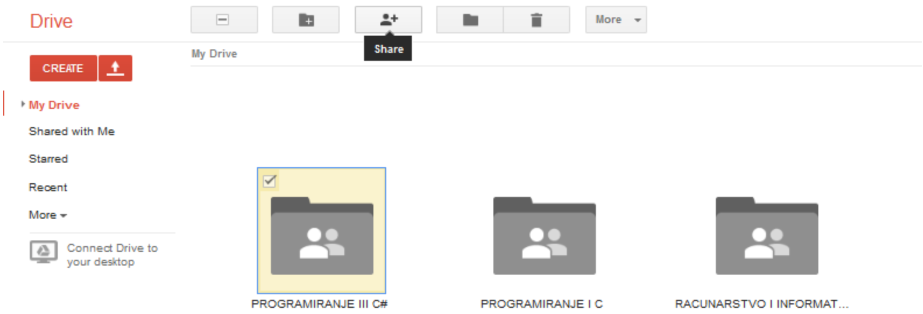

Figure 3. *Sharing a folder with students*

The next step is the introduction of mail address to the students who want to assign designated folder. Mail addresses are entered in the dialog box Sharing settings in the field Invite people, and then click Share & Save, Picture 4.

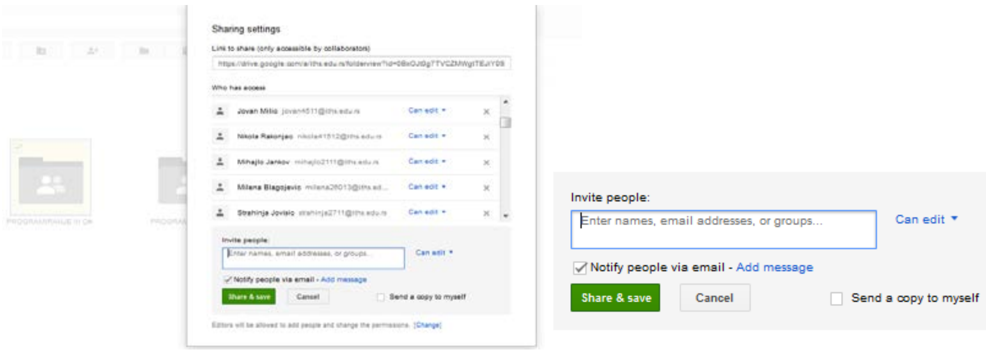

Figure 4. *Entering mail address assignment folder.*

When sharing you can limit access and there are three options that can be changed for each student individually. The highest rights which involve modifying, deleting or adding some content is included the option Can Edit. If you do not want students to change the content, only to see it chooses the option Can View .

The next step is the Upload of material. In order to make Upload material within shared folder , first you must designate a folder in order to know in which folder is to be executed Upload. Then click on icon Upload. Figure 5.

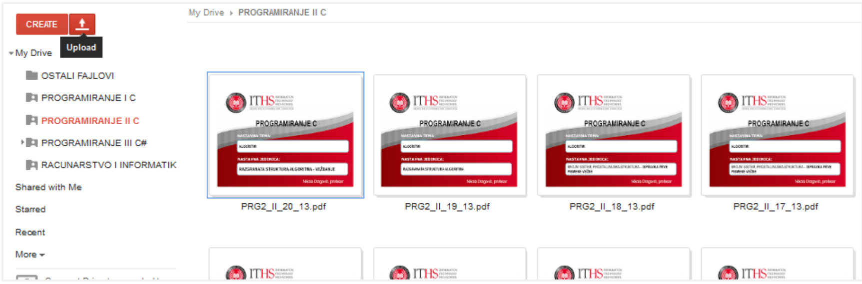

Figure 5. *Uploading of material which is opened by click*

Of course that any file or material which is meant to be upload can limit the right of access of edit options, through comment to view. What is important to note is that you can see all the changes that have been made, from the email address of the person and the changes made to the date and time when they were done. You can view a complete history of all changes and, if necessary, go back to a previous version.

3.2. Advantages of using Google drive

The presented method of communication and exchange of materials for teachers and students primarily helps organizations part of the teachers as well as the availability of teaching materials to students, more interactive and more organized lecture.

As all students ITHS bring tablets to the classes , they have the opportunity to approach to previously set materials (previous lessons) and review lessons in the case they forget somehow. Of course, a teacher can while renewing contents taught request students to open a file with the earlier lessons.

It is possible to demand from students that they add new materials in the form of some presentations, documents or that more students create a document (a form of team work). In other words, collaborative and interactive learning is greatly facilitated by using the said service.

The great advantage of the mentioned service is that teaching materials are available to students and the teacher at any time, and any place, it is only necessary to have a wireless connection to a computer or any other mobile device.

This lets you access your work from anywhere—mobile devices as well as other computers. It also means you can work collaboratively on the same document at the same time. [4]

Google Drive service consist many other tools:

- Google Docs – for work on reports, research or papers together with peers in different classes, schools,or countries [5]
- Google Sheet – for collect data from across the web for research [5]
- Google Slides – for creating presentations
- Google Forms – for creating different questionnaries (student group welcome forms or club event requests)
- Google Drawings – for drawing different shapes
- Google My Maps, …

4. EXAMPLES OF GOOD PRACTICE ON ITHS

New didactic – technical teaching method requires equipment that supports the High School of Information Technology. First, it is necessary to ensure fast and reliable internet connection - WiFi, to provide each student a tablet device and open the mail.

The next step is logging students on tablet with mail address thez got from the school, installation Drive applications and download other applications that are used in teaching. As a tools of communication and source of all the information necessary for successful learning and mastering, tablet combined with Google Drive service, provides a range of options.

In the context of educational work ITHS tablets and Google Drive service daily benefits from the start of the school year 2012/2013. year. In ITHS every teacher every teacher is required to make a presentation for his subject, and for each lesson , in the form of PowerPoint material. Presentation must include the teaching topics, teaching unit, serial number and date of the time, introduction, main part of the class, and concluding observations.

As a major part, in a creative and interactive way in the presentation is stored material intended for students to cope with a lesson which the presentation was made for.

The conclusion presents a brief overview of the distance traveled material, key issues of teaching units, setting homework, announcing the organization of work the next time.

After the class, every teacher is obliged to share material in the form of presentations with all students who have completed the educational unit. The teacher is allowed for that just through created folder on Google Drive service, which is assigned to students who attend the lesson.

The most important thing is that this way of teaching organization puts students at the center of the educational process, makes him active and include him in the work on time and from home. Students use the tablets as workbooks - for work on time, homework or labs, and as online volume which can be accessed by teachers and leave comments and / or evaluate students (electronic notebooks). This system of knowledge transfer is much more advanced and efficient than the traditional, as it is much easier to attract and retain the attention of students, motivate them to work and to engage in a lecture

This system of work allows them to make the learning process more interactive, dynamic learning is free, place and time are completely left to the choice of the student. Professors provide that immediately after the class set online presentations relating to the processed content, so their students can access at any time with the help of tablets.

Generally speaking, the positive experiences of professors and students ITHS have implied that the Google Drive service and tablet devices are used every day in class with continuous assessment of their new opportunities.

5. CONCLUSION

The education systems are increasingly turning to modern technologies, lead to the use of touch screen technology and tablet PCs, which allows easy manipulation of the Google Drive service.

New didactic - technical system, which is based on the use of tablets and Google Drive, allows classes to be designed as an integrated cognitive system, feedback monitors every step of the activities of students and achieves better interactivity and engagement of students and teachers.

The social aspect in group education is especially important because the communication affects the motivation of students, as well as a greater sense of security and satisfaction when participating students in combined forms and methods of work in class.

The great advantage of the mentioned service is that the teaching materials are available to students and the teacher at any time and at any place, it is only necessary to have a wireless connection to a computer or any other mobile device

ITHS, as a school that deals with the education of high school students exactly in the domain of IT, seeks to improve the processes of interaction between students and teachers, and between students using modern didactic tools as an aid in the overall educational process.

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Use of digital movies in teaching

Biljana Mihailović[1], Katarina Čutović[1] and Slađana Dromnjaković[1]
[1] OS „Tanasko Rajic“, Cacak, Serbia
e-mail biljana.mihailovic965@gmail.com, cutovickatarina@gmail.com, sladjadromnjakovic@gmail.com

Abstract: *Modern teaching involves the use of modern teaching aids and teaching methods . Teaching tool that evokes audio - visual perception of students is the film. Use of film in the classroom allows the teacher to express their creativity ,as well as active participation of students in the teaching process and builds partnership between teachers and students.*

Keywords: *film ; teaching; students*

1. INTRODUCTION

For better and faster comprehension in the classroom we use a variety of objects that we call educational tools. Teaching aids are: "all natural objects, models, models, paintings, drawings, equipment etc. that are selected, adapted or produced for the purpose of teaching process "(Bakovljev, 1998). Teaching aids can be divided into: the obvious means of teaching or learning and teaching aids or additional technical resources.

The obvious teaching aids include objects that are shown to the students, while students do not study them. According to the method of perceiving they are divided into: visual, auditory and audiovisual.

The visual aids are used only for observation and they include paintings, drawings, models, etc.

The auditory aids are used for listening and they include radio programs, audio recordings on compact discs and others.

The audio-visual aids include vision and hearing (sound, film, television shows, computer multimedia programs on CDs). (Romelić, 2003)

The most effective results are obtained by using audiovisual means, because they allow the participation to use more senses in the learning process, which seems complete and reliable.

The teacher should organize students to handle and use the teaching aids. It is essential that students know when that teaching resources are used and that they know the precise meter.

The successful application of contemporary, modern teaching aids means using the appropriate innovative substrate, ie.the teaching technology that is understood in different ways, among which the most favorable, "teaching technology is a set of tools, methods and organizational forms of teaching" (Bakovljev, 1998).

2. DIGITAL FILM

Film (eng.), The foreskin, membrane; flexible strips coated with a light-sensitive;the concrete product of film industry, artwork of"the seventh art" - and all other forms of film activities are included by the concept of cinema. The basic material for the recording and playback of the film is the film tape on which are recorded landscapes, people and events in a specific scenario by using cameras.

The use of digital film in teaching process has an important role and significance. A large part of the teaching material can be processed using the digital film. We can use finished film, but the planned parts must be thoroughly analyzed before the broadcast. This means that before watching the students must receive detailed instructions and notes on which parts of the film they should pay attention. Digital film can be used in the introduction, the main and final part of the class. What we should take of is the length of the film. In the introduction part the film should last about five minutes, in the main part about fifteen minutes, and in the final part of the class the film can be very useful teaching tool because it can be used for repeting and completing the teaching unit that is processed.

2.1. Application of digital film as a teaching aid

The use of film in teaching process achieves different objectives:

- Increase students' motivation to learn and develop interest in learning
- encourages students to recognize, observe, understand relationships and situations that they saw on film.
- Encourage students to evaluate, criticize and express their opinion on what they see in film
- develop imagination and interest of students
- Train students to build and apply independently their knowledge thanks to the film, through the independent film projects

Sources of the films for classes can be: educational- in accordance with the syllabus, downloaded from the Internet, or can be made by teachers and students.

2.2. Methodical approaches of film in teaching process

While in traditional teaching process prevaile lecturing and reproductive approaches, in contemporary teaching process the preference is given to methodological approaches that put thestudents at the center of activities. In this context, we will talk about academic interpretation, and problem-correlation-integration approach in teaching film.

School interpretation of the film - this methodical approach is focused on the student's observation of film facts and parsing of the film (thematic idea of the film, place and time of action, evaluation of characters` procedures).

Problem-solving approach to film - a student researchers and has a certain problem in front of him. In this way, students explore independently, compare and connect the facts with their own experience and get the answer.

Correlation-integration approach - based on connecting and synchronizing the programming content of particular subjects (geography, biology, computer science, history, music, Serbian language ..).

In contemporary methodological theory and practice, correlation and integration are methodological approaches that generate interdisciplinary methodology based on cross-curricular links

2.3. Making a film in teaching process

One of the aspects of active learning is when students record films with their teachers through the project of mastering the material. In this work it is important that each student choose their role in the team according to their interests: some students write the script,some students record film, some record voices, some edit scenes from the film. Of course, the students' work should be meaningful and time-align, a list of activities should be arranged and so the results that they should have during operation. The theme of the work must be in accordance with the age, interests and previous knowledge of students. This way, the students through well designed projects and their own experience, discover and acquire new knowledge, not only about the subject they study, but reveal different ways of reasoning.

2.4. Case study

When we decided to make a film, we knew that we needed: scenario, video camera, computer, and computer program "Movie Maker". Before creating the film, the students themselves determine the tasks, who will be the director, cameraman , and who will read the text, who takes care of music and of course of mounting frames. This way we avoid arguments during operation.

After shooting we started following steps: Copy the video from the camera to the computer using the USB cable, and then we used the program "Movie Maker" for further processing:

- Processing of video records
- Assembly (editing)
- Adding music (Import audio or music)
- Adding voice by attaching a microphone to our computer (narrator Timeline)

Now, get your camera and go for it! Try to direct your first feature film.

We dared to record our first film, "The Power of Water West Morava" https://www.youtube.com/watch?v=X9mV-rB_3IQ and "Our river West Morava" https://www.youtube.com/watch ? v = pK6RH5M9bYk and then we sent them to the competition that was announced by the Ministry of Education, Science and technological development and the company "Zepter". Conquering special award gave us the wind in our sails and we continued to shoot on.

The new film was shot for 12.International festival "Creative Magic", on the occasion of the competition for teachers on the educational film "Stimulating learning environment - a place where ideas form the reality," a film titled "Tanaskovci". https://www.youtube.com/watch?v=3gINDuO_Ums

Figure 1. *Special recognition*

3. CONCLUSION

Modern educational theory and practice puts students at the center of activities,so the methodological approaches to the film must comply with that request. When we choose a methodological approach we have to take care about students' intellectual and emotional capabilities. In this way we will achieve the set goals and tasks of teaching process, and encourage the development of film culture and develop a critical attitude towards film work.

4. AWARDS

Film "The Power of Water West Morava" is the competition "The power of water" that was announced by the Ministry of Education, Science and Technological Development and the company "Zepter" was awarded a Special Mention in the third category. The team mentor from the primary school "Tanasko Rajic" Cacak was Katarina Cutovic, a professor of geography.

At the same competition film "Our River West Morava" received a diploma for successfully completed project in the competition. The team mentor was Biljana Mihailovic professor of biology.

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Textbooks in three dimensions (linking in electronic textbooks)[1]

Nebojša Mrđa[2]
[2] Faculty of Political Science, University of Belgrade, Serbia
e-mail nebojsa.mrdja@fpn.bg.ac.rs

Abstract: *University (and school) textbooks must be, in electronic versions, available on the websites of educational institutions or teachers and they should contain a number of links to other websites where students can find additional information on the teaching matter. Learning is an individual process, but students should be encouraged to go to the broader and depeer of the teaching materials above the minimum required level. Routing students to additional texts, images, graphs, tables, video clips, etc. can be used for all students including those who are able to effortlessly acquire knowledge by reading testbooks written exclusively in textual form. The widespread use of links in electronic versions of textbooks can increase the efficiency of the individual's learning and may increase the overall quantitative and qualitative effects of learning of the entire student population.*

Keywords: *linking, textbooks, Internet*

1. INTRODUCTION

This paper was created as part of a continuous process of self-reflection on my job as a lecturer at the Faculty of Political Science in Belgrade on courses “Informatics” i “Internet and new media technologies”. During the completion of the work on the textbook “Informatization of the society – new opportunities and huge consequences” I noticed that the use of links in the electronic version of the text can be achieved multiplier effects and ease some of the difficulties faced by lecturers at universities and authors of university textbooks. This applies, for example, that:

- every textbook author knows that it is not possible to include all the content he'd like,
- often happens that students feel that some parts of the textbooks are not elaborated in detail and some parts are unclear
- it is often necessary to pass over couple of years for the publishing of the innovated version of the textbook,
- there is a different level of prior knowledge of students about some important issues that should have been learned in previous years of schooling,

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- for some students written text is enough, some require a graphical presentation and some numerical – tables,
- there are ready quality educational content on the Internet that can be directly used, etc.

The purpose of this paper is to make teachers and authors of textbooks for all educational levels place their books on the Internet, to fulfill them with links to relevant educational content and contionously update them with new knowledge and links.

2. IN THE CENTER OF THE EDUCATIONAL PROCESS ARE STUDENTS, NOT TEACHERS

Time when teachers were in the center of educational process and when what mattered the most were words pronounced in the amphiteaters and classrooms has passed. Now their role is to ensure to students learn as much as possible. In my teaching job at the Faculty of Political Sciences in Belgrade for a landmark and inspiration I chose Don Tapscott views published in 1999 in the article "Educating the Net Generation" including eight changes brought by the introduction of interactive learning in the process of education:

- "The transition from linear, for example, reading a book from the beginning to the end, the non-linear ways of processing information, such as parallel and non-sequential downloading information from the Internet and television,
- changing from giving instruction to the process of construction and development, which means that teachers instead of broadcasting knowledge give instruction to listeners how to get to the desired knowledge,
- locating the learner at the center of the education process, rather than teacher, which increase learners motivation for learning and the role of the teacher remains crucial for the process but it becomes different,
- instead of absorbing teaching material students have to learn how to learn, which includes not only the analysis of facts but an ability to synthesize facts and knowledge,
- transition to a lifelong, continuous education rather than a system in which the graduation means the end of this process,
- transition to learning adjusted to the individual rather than learning the same program for all, what the use of digital media can provide,
- learning as fun instead of learning as torture, and
- change the role of teachers rather than transmitters of knowledge becomes one that allows for the realization of those social activities."(Mrdja, 2016)

Many teachers have already included interactive teaching methods in education and this can not be done in the same way but it would be good to encourage teachers to take up new opportunities. This, of course, does not mean that everything has to be replaced in the education process whose essential characteristics have not changed for centuries, but many steps and procedures can be upgraded. Exam procedure in which the student and the teacher look "eye to eye" would be difficult to be replaced by some new technological solution but in the process of individual learning can be incorporated entirely new procedures and technological solutions.

3. LINKING

Linking in this paper indicates that by clicking on a certain place on the screen computer user access to a website where is set a certain set of information. Of course, linking is technically complexed and very important phenomenon in the history of computing and the Internet, but for purposes of this paper is not of importance. This is indeed true for many other things in the field of computers and the Internet because for a very large majority of computer and the Internet users is most important to decide how to use them in the specific field of their work in which is usually not necessary to know very complexed technical aspects of computers and the Internet.

Linking can be used in very innovative ways in many areas. Eg., in journalism is developed a special mode called "link-journalism" which is very elaborated and can be a useful example of how linking can be used in different areas. Bojana Barlovac in the article “Linking in web journalism” points out that the introduction of links in the structure of the web news creates a completely new architecture that overcomes space and time and then describes the possibilities for linking, explains how to create lethal link, describes the types and functions of the links, advises what should be and what should not be done in linking, highlights best practices and refers to the regulation. (Barlovac, 2011).

Here it is useful to specify one of the most famous examples of linking that applies to the case when the Republican Party in 1996 on their website set up a link to a website a competitive Democratic Party, which, however, did not follow the example of their opponents (Štambuk, 1998). Relations between the two major parties that operate in the political (two-party) system of the United States, of course, is special politicology theme but this example may be useful for university teachers who can route students to other authors and even those who represent different points of view. Every scientific knowledge can and should be subject to continuous review and their authors should not be scared of that. If that had not been in previous years, decades and centuries in universities would be taught the same as in the Middle Ages.

It's been over 15 years since the MIT (Massachusetts Institute of Technology) posted numerous articles, presentations and others materials used in the their teaching curriculums on their website. Many other educational institutions around the world have done the same, so there’s no reason to do as much as possible at domestic states universities. In the general interest of the citizens is to be educated, so whoever who wants to learn something it would be better if he learns according to the accredited university program.

Numerous "open educational resources" are available on the Internet. In the master work ”The spreading of knowledge in the digital environment – Open Educational Resources” Jelena Bogdanovic pointed out that the Internet spawned a whole movement around the idea of openness which is, among other things, led to open source software and open educational resources. It is the abundance of educational material that can not wait to be noticed and used for learning and this can be achieved if a large number of authors of university textbooks decide to link in electronic textbooks and work like catalyst in that proces.

4. LINKING IN THE ELECTRONIC TEXTBOOKS

All authors of printed textbooks know that many students buy illegal copies of textbooks and that it is very difficult to control it. These copies are often reduced, as the result of lower prices of textbooks, two pages to one and it makes it more difficult to read and learn. A long time ago I decided to put my textbook on a personal website where everyone can download them for free because it is better if I do it myself rather than someone else. I did that with the latest textbook “Informatization of the Society – new opportunities and huge consequencies” and that electronic version contains a number of links to different websites that students can use to learn.

Due to the limited scope and purpose of this paper is difficult to list all possibilities of making useful links. It would be good example if this text contained some links. These links can be identified by a different, probably, the blue color, and if reader just click on that places he will be transferred to other website content. Though the title of this article is referred to textbooks, everything above can be used, for example, in writing scientific papers. These papers can contain links and it might be useful to readers and reviewers who prior to their publication in journals should give their judgment. Now it has been customary in the footnotes do not cite sources of literature but it works by referencing the text with the fewest characters. If the authors of scientific papers put links instead of writing a quote or paraphrasing, it would be easier for reviewers to form an opinion on the paper because they get a direct insight into the quoted material. In the time when production of scientific information is rapidly increased for reviewers is difficult to obtain and read printed literature.

The title of this paper has been given a name of a third dimension because it is reminiscent of a special kind of children's picture books in which with opening a new page third dimension shows up. Thus, for example, was in the case of a picture book Hansel and Gretel with opening of Grandma's house. In the case of printed textbook pages have the width and height but with links in their electronic versions will be open up that the third dimension (depth) to enable the reader to go deeper into the matter.

5. CONCLUSION

Innovations in the field of information technology every day bring new opportunities to solve problems and improve the functioning of various organizations and processes. It is no longer a topic for specialists but for, almost, everyone. The question of the content and scope of learning materials, which usually consists of a textbook, is very important for teachers and students. Textbooks are often the subject of criticism of students, parents and different groups participating in the political process and some of them easily provide estimates that they are too large, and so incomprehensible. Embedding links to electronic versions of textbooks can reduce criticism and can be achieved wider and deeper understanding of the subject that is taught. Of course, students can independently find different sources on the Internet where they can deepen their knowledge of certain topics but it is better to be directed to start of that process by qualified teachers. Although in the schools different activities are often carried out in small or large groups, learning is an individual process. Sooner or later, every student will decide when he's had enough learning and he will take an exam where his individual knowledge will be assessed. The criteria for a passing grade, respectively, required a minimum level of knowledge may be the same for all students but for better marks could be evaluated ambition and success of students to achieve a broader and deeper understanding of the content of the subject. It will be easier to achieve if the teaching material is fixed not only on the contents of the textbook. Students should be encouraged to use and find new sources of information on teaching content because they will have to do it in the future. Almost any future private, educational, business or political activity of graduated students will include searching and finding new information that will be incorporated into existing systems of personal information and knowledge. Although this article was made on the basis of experience from university teaching all this may be applied in the schools. Textbooks for primary and secondary schools may also be in electronic form, available at school sites and may contain links to recommended content on other websites

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SECTION II:

INFORMATION AND EDUCATIONAL TECHNOLOGIES

TECHNICS AND INFORMATICS IN EDUCATION
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Open education resources in enhancing education of biotechnology engineers[1]

Milevica Bojović[2] and Snežana Tanasković[2]
[2] University of Kragujevac, Faculty of Agronomy in Čačak, Čačak, Serbia
e-mail milevicabojovic@gmail.com

Abstract: *The paper explores the concept of Open Education Resources emphasizing its importance in education of biotechnology engineers in Serbian education context. In order to fill the gap which exists in agricultural education of various target groups such as teaching staff at agriculture universities, teachers in high vocational schools teaching agricultural courses, and agricultural advisors in agricultural extension service considering the development of their professional competences the attempt is made to create the open resources in the field of agriculture. A result of such attempts is the creation of National Repository for Agricultural Education in Serbia. The National Repository for Agricultural Education in Serbia as an open education resource for biotechnology engineering is presented in the paper. Another result refers to the contents created for the repository - face-to-face, blended and online courses created by the agricultural university teaching staff for all stakeholders in biotechnology engineering education in Serbia.*

Keywords: *biotechnology engineering; open education resources; repository for agricultural education*

1. INTRODUCTION

The development of the information and communication technologies (ICT) not only set the path for new opportunities for learning but also questioned established teaching and learning organization patterns. Since the beginning of the 21st century, the digital technologies have been used in higher education to develop and distribute education. Until recently, much of the learning resources developed in such a new teaching and learning setting were protected by propriety rights, not being reachable without passwords. However, more and more institutions and individuals share digital learning materials via the Internet openly and for free. The open educational resource (OER) movement aims to encourage and enable freely sharing content.

At the same time, the education of biotechnology technicians and engineers at secondary and tertiary education levels in Serbian educational context has shown some insufficiencies

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considering their professional competences. These insufficiencies generally refer to their educational, content and communication competences, and ICT competences in acquiring and transferring knowledge in biotechnology engineering. The creation of OER in the field of biotechnology in Serbia is assumed to be the way to fill the existing gap.

2. THE CONCEPT OF OPEN EDUCATION RESOURCES

The term OER was first used at UNESCO conference "Forum on the Impact of Open Courseware for Higher Education in Developing Countries" held in Paris, France in July 2002, where the OER were conceptualized as "the open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for noncommercial purposes" (UNESCO, 2002, p. 24). Today, OER are defined as digitalized materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research (OECD, 2007, p. 30). To put it simply, the concept of OER describes any educational resources, e.g. curriculum maps, course materials, textbooks, streaming videos, multimedia applications, podcasts, and any other materials, that have been designed for use in teaching and learning, that are openly available for use by educators and students, without any need to pay licenses fees (Butcher, 2015, p. 5).

There is a need to emphasize that there is one key difference between OER and any other education resource – its license that facilitates reuse without first requesting permission from the copyright holder (Butcher, 2015, p. 5). Also, it is necessary to point out that OER does not mean the same as the term online learning or e-learning as the openly licensed content can exist in any form such as paper-based text, audio, video, or computer-based multimedia. Many open resources are simultaneously printable and shareable in digital form.

OER is said to include learning content, software tools, and implementation resources such as open licenses (OECD, 2007, pp. 30-31):

- learning content involves courses, content modules, learning objects, collections and journals;
- tools refer to software to support the development, use, reuse and delivery of learning contents, including searching and organization of content, content and learning management systems, content development tools, and online learning communities; and
- implementation resources include intellectual property licenses to promote open publishing of materials, design principles of best practice and localize content.

3. EDUCATION OF BIOTECHNOLOGY ENGINEERS: THE GAP TO BE FILLED

Education system has been remarkably changed since the beginning of the 21st century in Serbia. Earlier, the emphasis was on initial education; now professional development has become important. In the education in biotechnology field in Serbia three target groups are important: university teaching staff at the agriculture faculties, teachers in high agricultural schools teaching courses in the field of biotechnology and related fields, and agricultural advisors in agriculture extension service. Professional development of these three groups, of which two groups belong to teaching profession at tertiary and secondary education levels, implies acquiring and improving fundamental professional competences of both teachers and biotechnology engineers.

Teachers' professional competence includes: 1) educational competence referring to the system of knowledge, skills, abilities and motivation dispositions needed to realize professional roles, 2) course content competence meaning the system of knowledge and skills derived from the course content and developed abilities necessary to transfer this knowledge, and 3) communication competence referring to the system of the knowledge, skills, abilities, and motivation dispositions needed to realize the goals of communication and social interaction (Bjekić & Zlatić, 2006). Additionally, teachers' professional competence involves general teachers' competence in application of ICT (knowledge of basic computer operations, using ICT to facilitate his/her own professional development, for communication, collaboration and research, and to support teaching/learning process) and specific e-competences in shaping e-teaching/e-learning (using ICT as productive tool to integrate it into learning/teaching context, to research and present developed products, and to evaluate and use information in order to improve teaching/learning process) (Technology standards for all Illinois teachers, cited in Bjekić, 2013, p. 251).

Professional engineering competence, according to 5-tier engineering competency model (Engineering competency model, 2015), includes: foundational competencies involving personal effectiveness competencies, academic competencies, and workplace competencies; and industry-specific competencies involving industry-wide competencies, and industry-sector competencies, allowing an engineer to move easily across industry sub-sectors. Personal effectiveness competencies are personal attributes, often referred as "soft skills", vital for all life roles and learned in the home and community. Academic competencies include reading, writing, mathematics, science and technology, communication, critical and analytical thinking, and computer skills – they are generally learned in school settings and are applicable to all occupations; here, it is important to highlight that ICT competences, also called digital competences (Key competences for lifelong learning, 2007), and communication competences belong to generic competences, i.e. abilities and skills that people could learn in different ways in various learning environments and that are transferable to new situations (Young & Chapman, 2010). Workplace competencies refer to motives, traits, interpersonal and self-management styles also applicable to large number of occupations. On the other hand, industry-wide competencies cover the knowledge and skills and abilities from which workers across the industry can benefit, e.g. design, manufacturing and construction, operations and maintenance, etc. And lastly, industry-sector competencies are specific to any industry sector.

Nowadays, in Serbian education system all three target groups in the field of biotechnology lack some of professional competences. The university teaching staff have been trained to acquire course content competence during their undergraduate and postgraduate studies as well as through various forms of research so they have become the experts in the content; however, their education lacks educational and communication competences, and generally ICT competences for creating the material and using the software of open education resources. The high vocational school teachers teaching courses in biotechnology and related fields have also been educated in course content during their pre-service education (undergraduate studies) and have acquired educational competence to some extent in in-service education; however, they lack the latest knowledge in the field of biotechnology as well as ICT competences to use learning management systems in the attempt to acquire necessary content competence and possibly to develop teaching material for their high school students. Agricultural advisors in agriculture extension service have gained content competence in the biotechnology field both during their pre-service education (undergraduate agricultural university education) and in-service education (professional development training organized by the Serbian Institute of Application of Science in Agriculture); however, they lack communication competence in their everyday work with the farmers and ICT competences to find, use, and acquire current knowledge in the field of biotechnology.

The attempts to bridge the gap considering professional competence of biotechnology engineers in Serbia were put under one roof – National Repository of Agricultural Education (NaRA). NaRA was created in 2014 as an open resource in education of biotechnology engineers to offer the opportunity for more efficient education to all the stakeholders. It was created within TEMPUS project "Building Capacity of Serbian Agricultural Education to link with the Society" (CaSA).

4. METHODS – FILLING THE GAP

The aims of the CaSA project are to contribute to the improvement of biotechnology education to meet the needs of Serbian society, to improve the quality and availability of vocational biotechnology education, to strengthen professional competences of both university and high school teachers as well as agricultural extension service advisors, and to create open source repository to offer the possibility of lifelong learning in the field of biotechnology (CaSA).

The sample consists of the university teaching staff (63 teachers) of all the faculties of agriculture in Serbia (Faculty of Agriculture University of Belgrade, Faculty of Agriculture University of Novi Sad, Faculty of Agronomy University of Kragujevac, State University of Novi Pazar, and EDUCONS university), high school teachers in the field of biotechnology (60 teachers), agriculture extension service advisors (60 advisors), and IT administrators (7 administrators) at all five faculties and Serbian Institute of Application of Science in Agriculture. The university teachers were selected on the basis of the need analysis carried out among biotechnology high school teachers and agricultural advisors (Šćepanović et al., 2015) – which content areas these two target groups need.

All groups went through the process of in-service training programmes during 2014:

- The university teachers experienced active teaching/learning program (ATL) to improve their educational competence, communication skill training program, and ICT training program in order to be capable of creating the various types of courses such as face-to-face, blended and online courses using Moodle as Learning Management Systems (LMS) to be used in biotechnology high school teacher in-service programs and advisors in-service programs;
- The high school teachers in the field of biotechnology went through ATL training program to develop their educational competence and ICT training program to improve their digital competences to be able to transfer the content knowledge to students through ATL high school classes and use ICT skills to attend in-service blended and online programs and prepare online working material for high school students;
- The advisors in extension service went through communication skill program and ICT training program to strengthen their abilities to communicate with and transfer the current knowledge in the field of biotechnology to the farmers and food

processors as well as to be capable of using and critically thinking over open resource materials in order to learn the newest methods and processes relevant to producers; and

- the IT administrators were trained to assure infrastructural support to the functioning of the open source repository and software support for the created blended and online courses.

5. RESULTS

The first result of the efforts engaged through CaSA project was the development and improvement of: educational competence, communication competence and ICT competences of university teaching staff; educational competence and ICT competences of high agricultural school teachers; communication competence and ICT competences of agricultural advisors in extension service. The teachers at tertiary and secondary education level gained the knowledge and skills which they will transfer in their classrooms to the university and high school students while agricultural advisors are to apply their newly gained communication skills and ICT skills in direct contact with the farmers and food processors and in searching for valid resources in the filed of biotechnology.

Furthermore, the university teachers at five faculties of agriculture in Serbia created 63 courses in various sub-fields of biotechnology, i.e. plant production and protection (e.g. Alien invasive species, Plant breeding in food production), animal production and veterinary medicine (e.g. Organic animal husbandry), food technology (e.g. Fruit drying), agricultural engineering (e.g. Drip irrigation system, Application of the spreadsheet calculations in agriculture), soil sciences, agricultural economics (e.g. Project management in agriculture). The last sub-group of courses includes a course for developing a key competence for lifelong learning - communication in foreign languages (Key competences for lifelong learning, 2007); it refers to reading skills as the basic academic competence (e.g. Developing reading skills in English language for agriculture). This competence may be neglected in Serbian engineering education setting. The number of courses according to the learning environment, target group, and institution at which the courses are created is illustrated in Table 1 (modified according to Topisirović, 2015).

Table 1. *Structure of the courses created by university teaching staff*

Types of courses (N)	**Institutions**					**Overall per type**
	UB	**UNS**	**UNIKG**	**SUNP**	**EDUCONS**	
Learning environment						
Face-to-face	12	3	1	0	9	**25**
Online	3	1	4	0	0	**8**
Blended	3	13	6	8	0	**30**
Target group						
High school teachers	12	5	2	8	5	**32**
Advisors	6	2	5	0	0	**13**
Teachers & advisors	0	10	4	0	4	**18**
Overall per institution	**18**	**17**	**11**	**8**	**9**	**63**

N – number of courses, UB – University of Belgrade, UNS – University of Novi Sad, UNIKG – University of Kragujevac, SUNP – State University of Novi Pazar

These courses have been created to be applied primarily with high school teachers in the field of biotechnology and agricultural advisors in extension service or both; also, the potential users may be the university students, high school learners, farmers, food processors, stockmen, etc. The courses can be grouped further according to the type of learning environment the users are to be exposed to into face-to-face, online, and blended courses (Topisirović, 2015). As it can be seen from Table 1, almost two thirds of all the created courses (more precisely, 60.32%) are online and blended courses. The university teachers applied newly acquired skills to create courses using LMS. Moreover, a half of all the courses have been created for the agricultural high school teachers; if we take into account 18 courses applicable with both target groups, the number of courses offered to agricultural high school teachers increases to 50, which is approximately 80% of all created courses. If we bear in mind that in-service education of biotechnology high school teachers lack specialized courses in the field of biotechnology in their in-service education, this result has even a greater value.

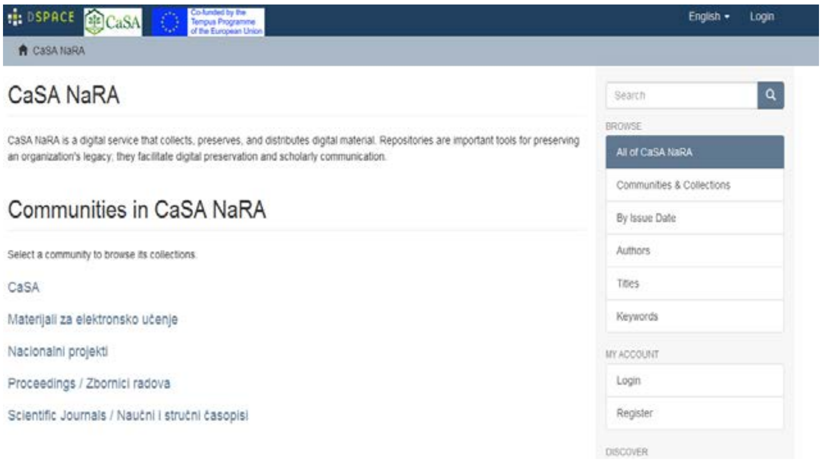

Figure 1. *The front page of NaRA*

Finally, the creation of the National Repository for Agricultural Education in Serbia (NaRA) is also the result of the CaSA project. The domain was registered in 2014 and supported by Computer Centre, University of Belgrade. NaRA is the digital open resource platform, which is also a library containing instruction materials in the field of biotechnology engineering and repository of the courses created by university teaching staff employed at agricultural faculties in Serbia, which could and should be accessed by both agricultural high school teachers and students, advisors in agricultural extension service, students of agricultural faculties-future biotechnology engineers, and broader academic and expert community with the purpose of lifelong learning. The structure of NaRA implies the integration of Moodle as an open source learning platform and DSpace as an open repository software package used for creating open access repositories. A plug-in was created to connect Moodle as Learning Management System (LMS) and a Document Management System (DMS) already used within DSpace platform. The front page of the repository is illustrated in Figure 1.

NaRA is currently being filled up with the contents such as: various materials for e-learning; the courses (face-to-face, online, and blended) in the field of biotechnology and related disciplines created by university teaching staff-participants in the project; the presentations of projects in the biotechnology field funded by Serbian Ministry of agriculture and environmental protection; books of proceedings from national and international conferences in the field of biotechnology held in Serbia; agricultural journals published by the biotechnology university institutions participating in the project.

6. CONCLUSION

The creation of open education resources in the field of biotechnology in Serbia is the process which is being carried out at two levels. The first level has been the design of the face-to-face, online, and blended courses in the field of biotechnology, created by the agricultural higher education teaching staff by applying the acquired and improved competences in ATL and using Moodle as LMS. The second level has been the creation of open access repository NaRA to which all the created courses are being uploaded. The National repository for agricultural education in Serbia is the unique education resource which, for the first time, offers relevant and updated knowledge in the field of biotechnology collected in one “place”. This repository is under open access regime meaning that it is reachable without passwords and for free by its final users – high school teachers, agricultural advisors, students-future biotechnology engineers, farmers, food processors, stockmen.

Taking into account that the courses created for in-service education of agricultural high school teachers and advisors in agricultural extension service are planned to be implemented during 2016, the effects of these face-to-face, blended and online courses as open education resources on high school teacher’ and agricultural extension service advisors’ professional competences are to be evaluated in the future. OER are among the potential enablers of the shift toward competency-based and learner-centered education if educational policies and organizational frameworks empower teachers and learners to make good use of such resources (Geser, 2007). The potential impact of NaRA as an open access repository on the development of professional competence of biotechnology engineers is another issue for future research.

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A contribution towards using multimedia and Moodle at the Faculty of maritime studies in Kotor (Montenegro)

Sanja Bauk[1,2] and Tatijana Dlabač[2]
[1] RWTH Aachen University/Chair for Theoretical Information Technology, Germany
[2] University of Montenegro/Faculty of Maritime Studies, Kotor, Montenegro
e-mail bsanjaster@gmail.com, tanjav@ac.me

Abstract: *The paper describes how multimedia can be used in the preparation of instructional materials and their exporting to the web. As an example, e-educational materials for the course "Information technologies in navigation", at the Faculty of Maritime Studies (University of Montenegro), are taken into consideration. Specifically, using Camtasia Studio (ver.7) multimedia program in the preparation of audio and video lectures in ECDIS, along with their adjustment for exporting to the Moodle portal are presented. Additionally, some general guidelines for further development of e-learning in the blended environment at the Faculty are given.*

Keywords: *e-learning, blended environment, Camtasia Studio program, Moodle*

1. INTRODUCTION

Over the past few years, at the Faculty of Maritime Studies (University of Montenegro), Moodle system has been used in support of the classical mode of carrying out education. Moodle makes teachers' job easier in terms of using it as a repository of educational materials, notice board, medium to communicate with students and testing of knowledge in manner that it automatically generates the results being achieved by the students. On the other side, Moodle is important to the students as well, since it provides unrestricted access to the instructional materials prepared in electronic form. By the web portal students are timely informed about the courses and their obligations; then, throughout the forums, students can exchange their views with teachers and other students on specific topics; they can also exercise self-check quizzes based on the possibilities of multiple-choices, etc. Most importantly, Moodle is a sort of extension of students' activities in smart environment created by extensive use of mobile phones (tablets). In other words, everything that is of e-type, including Moodle, is attractive to the students. In addition to traditional textual/PDF files, some of the teachers have made efforts to adapt instructional materials towards some specific courses' requirements through introducing formulas into Moodle, pictures, schemes of electronic circuits, complex mechanical drawings, etc. Some teachers have invested a lot of work in audio recording in the background of PowerPoint presentations. There are also some recorded tutorials for using certain narrow-purpose software tools (e.g., the one for managing electronic navigational charts). These tutorials are created in

Camtasia Studio program. We consider this very important, and therefore the special attention will be paid to these examples in the paper.

Teachers who have been actively involved in the implementation of Moodle in combination with multimedia, as an additional mode of education/learning to the traditional one at the Faculty, independently or in collaboration with colleagues from other higher education institutions of education, instructional design, information technology and new media in knowledge transfer, from abroad and from the home country, published a significant number of research papers devoted to the issue of e-learning in blended environment, with emphasis on the Faculty of Maritime Studies' individual needs and experiences. Some of these papers are listed in the references [1-6;8-11] with the intention of further dissemination.

Within the following segments of the paper, two examples of employing multimedia software for the (post)production (Camtasia Studio, ver.7) are presented, in the case of teaching ECDIS. Besides describing possibilities of highlighting important moments in teaching ECDIS, through the appropriate Camtasia Studio visual and audio effects, it is shown how the assessment of the students should be realized automatically. Moodle is used as a frame for the presentation and communication.

2. USING MOODLE AND MULTIMEDIA AT ECDIS EXAMPLE

In this section, we present an example of how Camatasia Studio multimedia tool and Moodle platform can be used to support traditional teaching within the subject of Information technologies in navigation, in the field of ECDIS, which is very important topic in the context of emerging e-Navigation concept.

ECDIS (Electronic Chart Display and Information System) is an entirely electronically based navigation system that integrates real-time navigational data from ship sensors (GPS, Radar, AIS, etc.) and electronic navigational charts (ENCs - Electronic Nautical Charts) [4-6]. In its nature, it is a centralizing instrument with the unique function of integrating many aspects of navigation. More explicitly, it allows the integration of numerous operational data, such as ship's course and speed, depth soundings, and radar data into the display. Furthermore, it allows automation of alarm systems to alert the navigator of potentially dangerous situations, and gives him/her a complete picture of the instantaneous situation of the vessel and all charted dangers in the area. ECDIS has been conceived in such a way to support and enforce the transition to the e-navigation concept.

Although the International Maritime Organization (IMO) officially approved it as the equivalent to the classical paper charts in November 1995, the transition to its full usage in practical maritime navigation is still slow. The causes are the lack of the official ENCs, the high cost of ECDIS, and a dose of skepticism in accepting this new technology by the traditional marine community. However, ECDIS has benefits in terms of time saving in route planning and monitoring, preventing accidents and thus protecting human lives, the ship and marine environment. ECDIS functions can be used effectively in restrictive waterway areas, during periods of poor visibility, i.e., under conditions of mist and during the night. In coastal waters it is generally very easy to derive the position with the view from the bridge windows, as well as with the information from other prime navigational devices. But, care must be taken to ensure that radar is always used as the primary collision avoidance aid and ECDIS as the primary charting aid. Some key components of ECDIS display, i.e., most of the visualized commands of ECDIS (on the exemplar of Navi-Trainer

Professional NTPro 4000 nautical simulator manufactured by the Transas Marine) have been described in detail within some previously published papers by the author in this field and cited in [5,6]. Also, the basic and some advance features of ECDIS have been covered by numerous referential secondary literature resources. Though, in the following section the focus will be given on using new media, supported by Moodle platform, in providing better teaching/learning ECDIS principles.

3. RECORDING TUTORIALS IN CAMTASIA STUDIO

In the process of recording screen captures on ECDIS, the Transas demo version 2.00.012 is used as a base upon which the recordings are done. The whole screen is recorded, along with the presenter narration, and after the recording had been finished, the capture is imported to the Camtasia Studio and edited. Different animated effects (callouts, captions, smart-focus tools: zoom, pan, etc.) are added, in order to make the captures more interesting, and ultimately more edifying to students. Although, all necessary details on screen recording, audio adding, and editing the recordings can be found in the references of the papers [4-6] - it is on a presenter, here teacher/instructor, to optimally allocate the place and duration of each animated effect within the presentation, aiming to make engaging and really worth audio/video recordings, prepared to be shared among students, colleges, and/or wider web audience within a MOOC (Massive Open Online Course) project [7], e.g., which might been developed at the Faculty in the perspective.

Two examples of screen captures being made over ECDIS demo version software in Camtasia Studio, and adapted to Moodle, are given below.

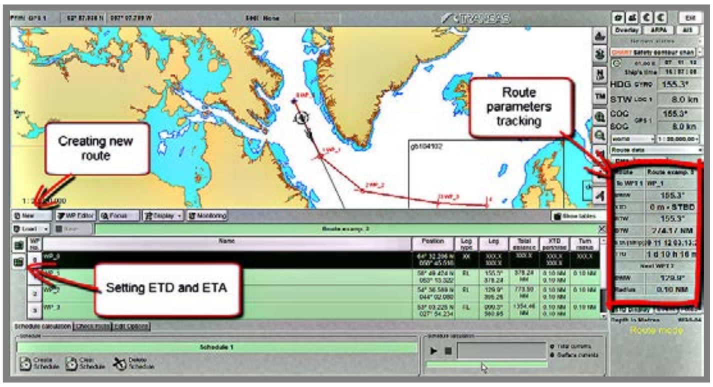

Figure 1. *Route planning procedure in ECDIS environment [4-6]*

Example 1: The main objective of the screen shot shown in Figure 1, along with the voice narration of the presenter, was the route creating graphically, and scheduling it by entering ETD (Estimated Time of Departure) and ETA (Estimated Time of Arrival). The process of route saving (for later reference and potential output to the autopilot), along with the possibility of deleting some of its segments, or inserting new ones has been presented, too. The possibility of waypoints' parameter tracking in the control panel from the route data sub-window has been explained, as well, and it is marked on the screen (Figure 1) as an important segment of ECDIS route monitoring. Within this context of route planning it is to be pointed that the operator should control the route parameters related to the alarms and indicators [5,6], like:

- *Cross-track error*: set the distance to either side of the track the vessel can stay before an alarm sounds. This will depend on the phase of navigation, weather and traffic;
- *Safety contour*: set the depth contour line which will alert the navigator that the vessel is approaching shallow water;
- *Course deviation*: set the number of degrees off course the vessel's heading should be allowed to stray before an alarm sounds;
- *Critical point approach*: set the distance before approaching each waypoint or other critical point that an alarm will sound;
- *Datum*: set the datum of the positioning system to the datum of the chart, if different, etc.

Example 2: In this tutorial, the process of acquisition of the AIS (Automatic Identification System) target data (in manual, not in random mode of here employed ECDIS demo version) is also shown in the short video presentation. For the purpose of making AIS targets visible and selecting one of them, the AIS overlay command button must be pressed in the command panel in the upper right corner of the display. In the simulation panel the random button has to be switched off and certain available AIS target is to be selected and enabled. Its position can be controlled by inserting manually its coordinates and course, or by cursor, i.e., by positioning it directly at the proper place, along with the direction onto the chart panel (Figure 2). By following a similar procedure, it can be carried out acquisition of NAVTEX (Navigation Telex) messages.

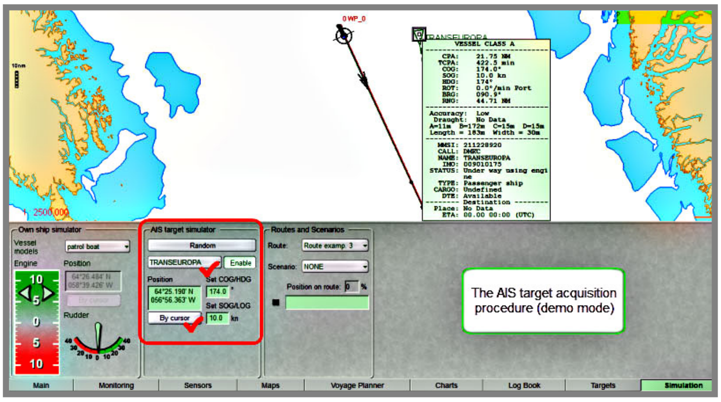

Figure 2. *Acquisition of AIS data of a ship in the vicinity of the own ship [4-6]*

3.1. Enhancing interactivity

The reader may get the impression that Camtasia Studio does not provide enough space to interact with the students. But still, there is a way that this lack of interactive dimension can "catch up", and that is through the creation of self-evaluation tests for students. With the intention to approach the procedural level in Camtasia Studio for creating self-evaluation tests, it is to begin by using the options (Camtasia Studio ver.7): Tools => Quizzing ... => Add quiz ..., and then by using the options Move => Quizzing …. Tests may include the questions of the following types:

- Multiple choice;
- Fill in the blank; and,
- Short answer (which is not automatically scored).

Within one quiz, or self-evaluation test all these types of questions can be included and combined in different ways, depending of the instructional material and the teacher's conceive of that how the test should be. Immediately after answering the question, the students can get the score, and though check their knowledge about the topic(s), except in the third case.

4. CONCLUSION

The work gives two illustrative examples in terms of how Camtasia Studio (ver. 7) can be applied in the tutorials (post)production, for Moodle system, which is used to support the classical ex-cathedra teaching methods at the Faculty of Maritime Studies in the field of ECDIS. The examples are described in detail, in order to put the emphasis on the didactic component, since it is presumed that the technique functions well and provides the students with the appropriate audio/video experiences. The goal is to get learning materials of greater quality and inventiveness, available to the students even when they are on board a ship. It is important to note here, that a large number of students from the Faculty have to study and sail simultaneously.

Logically, at the end, we have to consider a question of further development of the system. First of all, the current version of Moodle which is used at the Faculty, i.e., ver. 1.94, is to be replaced by the advanced version 2.x. This is because in the present version of Moodle are noticed some problems, e.g., in working with Wikis. This is also necessary for ensuring greater flexibility and scalability of the platform.

Then, the possibilities of realizing MOOC courses [12-15], independently or in cooperation with colleagues from the country (region) and/or abroad, are to be considered. These courses would be beyond the framework of the narrow specialized maritime courses, and they should attract considerably larger number of users, of heterogeneous structure, e.g., within the context of lifelong learning.

These issues, i.e., potential opportunities for improving and expanding the existing blended environment at the Faculty of Maritime Studies, will be the subject of further research in this area.

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Progress of web tools from Web 2.0 to 4.0 and their implementation into the educational process

Milena Marić[1] and Daniela Aleksić Minić[2]
[1]Deveta gimnazija “Mihailo Petrović - Alas”, Novi Beograd, Serbia
[2]Zavod za unapređivanje obrazovanja i vaspitanja, Beograd, Serbia
e-mail milena.maric.f@gmail.com, daniela.minic@zuov.gov.rs

Abstract: *Web has become and endless and ubiquitous component in all educational systems from the moment when it changed the theory of learning and enabled its users to create everything, including educational materials available for everyone, all around the planet. From the Web 1.0 that made all information available to the Web 4.0 that make the networked intelligence of the future, where an individual is just a part of the global mind, the goals remain the same - deeper integration of ICT into the process of education.*

Keywords: *web, information society, education, ICT*

1. INTRODUCTION

1.1. Motivation

Several strategic legal documents have been passed in Republic of Serbia within the last several years that aim to implement the ICT into the process of education. All those documents clearly emphasize tools on the web and their potential uses within the teaching process. The documents that were concerned with the improvement of the use of information-communication technologies in education gave some more specific recommendations. To integrate web 2.0 technologies in implementation of teaching activities, since for every subject in primary and secondary education there are numerous web 2.0 applications readily available online [1].

Application of web tools in teaching, and the education in general can be regarded to be the present, and not the future. Every form of technology brings some pros and cons. Therefore, the central idea of this article is to give us a better view on the development of web tools and their characteristics. Our goal is to introduce both aspects of the application of web tools trough the periods of their development.

Since our country is still in the early stage of using the web tools in education the idea of this paper is to encourage teachers to adequately apply web tools for preparing their didactic material.

Using web tools solely for their own sake should not be the goal. Introducing new technologies is justified only when there is a clear reason for that and when the teacher is sure that applying such tools gives a positive learning outcome. As the web developed over time, the number of tools that are available to the teachers increased. Nowadays there is a plethora of tools that are available, and the teacher can certainly find adequate tools that would improve the development process and the didactic materials, and, therefore, better motivate his students. Better motivation must result in better achievement, which is a goal of the teaching process. The winning combination is when innovative technology is successfully applied to the adequate teaching materials. The teacher must be a good designer of didactic material in order to be able to apply web tools adequately

2. THE INFLUENCE OF THE INTERNET TO EDUCATION

All actors in the educational systems know that the integration of ICT into every aspects of the education process i necessary to obtain more effective and efficient education [2]. Internet, combined with web tools that are free and available to anyone also has a positive impact on the education process. Currently, you could freely access various courses of mathematics, physics, biology etc. that have been created anywhere in the world, and you could use them in your classroom, discuss them in various forums on various topics. Teachers can use web tools to create educational content, track their progress, and test their pupils online. Pupils can use web tools to prepare for tests, to systematize what they have learned and to find new informations. The collaborative dimension of the internet and web-tools should also be considered and it can have positive results for many pupils.

Applying web-tools in education need not be beneficial. It is crucial to offer pupils well-prepared content and to guide the pupils trough the learning process (guided learning). Pupils must be educated about the potential dangers of using the internet.

3. HISTORY AND DEVELOPMENT OF WEB

3.1. Web 1.0, freely available information

Initial creation of web started in 1991. It was primarily based on publishing the content of traditional printed media that was digitized.Key technologies that made the web 1.0 are the HTTP protocol, markup languages HTML and XML, first web browsers, software platforms and development environments for web applications, programming languages such as Java and Java Script, the art of making web sites, commercialization of the web and the development of web business models. From the todays perspective, the possibilities that web 1.0 offered were quite limited. Only very skilled persons could create the web content, mainly because of the complexity of the technology that the user needed to know to be able to create publicly available content.

If these difficulties were overcome, technology still offered only limited possibilities. When considering web 1.0 from the educational perspective, the only thing that the teacher could offer was the static content that contained only text and images. Dynamics and interactivity was able to achieve only by using the programming language JavaScript, but the question remains how many teachers were interested to devote their time and learn programming and a new programming language, especially if their subject was not close to informatics and programming.

We can't say that web 1.0 did not have any advantages. On the contrary. The fact that the pupils could access the information created anywhere in the world and learn from such sources was a revolutionary discovery, unthinkable before web 1.0.

3.2. Web 2.0, everyone is part of a single network

Web 2.0 is a set of web technologies that have a social character. Namely, this step in the history of web enabled ordinary users to engage in creating web content that was ont possible before web 2.0. Before the content could be created only by skilled professionals who had a good knowledge about the web technology of that time. With web 2.0 the user is not just a passive user, but it can it can participate in the communication user – computer and user – user, over the web. With web 2.0, the user is in the center as the creator of the content. The main characteristics of this stage of web are openness, freedom and collective intelligence. Important characteristics of web 2.0 tools are that they need not be installed before they could be used.

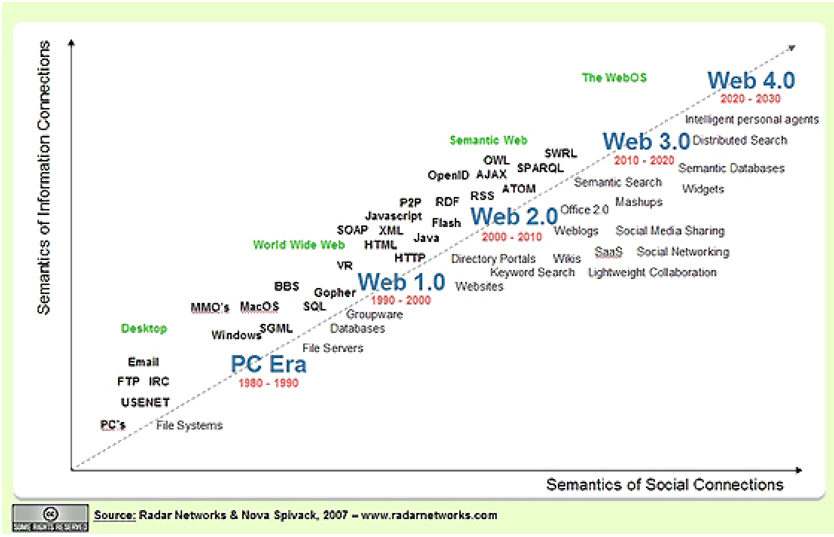
Web 2.0 tools are a set of social programming tools that enable users to independently create content, share it to other users on the internet and to be engaged in collaborative creation of the new content on the web.Collaboration is one of the basic characteristics that became possible due to web 2.0 tools. The key advantage of these tools is that there are many publicly available, free tools that that the teacher can include for creating didactic content and enrich his teaching in a creative, interesting manner, very close to the kids. The only precondition for teachers to use those tools is that they are educated and prepared for their use. Since the tools are intended for mass use, it is not complicated to learn how to use them and a number of teachers learned how to use them by themselves and started using them in the classroom.

There is a number of tools that that users can use. Although they have identical or similar characteristics, we classified them based on how teachers can used them in education. The first group was named web 2.0 tools for content representation, the other was named web 2.0 tools for systematization and practice, and the third was named web 2.0 tools for interactive knowledge sharing. Note that these groups can overlap and some tools belong to several categories.

Table 1. *Classification of web 2.0 tools odela Veb-a 2.0 tools*

web 2.0 tools for content representation	***web 2.0 tools for systematization and practice***	***web 2.0 tools for interactive knowledge sharing***
• presentations (*Prezi*) • interactive online books (*FlipSnack, StoryBird*) • online games • creating movies and animations (*Animoto*) • creating interactive posters (*GlogsterEdu*) • generating words (*Wordle, Tagxedo*)	• cognitive maps (mind maps) (*Bubble*.us, *Mindomo*) • dynamic poster boards (*Lino it*) • quizies (*QuizeRevolution, Quizlet, Brane Games ProProfs*)	• Social networks (*Edmodo, Facebook, Twitter, Pinterest*...) • tools for avatar creation (subcategory – speaking avatars) (*Voki*)

Social networking is the most fundamental principle of web 2.0 philosophy. A great advantage of this philosophy is that the user centric perspective, since the user is the content creator. The user can create his forum, blog, web portal, web encyclopedia. Another advantage of this philosophy is that users can safely access information. Also, an advantage is that pupils can collaborate on different interactive content. Interactivity is a very important characteristics which helps pupils to learn.



Slika 1: *Razvoj Veb-a[3]*

3.3. Web 3.0, networked knowledge

While the implementation of web 2.0 tools in educational systems is still in progress, it clear that the next step in web development is even higher integration of the content, great openness of the internet and work of intelligent systems that user will use without the need to understand how their work.The whole web should be completely transformed from a collection of separate applications into a unified framework. Several directions for such development can already be recognized.

Speed of connection

Accessing the internet over mobile devices has been expanding and all statistics show that a third of all online access is over smart phones, due to a great expansion of 4G network use.On the other hand a wide range network, fast internet access with prices affordable for all people (regardless of their income or location) is a so called digital inclusion, that is a necessary step in the development of the digital society. Therefore, networking and infrastructure will still be the primary condition for the web development. The future providers will probably be working on the regional and not only on the local level.

Still in the cloud

Great change in web 2.0 tools has been brought by the cloud computing, enabling users to access all the necessary data, applications and services trough the web browser without limitations imposed by the hardware and the software of their computers. Further development of this concept would include forming the whole “cloud fields” that carry global or regional systems, where software is developed as complex business packages for supplying for the complete needs of a user. The needs cannot be estimated since the structure of needed jobs and the necessary competences of individuals in the information society are changing almost on daily bases.

Free software

Using free software and the open technology movement is related to usage rights and that will probably be more regulated in the future. The need for knowledge sharing is continuous and it is a common interest that the abuse is minimized, and the knowledge transfer is maximized. In the current state very respectful and relevant educational institutions use free software for education of their students and graduates. This trend is to further "legalize" the use of free software in all human activities, and it remains only to establish rules for its use.

Portable Identity (*OpenID*)

The need that all services and resources on the internet a user can access by a single user account yielded the concept of OpenIDidentity, where OpenIDis a provider that is a key figure in the communication between the services and the end users.It would be very beneficial if a user account could be transfered from a service to another service without a further authentification.

Intelligent Web

The semantic web will probably become the most challenging field in informatics in the years to come. The idea of the semantic web requires to tag every information that appears on the web and to connect connecting data from different categories only based on its description and meaning (semantics). The content that is only available, unless the user uses it in the right way, connecting the related content. Searching information by its format and its meaning becomes a fundamental goal and a present challenge. Databases that could support such selection of data will become the cornerstone of the semantic web technologies. By identifying the meaning of a term with its description given in a form of tags moves the focus from the linguistic to the information field, overcoming the liguistic barriers and unifying very different databases.

3.4. Web 4.0, a global mind

Web 4.0 is a term that is still "in the air" since no one can describe what would the next stage in the internet development bring, but there are some predictions that descrbe web 4.0 as a global operating system that offers complete business and economic models or platforms based on the latest digital technology. In every new revolution of the internet, the emphasis was on the accessibility and ease of use, but now we can say that "a cumulative aggregation of tools" brings control back to the system, and not to the user, that was brought by the web 2.0 tools. Personalization and giving a personal identity to so formed web services might be the field where web designers could go trough their creative revolution. We can say that the end user will slowly feel that everything is customized towards his personal tastes and needs. Is the user in such an atmosphere in a constant advantage is a question of the advance of technology and its influence on the development of the society, and that is a question that is considered by both sociologists and the IT experts.

4. CONCLUSION

The education, as all other activities, is impossible to consider without considering a current social context. The use of technology is a necessity in all areas of the moder society. The only question is to what extent and for what purpose. Respectful and relevant educational institutions adopt such trends in education and adapt the forms of teaching. The traditional forms of education are constantly enriched with the use of new web tools and the development of the online learning. This is the current reality, a process that has been started around twenty years ago and is still going on. The question that arises is whether the future development of the web will leave the user enough choices or will the global system chose for him and trough its formed digital profile offer him what the system judges that is the most appropriate for him. Currently we can only have some vague ideas in which direction that development can proceed and we can only expect that the future work of experts on integrating the technology and education.

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A new approach to learning with the introduction of modern information tools and software in the teaching process

Jezdimir - Luka Obadović[1]
[1] JUSSŠ „Vukadin Vukadinović”, Berane, Montenegro
e-mail luka.obadovic@gmail.com i jezdimiro@t-com.me

Abstract: *The paper presents the importance of the concept of lifelong education in the time we live and necessity for a modern school where the teacher is appointed to the student. In this context, the work is based on research analyzing the reform of introducing modern information tools and didactic software, both in teaching and learning process, which can significantly contribute to the quality of teaching process, learning efficiency and better didactic organization of individual subjects. The paper affirmed the logic of development of modern information society, both teachers and students, which must be directly supported by introducing adequate information technology in schools, aspects of tools in teaching, OneDrive software applications for the storage of educational materials, the use of blogs and social networks in the implementation of modern teaching and use software package GeoGebra in teaching.*

Keywords: *information technology; tools; software; teaching; learning; changes*

1. INSTEAD OF INTRODUCTION: A REVIEW OF INFORMATION TECHNOLOGY, AND SOFTWARE TOOLS IN MODERN SCHOOL

The vision of the information society development in the third millennium involves the application of modern information and communication technologies (hereinafter ICT), which are considered the main driving force for change in the education system of Montenegro. Modern ICT is imperative that our modern society imposes. In this context, open three aspects of the study of ICT in teaching and learning: defining ICT-assisted learning, continuous adaptation of ICT as a means of teaching and the inclusion of ICT as a new scientific field and appropriate methods of education in the regular education process. The research analyzes the construction of a modern educational system of Montenegro, through the examination of the possibilities opened up by introducing modern ICT in the teaching process follows the logic of the development of modern information society, both teachers and students, which must be directly supported by the introduction of adequate ICT in schools. Taking into account that this time the inevitable must be made specific and long-term efforts to innovate in this way the teaching process, as far as possible adapt both to the needs of the educational process in modern conditions, and the real needs of teachers and students. It is on these premises construction of a modern educational system of Montenegro has justified the introduction of ICT, both in the teaching process and the learning process, but it does not need to fit more systematically analyze, adjust and monitor its development and its positive side. The research part is related to ICT, which can significantly contribute to the quality of the teaching process, the learning efficiency and better organization of individual didactic courses, because the **teacher** allows you to: *improve its awareness*; *uses modern teaching methods and forms of work*; *teaching process more interesting, more relevant, more dynamic, which is the basis for active teaching*; *always have feedback on learning*; *classes tailored to the individual abilities of students*; *guide students in independent research, organization and realization of teaching*; *easily carried out by connecting the teaching content with the real world*; *has a two-way communication with students using social networks in the implementation of the Hours*; *objectively evaluate the knowledge of students*; *to time update its work*; *shall be devoted to creative work, because routine tasks can be performed quickly* (*draw scheme, calculating, copying, etc*.); *instead of lecturing probing the role of becoming a collaborator and advisor to students*; *i always uses the principle of obviousness*; on the one hand, and on the other hand, allows the pupil to: *teach according to their abilities*; *teaches a speed that suits him*; *develops the ability to work independently*; *acquired permanent knowledge*; *develop their creativity*; *be active in the learning process*; *be motivated to learn*; *acquire knowledge that can be applied*; *always have access to their accomplishments*; *easily and effectively share their knowledge with other students*; *uses different sources of information*; *critical access to sources of information*; *Always be on time informed about the education process, its objectives and tasks*; i work *in a pleasant environment*. The time in which we live shows that the knowledge-based society at the same time the company for continuous learning and education. The Ministry of Education of Montenegro through the project MEIS implemented the most important part of the use of ICT in education. MEIS project consists of several activities: equipping all schools with computer equipment, the introduction of broadband Internet, the training of teaching and administrative staff to work on the computer by school ICT coordinators... and finally the introduction of MEIS applications, see [1]. Computer literacy teachers in Montenegro is the process of continuously running, through training for computer skills and gaining corresponding ECDL certificate confirming possession of the necessary knowledge and skills.

2. INFORMATION TOOLS IN TEACHING

Tools for creating interactive content are important factors of effective teaching and learning in the future. In a broader sense, the tools should not be seen as a substitute for traditional books and textbooks, but should be accepted as a new way of organizing teaching and learning, as well as innovation and qualitative supplement more traditional and conventional methods of education. Learning in the future must be such as to allow access to content and knowledge to everyone. Aims to enable easier, faster, simpler, more flexible teaching and learning through real examples, which should build on and create new opportunities for the acquisition of knowledge. The role of students in creating learning content with the use of tools will grow significantly in the future. We should emphasize the fact that the tools are widely used in teaching, especially when using programs that are, in most cases, already installed on your computer and are used in everyday practice. In addition, tools in teaching and learning can be used by teachers and students:

⇨ ***teachers*** the tools used to create interesting teaching materials for students, introducing them to the topic and thus motivate students for further work, while

⇨ ***students*** after learning of basic skills, tools applied in independent problem solving individually, in pairs or in groups. They begin themselves to work, study material and acquire knowledge, which is very different from the passive listening that is present in the classic set, connecting material with the phenomena of everyday life, develop critical thinking and logical thinking. In this way the students themselves using tools partly created the content of the class and actively participate in class.

ICT offer a wide range of tools that can create new opportunities in the classroom, see: [2].

2.1. The division of tools for e-learning by category

Bearing in mind the identified tools of teaching and learning, it is necessary to indicate the possible division of tools that have to be carriers of all future changes and innovations in the educational system of Montenegro in the foreseeable future. In this context, starting from the current situation and current tendencies, tools for e-learning can be divided according to categories: *tools for teaching*; *tools for the processing of images, sounds and videos*; *tools for web meetings, conferences and virtualization*; *tools for social and kolabaracioni space*; *presentation tools*; *communication tools*; *personal tools*; *blog and wiki tools*; *Microsoft Power Point*; *Skype*.

ICT tools are widely used in teaching, especially with the use of programs that are already installed on your computer, and install programs from the Internet.

2.2. OneDrive computer application for the storage of teaching materials

Overall, **OneDrive** (formerly called SkyDrive, Windows Live SkyDrive and Windows Live Folders) is a free computer application that allows the user files on different computers synchronized automatically. In line with contemporary trends of the reform of the educational system of Montenegro, allowing users to store their files private, share them with their contacts or to publicly announce that the students can use during class and after class. To be able to log on OneDrive, you need to open an account on Microsoft web page login.live.com and thus allow yourself a free email address to which you will be able to receive and send electronic mail, see [3].

It should be noted that the educational materials that teachers prepared easily mounted on OneDrive. In this regard, the OneDrive can store about 15 GB of material. Within this framework, the teacher can set up a plan and program of continuing professional development for all, as well as the basic criterion for further work, presentations, pdf books, photos and everything that is considered important for the implementation time and achieve goals. When the teacher puts the material on your OneDrive account, students can on your PC, wherever they are, to take this material and use it in the acquisition of materials. All they need is to have an internet connection. In addition, students can create their OneDrive apps installed presentations, exchange ideas, and the like.

2.3. The use of blogs in the implementation of modern teaching

Blog or **weblog** is a type of website that does not require any knowledge of programming languages (html, php, css) to run and makes a series of chronologically organized texts that are displayed on Web pages. In this regard, the entries are sorted from the most recent content at the top of descending to the bottom of the page. Keeping all this in mind, through automated software can easily create and manage a blog, see [4]. In that sense, blogs allow you to express your opinion without any restrictions. They can write to anybody. The design and implementation of blog posts can vary not only by its subject and scope but also in terms of format. It should be noted that the blog online diary or album, where you enter the new content is done in the style of the journal, which provides an opportunity for the teacher without any restrictions to devise a teaching unit (or for teaching the subject), and set it on its space from several smaller parts. Smaller parts are easier to acquire, but that feeling will be the engine for further learning. Students will be able to easily and quickly access the information they provide.

Today, the number of blogs is increasing day by day and more and more of those who share their thoughts with students, friends and strangers. In this sense we can see and blogs that combine the written word with photographs, video or audio content.

Blogger is one who governs blog. Instead of recording his thoughts in the physical log, blogger/she puts their ideas, thoughts and conclusions on the Internet in order to share with readers of his blog. All these facilities go to the blogosphere, and blogs can be classified into three basic categories: personal blog (focused on the subject), organizational blog (arranged by organizations or schools) and business blog (made for the purpose of making money, whether it comes to advertising, sale or promotion of products or services). Increasingly, bloggers act as a pressure group. Within this framework, a common custom of leaving comments, mostly mutual praise minded. In this regard, there are blogging spams, objectionable content that is not in accordance with the theme of the blog. In addition, advanced services have on the web spam-filters that prevent comments that are not in line with the theme of the blog. Application of the blog in the implementation of modern teaching ICT as a tool is multiple sets faster and easier communication; provides an easier way to exchange ideas and realized educational content among teachers; gives students an opportunity that no additional classes, using the blog compensate for lost teaching materials; teacher continuously creating blog (blog teaching) which encourages students to cooperate, establishing peer learning and communication through certain activities, for example: inform students about upcoming events, sets the assignments for assessment, for talented students for the competition; your blog can have some compartments school (homeroom or class blog) that the students edit their own departments or together with homeroom teachers or other, which would publish articles, news related to the activities of the departments, and schools; school can have your blog (school blog, some are appointed by, and as a school website) which would publish regular school activities teaching.

In the foreseeable future it is essential to establish a much closer relationship between the Internet and, blog and modern teaching, in order to shorten the time required for learning and enable teachers and students to become creators of modern teaching process.

2.4. Social networks continue to function

The **Social Network** (Social Network) is a service of the Internet which occurs in the form of platforms, windows or web pages and is used to interconnect users. It should be noted that today there are hundreds of such services, among the best known are: Facebook and Twitter. **Facebook** is an online social network, which was founded in 2004 by *Mark Zuckerberg*, a former Harvard student. In its infancy, Facebook was intended only to students at Harvard University who in this way could communicate with each other and exchange information. Later, many other universities, schools and companies around the world have joined the network. Available to all operating systems. It is free for all its users. Facebook profile is your personal page by the time i complete a variety of applications. The most popular place for posting photos. Users who no longer wants to be a member of Facebook, you can delete your profile by typing this, see [6]. Facebook is now the most popular service for socialization with a growing number of users.The majority of pupils in schools has a Facebook profile, and if it does not have all that is necessary is to have an account on e-mail and to sign up. The teacher can make a special profile classes, invite students to friends and communication can begin. There are students who would not be what the teacher asked the class, asked Facebook in chat (conversation), or through a message left by the teacher inbox. Bearing all this in mind, the teacher can make a website that students themselves need to like (like - like it). Accordingly, there is the possibility of banning access profile, "*undesirable*" persons who might possibly disturb some inappropriate content other members. **Twitter** is a microblogging service and a social network that is based on the exchange of short text messages no longer than 140 characters, gathering and monitoring of other users. It is used via the web, a variety of desktop applications, and mobile phones, as it was in the beginning and the main purpose. The founders of Twitter are *Jack Dorsey*, programmer and web enthusiasts, the idea of a web service which allow users to quickly report what they are doing and where they are, and the originator of social networking and user content, *Bizu Ston*, which together within two weeks agreed prototype Twitter . They were joined by *Evan Williams*, the man who coined the term "*blogger*" and was one of the people who initiated the mass blogging, see: [7]. Using Twitter is free. Twitter does not require any setup and installation, after registration you have your twitter profile with the address "*twitter.com/imekorisnika*" and you can start to tweet to your heart's content. It can be said that the whole concept is based on Twitter: tweets setting, selecting the users whose tweets you want to follow - '*Following*' and users in your account can follow your tweets - '*Followers*'. In order to track a person's tweets permit is required from the users whose tweets you want to track, just finding and clicking on the '*Follow*' and that's all you need to do to track a person's tweets.

3. SOME USE OF SOFTWARE IN TEACHING

GeoGebra is an interactive application designed for geometry, algebra, statistics and budgets. The application is intended for teaching and learning of mathematics and other sciences. It is used in schools and universities, see [8].

Application creator *Markus Hohenwarter* GeoGebra. GeoGebra is available on a variety of platforms. It can be "*combined*" with HTML, CSS and JavaScript. In this way you can get the dynamic and achieves that created material is interesting for students. Classes are designed as a web site where you can find materials on the construction of the triangle, and then presents tasks whose resolution is implemented in GeoGebra. What is new is that the teacher, in this form of lectures, does not need to use a chalkboard or even a classic resource in the classroom. Full demonstration was achieved using the software which he directs, and may later i'm a student. Featured content is not a substitute for attendance time, it serves as a complement and support learning during which the teachers and students to find advantages. By mastering software package GeoGebra, as well as their creativity, teachers can create electronic lessons from any other field of mathematics and thus the time to do more interesting and dynamic. Electronic lessons can later be left to the students when learning another look at how the obtained solution which contributes to a better understanding of the area that was treated.

In order for this approach to teaching mathematics in schools has come to life, it is necessary to work on additional IT training some teachers of mathematics, since it is concerned only with mathematics, computer science, and not in the foreseeable future.

4. CONCLUDING REMARKS

The time in which we live shows that the knowledge-based society at the same time the company for continuous learning and education. In this context is seen insight into the results of numerous studies and outcomes of planned changes that testify to the rapid development of digital media and information. Consequently, all European countries have established a national strategy for the use of ICT in education, among them Montenegro through the project MEIS. The vision of the development of the information society implies the use of modern ICT tools for creating interactive content and books in electronic format to all. In today's time when the IT revolution at its peak, it is only natural that the modern schools and modern teaching methods can not be imagined without the active use of ICT tools in teaching and learning, OneDrive app for storing documents, blogs and social networks in teaching and GeoGebra software package for teaching and learning from school to university. Social networks aim to connect teachers and students as active participants on the Internet, gathered around the teaching of educational content, activities, and provide a new way of communication and exchange of information with each other in real space. They have become part of our lives. There are a variety of social networks. Moving from those that are created to meet people (*facebook.com*), exchange short messages and socializing (*twitter.com*), those who serve in music (*flotones.com*, *mog.com*), to the network to registered users achieve their business contacts and stay in touch with them (*linkedln.com*). Today there are over 200 internet sites social networking. Modernization of teaching and learning is a process that is carried out according to the circumstances and possibilities, showing significant results. Existing Montenegrin conditions should not be a limiting factor for innovation, the introduction of modern information tools and software in the teaching process, if we want to really be teachers of the 21 st century and to bring our lessons to the needs, interests and abilities of students in the future

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Computer games in the function of developing initial mathematical concepts

Sanja Janković[1] and Marija Jordanović[1]
[1] Pedagogical Faculty in Vranje, University of Niš, Vranje, Serbia
e-mail sanjaj@ucfk.ni.ac.rs

Abstract: *Since modern civilization flows move towards the information society, the computer has become a central medium of our everyday life. The computer is an integral part of childhood, for the children who grow up in the 21st century and it increasingly finds application in the process of learning and games. The paper describes characteristics and educational value of computer games for children, as possibility of their use in the development of initial mathematical concepts. Also, the paper describes some sites that contain lots of interesting games that can be in the function of developing initial mathematical concepts. There are some useful links to web sites with diverse and interesting games.*

Keywords: *computer, computer games, initial mathematical concepts*

1. INTRODUCTION

The rapid development of science influenced the innovation of the education. Computers have become inseparable means of modern teaching. Due to its positive influence on knowledge acquisition the computer is more often used even in preschool institutions and it has a significant role in the process of the development of mathematical notions. Research has shown that preschoolers learn best and most efficiently by playing games. Through games it is possible to transform different patterns of children's behavior and encourage new models which contributes to further development of potentials. In connection to this, with the foal of modernizing preschool activities, more and more preschool teachers are trying to explain appropriate notions through computer games. Since learning process on preschool level is dominated by learning through sensory and motoric experience, teaching children of this age demands total practical and cognitive activity which is also set as the basic condition for development of mathematical notions. This condition is greatly met by computer games, thanks to multimedia content and the possibility of interactive work.

1.1. Child's play and its educational values

Child's play is as old as humanity itself. It has always been pivotal and most important activity in children's lives. First thought on child's play are found in the oldest philosophers and pedagogues.

Since child's play is a very complex activity witch is still being examined, in literature we find many of her definitions. So Topličić (1996: 104) sees play as a "spontaneous and creative activity without practical or utilitarian goal which resembles art" .Minić (2012) points out that child's play can be seen as a basic form of child's activities through which it most naturally and most freely satisfies its needs for movement and action. More precisely, play is a "conscious activity which shows a type of relation of a preschooler to things and notions in reality "(Mitrović 1980,according to: Minić, 2012: 77). This and other definitions of play point out the fact that spontaneity , creativity and free activity of a child in which the process of the play itself is more important than the results, characteristics which set play apart from other activities which are a part of a child's life. The most important characteristics of each game is child's enjoyment in it and its sense of satisfaction.

In literature we often find a statement that play represents a specific way of learning for preschoolers. Though play child learns, discovers itself and the world by experimenting with various materials, sounds and means, it solves problems in a specific rational and intrinsic way, it understands spatial relations and causal connections. Play creates interests, it activates attention and will and in so doing enables learning process and makes a child organized and focused. Play also influences regular growth and development of motoric, emotional, cognitive, social and speech abilities. It also stimulates the development of perception, creativity and aesthetic perception in children. Learning through play entails fiction, contrivance and research, during which a child freely creates a situation that is under its control, which it understands and which makes it feel safe. In so doing, through play, a child turns formed experience into knowledge. Assimilation of a child's experience into personal view of the world represents a preparation of the child for later accommodation to that world (Pijaže and Inhelder, according to: Kopas-Vukašinović, 2006: 183).

Play is a strong educational means for through it a student simultaneously expresses and develops his or her feelings, learns to respect the rules, develops cooperative and competitive spirit, it affirms himself or herself, expresses his or her opinion, develops a sense of security and individuality and he or she strengthens confidence.

"Upbringing through games represents the most suitable way of upbringing, especially in younger ages" (Kamenov, 1997: 8). Due to the before stated and because of numerous advantages play has a special place in educational work with children.

1.2. Computer games

Modern society is characterized by significant changes in all its areas, and especially in the field of education. Therewith, contents which occupy children's free time have significantly changed and the changes have influenced child games, which are now significantly different than before.

Since modern civilization courses move in the direction of information society, computer has become central medium of our everyday life, so for children who are growing in the 21st century computer represents an integral part of their childhood. The use of computers in preschool age mostly boils down to play and pastime, which are exactly the ways in which preschoolers learn most efficiently. With greater availability of computers and with the ease of their use comes the development of computer programs for children and thus the possibilities for their use become ever greater. Multimedia content and the possibility of interactive work which those programs offer contributes to a more efficient acquisition of content which need to be mastered. Currently there are many programs in the form of fun and yet educational character.

Research indicates positive effects of educational computer games on a child's psychomotoric development. Children through educational games learn in a simple and interactive way, they develop their intellectual potential, problem solving skills and abilities to find their way in a new situations, they gain a sense of competency and confidence, develop perception and motoric skills. Educational and general computer games incite explorative spirit, creativity, memory and logical deduction in children.

As a key factor for children's use of computer games adaptability if content to her age and involvement of adults in this process impose themselves. It is important for the child to use only software and games adapted to its age, which for age of up to six is exclusively educational software in which a child can draw, paint, design various things, learns letters, numbers and other notions.

If a computer game has afore set pedagogical goal in the sense of developing some skill, abilities, useful habits or new knowledge, it, as any other game with that kind of characteristics, represents a didactic game. Thus, with controlled use, computer can be effectively used as a didactic means (Bajić and Lukić, 2014). Having this in mind, the modern educator is expected to use a computer, among other means, in his work as a didactic-game means.

1.3. Computer games in function of the development of elementary mathematical notions

By browsing through the offers of computer games online, we have found a wide variety of free online games for all ages which can be used for the development of elementary mathematical notions. Adequate educational computer games, apart from requiring of children to notice objects, also demand activating of certain thought operations during their solving. Namely, this accessible games turn learning mathematics into fun, through them the children will forget that they are actually learning, and this will help them to love this subject. In the text that follows we will focus on some of the educational games and in short describe those which can help in the process of learning mathematical notions.

Site **Kindergarten math** which can be find at the internet address http://www.ixl.com/math/kindergarten (Picture 1.) contains many interesting computer games suitable for children of various ages. The games meant for preschoolers are grouped in thematic wholes with different levels of complexity. So games from the area of geometry are based on recognition and naming the forms have to levels of complexity. In the first level are tasks which solely require that a child recognizes the given form or to mark one of the three offered. The second level is somewhat more complex and in it are multiple choice tasks which makes them more demanding for the child. There are also games which demand that children recognize objects from everyday surroundings and answer questions related to similarity to a geometrical figure or a body. Group of games *Positions* helps the development of spatial orientation in children by asking children to mark objects which are in, on, outside, below, above, next to, left, right… In the group of games named *Sorting, ordering and classifying* asks the children to group and perform logical operations of classification and serration of objects according to color, shape or both color and shape. These are the operations which must precede work with numbers. The group of games named *Comparing* gives children insight into quantitative relations between sets, they join elements of one to elements of another set and in that way develop set relations more or less equally. By playing games in the area of (*Numbers and counting*), children develop the notion of number, join numbers to appropriate sets, learn to count forwards and backwards, developed number relations smaller than, bigger than.

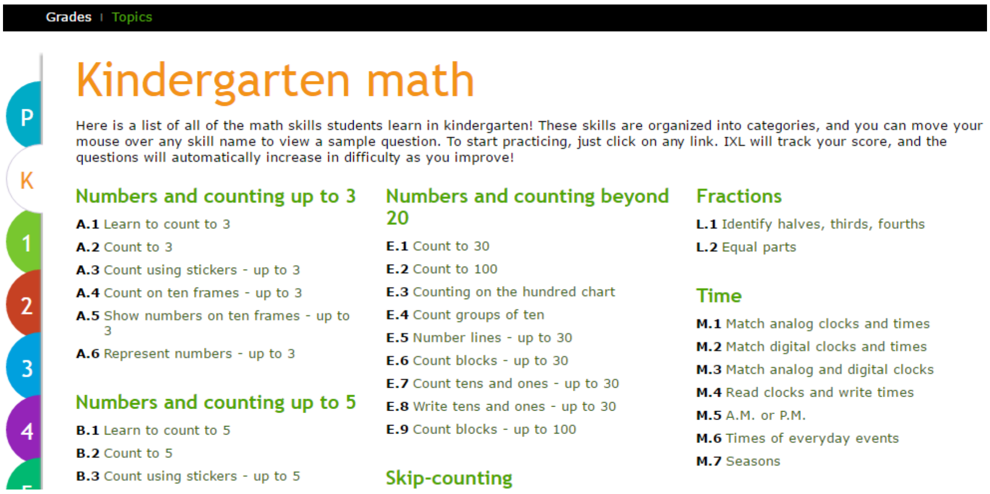

Figure 1. *Appearance of Kindergarten math*

One of the more significant projects which enables the creation of virtual environment for learning mathematics is **National Library of Virtual Manipulatives** (NLVM). Project NLVM was started in 1999. with the goal of developing a unique virtual library of interactive objects and mathematic tutorials, mostly in the form of applets. On the internet address http://nlvm.usu.edu there are thematically sorted games for all ages of preschoolers and school children. Some of the encompassed areas are numbers and operations with numbers, geometry and measurement. In certain games the child learns colors and shapes by sorting virtual blocks. In some games the child can make a new form out of the given forms. For example, in the game named *Pentominoes* child using 12 different virtually manipulative objects makes two or three congruent figures. Similarly, the game *Pattern blocks* is excellent for creation and description of patterns. Children need to make the given geometrical shape by combining various geometrical shapes. In the game *Turtle Geometry* child explores numbers, shapes and logic by independently programing turtle's movement. *Geoboard* is a game in which children through virtual erasers draw geometrical figures in a set scheme or arbitrary (on their own, independently). The game *Time-match clocks* asks the children to show the correct time on the clock. In his way children learn how to use it.

Huge offer of interesting educational games can be found on the site dobreigre.com, which is at the internet address http://www.dobreigre.com/. On the site there are various memory games, games which encourage children to distinguish between geometrical figures and colors, puzzles, counting games etc. Among others, these games help train mental abilities of memory, perception and concentration. AN example of one such game is *Small-big fish*, which enables the acquisition of notions bigger, smaller and equal. At the beginning of the game on the screen there is a small fish, which can be fed by fish of its own size or smaller. After a certain time the fish gets larger. If the player tries to feed the fish with a bigger one, the bigger one eats the smaller one. In that way children form the notion of size through game and fun.

Apart from afore stated, we recommend also the following websites on which there are plenty of educational games which are useful for development and practice of mathematical notions:

- http://www.igrezadecu.rs/Edukativne-igrice/
- http://www.primarygames.com/games.php
- http://www.arcademics.com/
- http://www.coolmath-games.com/
- http://www.kidsmathgamesonline.com/

As a limiting factor of the described computer games we can list that a significant number of them are in English. This is why a child needs and older co-player, mainly educator, who must know foreign language and be next to the child so as to help during the game. However, this does not lessen the significance of the mentioned games. On the contrary, the accompanying sound effects help the child to hear a question in English and this can be a starting point for language learning.

2. CONCLUSION

Having in mind the large interest of children for computers and usefulness of educational games, the modern preschool institution is tasked to apply computers as didactic-game means. In order for the use of computers, educational computer games that is, to come to life in our preschool institutions, certain conditions are necessary regarding technical, hardware, software and staff demands, as well as in the domain of the didactic-methodic organization of activities, including the choice of methods and forms of work. Therefore, the modern educator must elaborate the realization of the set pedagogical goal by using educational computer games, adjusting the game content with the characteristics of preschoolers. Only under that condition can the use of educational computer games in the educational work with preschoolers be fruitful.

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The effects of digital dialogue in teaching programming

Momčilo Ranđelović[1], Alempije Veljović[2], Ljiljana Stanojevic[3] and Lidija Paunović[4]

[1]"Nikola Tesla" Vocational School of Electronic Engineering, Niš, Serbia
[2]Faculty of Technical Sciences, Čačak, Serbia
[3]John Naisbitt University, Belgrade, Serbia
e-mail moca@etstesla.ni.ac.rs, alempije.veljovic@ftn.kg.ac.rs, univerzitet@nezbit.edu.rs, lidija.paunovic@ftn.kg.ac.rs

Abstract: *This paper describes the testing of the application of digital dialogue during direct teaching on the process of the presented material. The conducted experiment had the goal of showing that by applying digital dialogue through the transformation of acquired information in different representations and bigger involvement of the students, the students' memory processes in class could be enhanced. In the experiment, the students were required to memorize the basic information from the content of the programming class unit. Immediately after the class, the tests were conducted. The acquired results, processed by the t-test, have shown that by getting the students more involved in the class, through digital dialogue, the process of memorizing the content of the curriculum can be greatly affected and they have confirmed the purposefulness of applying digital dialogue as a teaching concept that enables the students to functionally use their mobile devices during class for the purpose of acquiring the material more easily.*

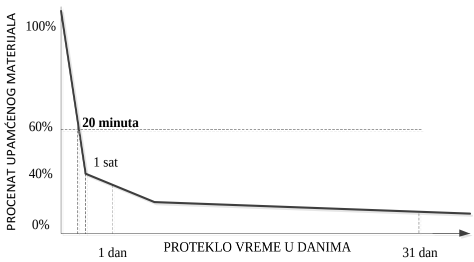
Keywords: *Digital dialogue, teaching programming, interactive teaching, the process of forgetting*

1. INTRODUCTION

When the utilization of computers started in schools, it was expected that this new means of education would open the door to the new and modern methods of teaching [1]. Today, we know that education software and electronic teaching materials, though reliant on modern and innovative pedagogical solutions, provide excellent support to the traditional, head-on teaching, giving it a new level of quality. The products of IT, as modern and digital teaching means, are modern to the extent to which they are required to be by the user and within the teacher's ability [2].

Teaching programming in high-school presents an excellent area to demonstrate the application of modern IT and modern didactic solutions. The teaching course content itself is relatively new, and is thereby practically uninhibited by certain stereotypes and already established, traditional methods of presentation [3].

This paper presents the display of research that was conducted among the junior vocational school students in the subject of programming. The basic theoretical starting points are the Ebbinghaus's Forgetting Curve (Figure. 1) and the stance that student testing could also be used to improve teaching, and not only to evaluate it [4].



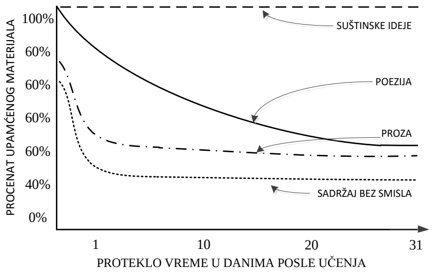


Figure 1 *Ebbinghaus's Forgetting Curve*

The problem of research is determining the importance of the influence digital dialogue has on teaching programming, retaining the traces left by studying, and testing the level of retaining or losing certain content of the material, immediately after the class.

Research topic is elevating the level of recognition and reproduction of the presented material by the immediate, head-on teaching with the application of digital dialogue, in comparison to traditional teaching methods.

The starting hypothesis of the experiment is: applying digital dialogue while teaching provides significant support to the students in terms of more effective and sensible remembering the content of direct teaching. Digital dialogue significantly influences the level and quality of reproducing key data from the directly presented material.

The purpose of the research is to contribute to eliminating uncertainties in the available knowledge regarding practical possibilities of introducing digital dialogue to the educational process and its possible advantages, and showing that applying digital dialogue can significantly influence the quality of remembering the material during class.

The mission of the paper is to determine the success rate of teaching supported by digital dialogue through the experiment, based on test materials and thereby getting the full picture of the effects of digital dialogue on teaching programming.

In the first part of the paper, the concept of digital dialogue is briefly described as a means to support traditional teaching methods and its place in hybrid learning. Part two of the paper displays the basic specificities and demands of teaching programming, key terms that student should memorize after the class and the different ways of them being supported by digital dialogue to be more successful at it. In part three, we describe the process of research, and part four shows the results of the experiment and the commentary.

2. GENERAL PROPERTIES OF DIGITAL DIALOGUE IN TEACHING

Considerable defects of traditional teaching are still present, even with more and more observable utilization of modern Information and Communication Technologies (ICT) and the practice of hybrid learning: the hindered permanent record of the student presence, attention deficit, lack of interaction and, frequently, the insufficient motivation in subjects. Application of the concept of digital dialogue provides the hybrid learning system with additional advantages - in fact, it elevates the degree of interaction between the subjects and at the same time forms a digital record of the entire teaching process.

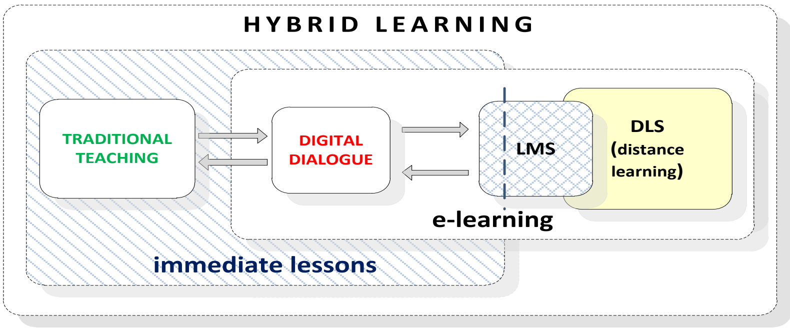


Figure 2 *The position of the digital dialogue in the hybrid learning system*

The concept of digital dialogue complements the system of hybrid learning, because it enables overcoming the limitations of e-learning and direct teaching by being placed between them (Figure 2).

Application of the concept of digital dialogue as an asymmetric communication process, integrated into the hybrid learning system, is not only an application of new didactic resources, but it also implies numerous changes in the education process, such as new teaching methods, different kinds of teacher preparation, the equipment in classrooms and cabinets, teacher's new abilities and so on. This kind of dialogue provides the teacher with the exact insight into the number of students following the lecture, during class they can also acquire the insight into the degree of student's interest in the unit, and even evaluate each student at the same time through standardized testing.

Owing to the massive use of personal mobile devices and the fact that majority of pupils and students use smart phones on the daily basis, a new space for innovation and improvement of direct teaching has been created [6, 7]. Namely, by using PRS technology (PRS - *Personal Response System*) new systems have been created (*Mobile Classroom Interaction System*), which, using new features of SMS and Wi-Fi standards, introduce in the classroom new systems for communication with students CRS (*Classroom Response System*) and devices - CRD (*Classroom Response Device*), as standard didactic tools [8**].**

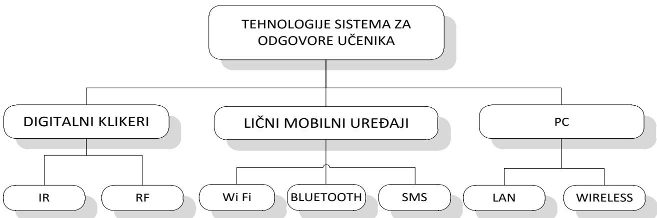


Figure 4 *Student's response system technology in digital dialogue*

System that connects the students' devices with the teacher's computer may be based on different technologies: *infrared* (IR), *radio-frequency* (RF), SMS, WiFi, and LAN (Fig. 4). Within each of these systems of communication, it is necessary to ensure the simultaneous receiving of a huge number of the students' responses from their mobile devices – real-time PRS (*Personal Response System*).

3. SPECIFICITIES OF TEACHING PROGRAMMING

The subject of Programming has been facing numerous dilemmas ever since it was introduced to standard education. From deciding which programming language and which platform is optimal for learning, as well as what's the quantity of information that the students can acquire, to how to enable the students to solve practical problems through the forms of programming languages. [9, 10]. The Teaching Methodologies of Programming is a new field that relies and builds itself on psychological cognition, presented through modern teaching methods. Also, interdisciplinarity and multidisciplinarity are reflected through the correlations in general methodology, didactics, and IT methodology. Didactics and IT methodology study the same field, but on different levels of generality. IT methodology specifies didactic principles to specific content of teaching programming, and this is where the two disciplines complement each other.

4. TESTING THE EFFECTS OF THE APPLICATION OF DIGITAL DIALOGUE

The research described in this paper is motivated by the fact that there is no reliable and available info on the possibilities and effects of the application of the digital dialogue in immediate lessons in Serbia. It was conducted in the multimedia cabinets in the "Nikola Tesla" school of electric engineering in Nis, during regular classes, per the school's timetable. The sample consisted of two classes of juniors, vocation "IT Engineer", with the permission of the school council and the principal.

One class was selected as the test group (TE) and the other as the control group (TK). Digital dialogue was applied in the test group, while the traditional methods were reserved for the control group.

The results of the experiment were viewed from the stand point of the manifestation of remembered material, evaluated by standard tests. The degree to which the material was remembered was measured immediately after the class. The research has been done through two experimental classes for each of the two groups. The first experimental class unit for both groups was: "Defining and Application of Statistic Functions in C#". The classes were conducted in two consecutive days. The following week, the experiment was repeated. Unit title: "Returning Parameters to the Main Program and Function's Side Effects".

The students were expected to memorize basic ideas after the class: the way of defining and operating of the statistic functions in C#, their advantages, and how to invoke them.

Each of the test consisted of ten specific questions. Each answer that was completely correct awarded the students ten points. Students were graded on a 0 to 100 scale. For the complete duration of one experiment, two connected school classes were planned, meaning 90 minutes, involving the activities in the table (Table 1).

Control group students were revising the material through the traditional oral exam, while the students from the test group, through digital dialogue, had additional 8 short questions in the form of a quiz, suggestion, vote or commentary. The results of the answers given by the students using the digital dialogue are not displayed, since they are not the subject of this paper. The results of experimental testing has been analyzed and displayed.

Table 1 - *Conducted Classes Data*

Experiment no. 1			Experiment no. 2		
Group	TE	TK	Group	TE	TK
Theme	*Defining and Application of Statistic Functions in C#*		Theme	*Returning Parameters to the Main Program and Function's Side Effects*	
Duration	90 min		Duration	90 min	
No. of students	26	24	No. of students	25	24

5. RESULTS AND DISCUSSION

At the end of the class, both groups did a test. Each of the tests was graded with a number of point between 0 and 100. Results achieved have been processed with the t-test an presented in table 2. For the comparison of the test result, the data has been processed in MS Excel using the t-test (Table 2).

Table 2 - *Test group and control group test results, processed by t-test*

TEST NO.	AVERAGE NO. OF POINTS		DIFFERENCE (NO. OF POINTS)	p		COMMENT
	TE - group	TK - group				
1	62,667	49,852	12,815	0,007	p<0,05	There is a significant difference
2	69,926	54,704	15,222	0,048	p<0,05	There is a significant difference

Based on the results in the table, we can observe that there is a significant difference in the score between the students in the TE and TK group, respectively. Experimental group students have, on average, scored better. Seeing as how the numbers achieved in the test are $p= 0,007$; $p<0,05$, meaning $p= 0,048$; $p<0,05$, we can accept, with a 95% certainty, the starting hypothesis and we conclude that applying digital dialogue in class has provided a statistically significant support to the students in terms of more effective and sensible remembering the content of direct teaching. In addition, the test has shown that applying digital dialogue can affect the quality of remembering the material and the level of reproducing presented material immediately after the class significantly.

Multiple repetition of the tests would definitely provide a clearer picture regarding the lengths the application of digital dialogue can reach, but the tests were not conducted in a laboratory setting, but rather with real students in real classes , according to the official curriculum. A larger number of frequent tests using same classes could endanger successful completion of the curriculum. However, future test results are expected to confirm the results gained so far and undeniably recommend digital dialogue as part on re-engineering hybrid teaching.

6. CONCLUSION

Based on the displayed results we can conclude that the basic goal of the research has been achieved - there was a contribution to overecoming uncertainties regarding the available knowledge of practical possibilities of implementing digital dialogue inot the educational process and its possible application advantages in direct teaching. The test was not concerned with acquiring information regarding the students knowlegde of programming, only with the degree and quality of reproducing key data from the immediately presented lecture. Ergo, it is about the effects of digital dialogue on the students remembering the content of the class more effectively and sensibly. Only osme of the possibilities of the digital dialogue were used in the experiment, such as short-question answers, voting, commentary, and quiz. Digital dialogue displays its fullest potential while being applied in regular, direct teaching, with large groups of students with using mutliple activities from its arsenal. Seeing as how the time of mobile advancement is still coming, we can say that we are yet to see the period of intensive utilisation of digital dialogue in hybrid learning, because the achievable technical and safety demands for the digital dialogue enable most of high-schools to start application today, within its means, and use the examples of fine practice to contribute to the quality of direct teaching.

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Bitstrips in school

Predrag Novaković[1] i Snežana Tošović[1]
[1]OŠ „Tanasko Rajić", Čačak, Srbija
e-mail pedjanole@gmail.com, snezana.matematika@gmail.com

Abstract: *The aim of this paper is to present the characteristics and possible applications of the Bitstrips tool in curricular and extracurricular activities of primary school pupils. The tool allows you to work in a virtual class through individual and /or team work of students with the help of teachers. The product of this tool is a strip, which can represent the content of teaching units which are dealt with in elementary-school subjects. Specifically in this paper a lesson in mathematics designed for the needs of regular classes and Math Club "Kefalica". This paper also represents a display of works of pupils – members of the Club, presenting the theme "Rules of Conduct", which can be used to present this topic in the homeroom class.*

Keywords*: Bitstrips; curricular activities; extracurricular activities*

1. INTRODUCTION

We are faced with a reality in which mobile phones have become an integral part of life for children of different ages. We are also aware of the large scale of information-technology use by the young. On the other side, teaching is still largely based on traditional classroom practices and use of the board. Bitstrips is a tool which can be used by both teachers and students, inside the classroom or at home, working to a set framework. The tool can be effectively used to change the routine class dynamics or as motivation booster in the learning process.

1.1 Novelty of Bitstrips

Since 2014, the application can be shared in real time through social networks. It is currently popular with the young frequenting the Facebook, in imitation of a number of other novelties that managed to arouse general interest. It enables the user to produce an idealised virtual version of oneself which – given the form of an actual comic-strip episode – can be shared with friends on the Facebook profile. The application is easily downloaded free of charge from Google play [1].

2. BITSTRIPS

2.1. Description

Bitstrips is a software tool for creating comic strips. 'Bitstrips for schools' is an educational application, intended both for teachers and students [2]. "It is very simple and entertaining, while at the same time offering diverse opportunities, from illustrating characters and scenes from a novel, to creating one's own story, to presenting complex scientific theories", is a comment supplied by Jugoslava Lulić, Serbian Language teacher in the secondary technical school ‘9th May’ from Bačka Palanka, in an article published by the Microsoft *Partner in Learning* magazine. [3]

The software is free for the first 30 day’s trial and it does not have to be installed, which offers considerable advantages for use in school. The monthly subscription for a teacher is USD 9.95, for a class of up to 40 students. More classes can be included at a charge of USD 4.95 for each additional class. Annual subscription for a school is USD 1.5 per student, provided that the school has a minimum of 200 pupils. The use of the tool is somewhat limited due to the fact that being available only in English and French, it has no Cyrillic Alphabet as one of the options.

2.2. Registration

It is necessary for the teacher first to register at the application portal and create a list of the virtual class, i.e. to make corresponding ‘student entries. Each student will log in using the class code created by the teacher, with a possibility to change their ‘avatar’ – the way they are seen by others in the same class, i.e. they wish to present themselves to the others.

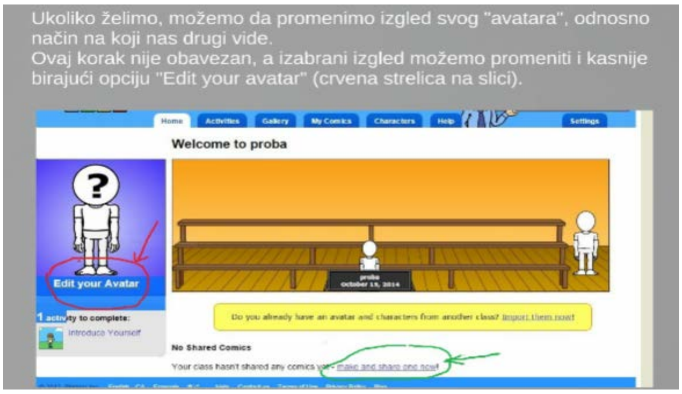

Figure 1.*Istnructions for pupils are posted on the website of the Math Club[4]*

2.3. Production of comic sttrip

Production of a comic strip using Bitstrips is not at least complicated. It is necessary to adjust the following options: **Layout**, **Art Library**, **Text Bubbles**, **Controls** and **Filters.**

2.3.1. Layout

This option allows setting the number of squares or scenes (panels) which is required for the planned comic strip. Regardless of the shoed layout, the title of the comic strip must be entered into the **Title of Strip** filed. This can also be the title of a unit of the corresponding subject. The space to the right from the title is reserved for an optional entry of the comic strip author. The **Border** option in the top right corner can be used to change the colour of the border.

Figure 2. *Overview of Layout option*

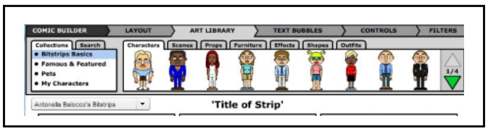

Figure 3*. Art Library option*

In the same way, options **Sky** or **Ground** can be used to change the colour of the scene. (*Fig. 2.*)

2.3.2. Art Library

Adding figures and/or objects is performed by dragging to the corresponding field. Using the green arrow (*Fig. 3.*), we choose the most suitable character from the gallery; alternatively, we it is possible to use a character created by the user themselves using the **My Characters** option.

2.3.3. Text Bubbles

The appearance of the text bubble is chosen depending on the type of communication (*Fig. .4.*) It is possible to use the corresponding font options as ell.

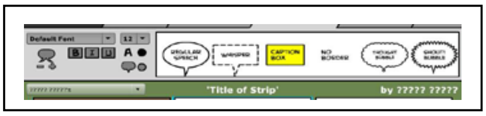

***Figure 4**. Text Bubbles option*

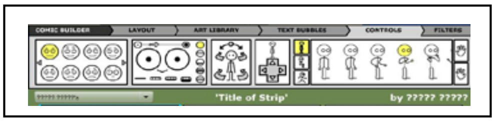

***Figure 5.** Appearance of Controls option on the screen*

2.3.4. Controls

By using the Controls option, it is possible to change characters' face expression, to reflect a particular mood. This option also allows different body postures and movements (*Fig. 5.*).

2.3.5. Filters

This option is used to give an image a blurred or dimmed appearance.

2.4. Bitstrips used in curricular activities

The first comic strips dealing with contents of presenting certain Mathematical units were created within the 'Kefalica' Math Club. Some of these deal with a subject unit, whereas others focus on a relevant point, such as the one shown in the example (*Fig. 6.*). Pupils of years 7 and 8 produced comic strips in relation to many different topics, which at the time of making helped them to consolidate the learning input, as well as to prepare for the final examination. Some of these works are posted on the Club website [5]. The same works were later used by the teacher to present units in grade 5, as well as to familiarise pupils with the possibilities of using this tool. In the implementation stage, year five students worked in smaller groups according to their abilities and guided by clear instructions regarding the part of the unit to focus on, eventually producing their own comic strips. Bitstrips provides teachers with a possibility to assign mentor-guided homework, meaning that student's initial ideas can be revised by the teacher directly within the work produced by the student. It is also possible for other students to contribute suggestions and comments aimed at improving their peers' production.

One of the groups of pupils were insecure about their possibilities and knowledge, and decided not to publicise their strip in the previously created virtual class, together with works produced by other groups. Instead, they chose to e-mail their work to the teacher. There were many students who actually wanted to improve different aspects of their works, and they came up with several different comic strips dealing with the same topic. These works were later used to consolidate the learning subject prior to the written test.

2.5. Bitstrips used in exttra-curricular activitites

Topics (*Fig. 9.*) were produced by pupils attending grades 5-8, members of the 'Kealica' math club. The club also has members from junior grades, starting from grade one. After seeing the works on the club's website, the younger pupils also took a great interest in this type of activity, so that senior-grades pupils eventually taught their junior club-mates how to create their own comic strips. Their works deal with rules of conduct in the classroom, in the class and the school building (*Fig. 7.*) and yard, as well as with anecdotes from math classes shown in 'Funny Maths' rubric (*Fig. 8.*) of the 'Matiš' fanzine [5].

Figure 6. *Bitstrips in curricular activities*

Figure 7. *Bitstrips in extra-curricular activities*

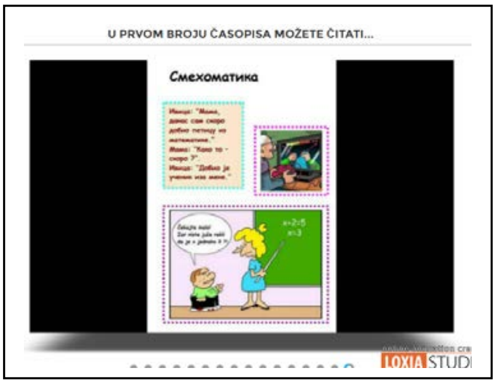

Figure 8*. Bitstrips in math fanzine*

Figure 9*. Virtual class of math club and some of the topics addressed by it*

2.6. Other advice

Not only did students of the contemporary digital generation find it relatively easy to research the possibilities of the Bitstrips program, but they also found a lot of pleasure in this work and a challenge they gladly lived up to. The problems they encountered were mostly the following ones:

- choosing the topic,

- processing the topic (colleting the data and – even more than this – recognising the relevant facts),
- choosing the way of how to present the facts (in a humorous or 'scientific' manner),
- choosing the setting for their plot,
- creating a dialogue,
- establishing and creating the character profile for their protagonists.

The time required for completing a comic strip depends on the student's affinities, their freedom of expression and knowledge of facts. The process is made easier by the fact that this time is not limited to the frame posed by a school lesson. Knowing all this, the teacher ought to take care of the following:

- good organisation of the lesson,
- giving precise instructions regarding the work done from home,
- incentives for collaboration,
- assure his or her availability for any assistance the students may need.

Production of an educative comic strip teaches a student how to learn, developing their creativity and team work skills, together with tolerance, appreciation of opinions stated by others and critical thinking. This is an opportunity for a student to revise and widen their knowledge, learning how to summarise his or her own ideas. Students who read the comic strip created by either the teacher of their peers are given an opportunity to observe relevant facts presented in an interesting manner, supported by examples of practical use of the object of learning, thus stimulating the visual experience.

3. CONSLUSION

Parents used to limit the reading of comic strips for their children, believing that this medium has a limiting impact on the child's vocabulary. And they had a good reason for this, knowing that reading a book would be much more useful. However, in the present-day situation when children either have no time or enough interest for reading, this method of work actually helps to enrich their vocabulary. It is a challenging task trying to formulate adequate phrasing to present key concepts that must be presented within the limited area of the speech bubble, containing the gist of information for the reader. This is a process that demands a research into the limited number of appropriate options. Bitstrips is a simple tool conducive to creative learning, encouraging collaboration and communication. Learners can be set either independent or group assignments. As a safe tool which enables monitoring of the student's progress, it can be used in the teaching process of any subject, as well as a means for facilitating a range of skills development in extra-curricular activities for students of different ages and abilities.

The Bitstrips blog [6] contains a number of comments and impressions by the users around the world. They are all highly positive, such as the flowing comments made by teachers:

- "I just wanted to let you know that my students love Bitstrips for Schools! What an awesome and safe teaching tool. My kids think that I am the greatest. Thanks so much for creating such an engaging website...", Michele Zoccoli, Virgil Public School;
- "My students are addicted to this program. I could hardly keep them off it, and they were happy to have new assignments and complete them so they could share with the rest of the classes. Having a purpose in playing really kept them interested in what they were doing. Some of my most highly reluctant writers were among the first to accomplish the assignments I gave, and proved that they can write after all. With this program students don't have to be limited by their drawing talent. And

the feature where we can upload and even search for our own images will mean that anything we can think up is possible!“, Shannon Powell, Central Montcalm Middle School;

- “I would say that this is one of the best educational applications of all times.” Royan Lee, Sixth Form Teacher, Charles Howitt Public School.

Here are some of the parents’ coments:

- “Phenomenal... Kids absolutely love it and I think this is an excellent tool helping the language development and medial literacy. The level of collaboration between the children is unreal. The fact that kids can share their cartoons and post comments and flags for inappropriate cartoons contributed by other students is really a wonderful thing...“, Ray Mirshahi, Timberbank Clicker Center Coordinator.

The application blog features a number of posts with comic strips created by users around the world, organised around different topics, which can be used in their entirety in developing and implementing a teaching plan, or as an example of how to crate certain content.

RECOGNITIONS

The ‘Matiš’ mathematical fanzine produced by the pupils – members of the Math Club of the Tanasko Rajić elementary school won the first place at the 4th School Publishing Fair of the Moravički Region in the academic 2014/2015. [5]

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[4] Website of Math Club “Kefalica”:http://ucionica17.weebly.com/korak-po-korak-do-stripa.html
[5] Website of Čačak Central Schools Administration: http://www.skolskaupravacacak.rs/oblasti-rada/struno-usavravanje/1088-pobednici-cetvrtog-sajma-skolskog-izdavastva.html
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Some examples of using One Drive in establishing more interactive cooperation of students, teachers and parents

Snežana Mijailović[1], Draško Simonović[1] and Danka Đokić[1]
[1] Gimnazija „Takovski ustanak“, Gornji Milanovac
e-mail gimnazgm@eunet.rs

***Abstract**: This paper will present some opportunities offered by cloud service OneDrive, through examples of good long-term teaching practice in High school "Takovski ustanak" in Gornji Milanovac. The areas covered are: evaluation and self-evaluation of students' and teachers'work; exchange of good teaching resources, work on projects and cooperation with parents. The aim of this paper is to introduce the opportunities and positive effects of the appliance of OneDrive in education to the wide audience of teachers and to encourage them to apply it in their work and contribute to their professional development.*

***Keywords:** (self)evaluation; project; good teaching practice; cooperation.*

1. INTRODUCTION

The modern teacher has the task to constantly monitor and implement the new information technologies in working with students. The possibilities for application of Cloud computing are endless. What remains to us, the teachers, is to devise ways to implement ICT as much in our daily work.

In the next section, an example of the application of resources offered by the OneDrive will be shown. The method described in this paper is in use for several years. The explaination of the examples includes the advantages of this kind of work and it gives the other teachers the idea how to use OneDrive in the same or similar way.

2. THE APPLIANCE OF ONE DRIVE IN EVERYDAY ACTIVITIES IN SCHOOL

2.1 Description of OneDrive service

OneDrive is the free Microsoft service that enables storing documents in the “cloud” (cloud computing). Storing data in the cloud allows you to always have a backup copy of your data, but also to access documents from any device and from any location. You can share files and folders so other people can edit, view, or comment on them. There are several ways to use Google Drive: using a browser (go to drive.google.com), downloading the app (for Android or iPhone/iPad), downloading the desktop app to automatically sync files from your computer. You automatically get 15 GB of storage for free and you can buy more storage. All these files can be accessible the public on the Internet or be integrated on your website or blog. OneDrive can be used as online Office applications such as MS Word, Excel and PowerPoint, and offering additional features such as online surveys and questionnaires, calendar. There is a possibility that the same document can edit multiple people simultaneously, and you can assign people the rights to view or edit document as desired.

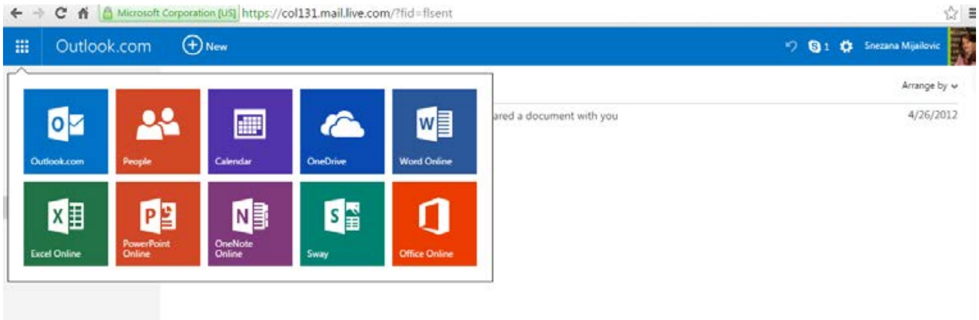

Figure 1. *One Drive environment*

2.2 Using OneDrive in evaluation of student achievements

According to the legal regulation the process of monitoring and evaluating student progress should be a continuous process. The focus of this process should not be a teacher and his/her obligations that is faced with but the student who needs to become aware of his work and progress during the educational process.

The possibilities of OneDrive system can be helpful. The disk space in the "cloud" can be used for data storage. In addition, we have complete control of who can and who can not see documents or entire folders with documents. There are folders with the names of students who are registered in the contact list. Each item of student work is stored in the appropriate folder. A folder is shared with a particular student and all the contents of that folder is visible only to the student. This concept of work allows us to greatly differentiate and individualize their work. In particular, it relates to homework. In the students' folder is a task that is created based on the students' abilities but on the other hand contains stimulus for his/her progress. The student works using programs like MS Office or works on paper that is scanned and placed in the Cloud. They get instant feedback with guidelines for troubleshooting, if they exist. In this way the work is adapted to each student or group of students because it is based on the students’ work, respecting their individual abilities, skills and aptitudes. In accordance with that, the teacher adjusts the teaching content, requirements, methodology and methods of work. All this is a condition for the elimination of low efficiency of teaching and educational work in general.

Another important area of work is the evaluation of student achievement - designing knowledge tests and control tasks. After making tests teachers evaluate their result. Cloud computing applications additionally provide more efficient work and opportunities for students to learn from their mistakes. After the examination of the papers, teacher scans and places the papers in the appropriate folders in the cloud whose contents only the particular student can see. The student can immediately carry out an analysis of his/her work, notice the errors and study further the sections of the course in which there are weaknesses. So, in the first place there is an individual analysis of the test and only after that a collective analysis of the test is doing in the classroom. A very important advantage of this kind of work with students is that students have access to all of the work during a schoolyear and they can constantly go back and re-analyze them. On the other hand, the teacher has a personal collection of students' tests in electronic form that can easily access, analyze and based on the results teacher can plan and program his/her work but also work to address the identified shortcomings.

2.3 Using One Drive with projects

Another aspect of using cloud computing is writing seminar papers or doing project activities. While doing these kind of activities, the students have the task to break the complex problems to simple parts and each member of a team does the part that is in accordance with his/her affinities and abilities. Cloud service enabled a new approach to students creative process of creating common documents. The possibilities of public sharing and editing of documents are of great importance for students and their projects, and they are more effective, original seminar papers and projects are easily completed. Students mostly use OneDrive in their projects and seminar papers and this is established standard.

2.4 Using One Drive at exemplary classes

The regulations on the professional development of teachers, concerning the development in the institution, provide the obligation of professional training for a period of 44 hours, including the performance of the exemplary classes and presence to them. Exemplary class is an example of good teaching practice in terms of appropriate usage of innovative methods and forms of work with students. The fact is that teachers are not coping well with this requirement and often do not know how their class should look like to be called exemplary. For this reason, the exchange of experiences in performing exemplary classes among the teachers all around is very valuable. The following picture (Figure 2) presents the materials which are placed in the cloud and can be accessed using this link [13].

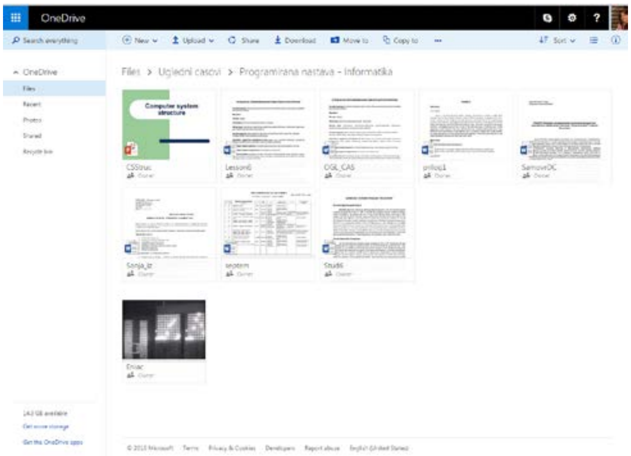

Figure 2. *Exemplary classes' materials*

The materials that are included are very extensive and includes the month teaching plan, teaching material for the class (presentations, text documents, video files), self-evaluation report of teachers (self-evaluation and correction) and the reports of the pedagogue and all of the teachers who were present in the class. In this way, evaluation and self-evaluation of the students and teachers are being done that provides professional development of the teachers inside the institution, but using a cloud service, the professional training receives a broader context - the possibility of easier access to these resources helps teachers who experience difficulties in organizing this kind of class.

2.5 Everyday communication between a homeroom teacher and parents using OneDrive

Good communication between a homeroom teacher and a parent is very important to ensure monitoring the progress of students. OneDrive, with its resources offers the possibility of daily communication via an email address. In order to support parents, the school organises workshops first, where they receive detailed instructions on access to information related to their children (success, absenteeism, list control exercices and written assignments, notices regarding parent-teacher meetings…). All parents of students who have submitted an email address have access to OneDrive group formed for the department which the student belongs. The parent has access to data that shows the achievement of the department and the folder in which there are information about all students, but each parent has the access only to folder containing the information about his/her child. A parent can see the achievement of his/her child and two forms: a notification for homeroom teacher and for a parent. The notification for the homeroom teacher is filling in the following manner (Figure 3):

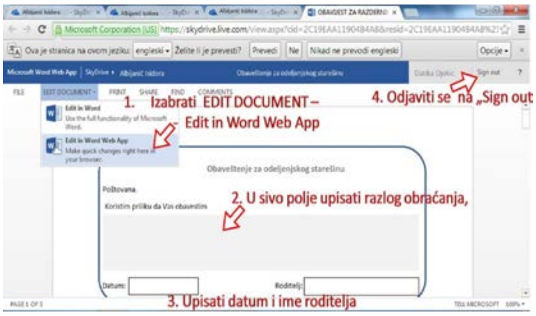

Figure 3. *Data about the student*

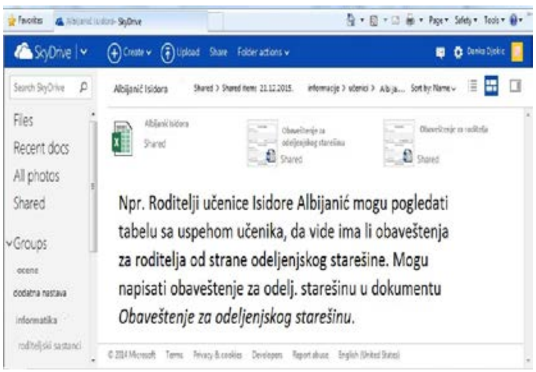

Figure 4. *Notification for the homeroom teacher*

This way of communication between parents and the homeroom teacher is very comfortable and above all free. Almost all parents have access to the Internet via desktop computers, tablets or, at first, smart phones and that's why they can often be in contact with homeroom teacher and found out important information about achievements and behavior of their child. Of course, considering that this is only a possibility, but not the obligation of the teacher, the teacher is someone who determines whether or not use the cloud service.

3. CONCLUSION

The development of the modern society demands from each individual constantly to improve knowledge and skills of ICT in everyday life. Considering that the modern man is still in a race against time, given examples of applying service OneDrive in everyday school activities describe that very easily and with minimum effort, the activities of teachers, students and parents can become much easier and faster and responsive to all actors, in order to achieve a common goal: the constant improvement of students. Applying the above service, communication between teachers and students achieves a remarkable level because there are the great opportunities to take the necessary corrections opening up the new opportunities for professional development of teachers through easier and more effective exchange of best practices, while cooperation between the parents and homeroom teacher, which is performed if necessary, takes on a higher quality, taking into consideration that it is a common occurrence, due to lack of time, the parents are not always able to follow the work and progress of their children. The above examples are just a few of the countless possibilities offered by this service, and what is its greatest quality is that it allows greater interactivity of collaboration between the student-teacher, parent-teacher and vice versa. We hope that the examples given in this paper will stimulate teachers to implement some of their ideas in this or a similar way.

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Using PowerPoint presentation in teaching

Olivera Iskrenovic-Momčilović[1]
[1]Faculty of Education, Sombor, Serbia
e-mail oljkaisk@yahoo.com

Abstract: *PowerPoint has become very popular presentation software used in educational settings. This paper presents the analysis of the use of PowerPoint presentation in teaching. The paper presents the results of a survey conducted among the students of the Faculty of Education in Sombor. These results show that teachers often use PowerPoint presentations in class, because in that way increase the motivation of students. Half of the students believe that the biggest obstacle to the use of PowerPoint presentations still lack sufficient competence professors, and should be provided with more training seminars and courses.*

Keywords: *student; professor; PowerPoint presentation.*

1. INTRODUCTION

Today's students belong to a generation where the use of computers, the Internet and the mobile phone has become an inevitable part of everyday life. When teachers use it in their classrooms, in fact, they want to attract the students' attention, so that they can enhance effective ways of learning (Lari, 2014). The use of new media is a traditional training classes, dominated by the teacher with his speech and tutorial as the most important medium for transmitting and receiving information (Stevanovic, 2003).

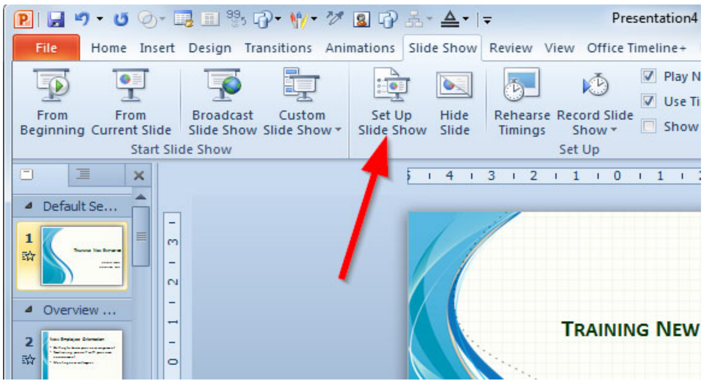

Figure 1. *PowerPoint presentation as slide show presentation*

The main characteristic of modern education is the use of computers in education. The increasing availability of computers and projectors has enabled the use of PowerPoint presentations (Fig.1). PowerPoint has become very popular presentation software used in business and educational contexts (Ackilan, 2011). It allows you to present information in a visually effective format, usually in the form of automated, an interactive slide-show presentations. The multimedia learning environment uses several types of representation including text, audio, graphs, photographs, animation, or video (Lai et al., 2011).

Information better remembered if it is received via multiple senses. Information received sense of vision are better memorized information received from the sense of hearing, because more than a third of the cerebral cortex deals with processing of visual information. Students will be new material to be much clearer if the professor monitors multimedia PowerPoint presentations.

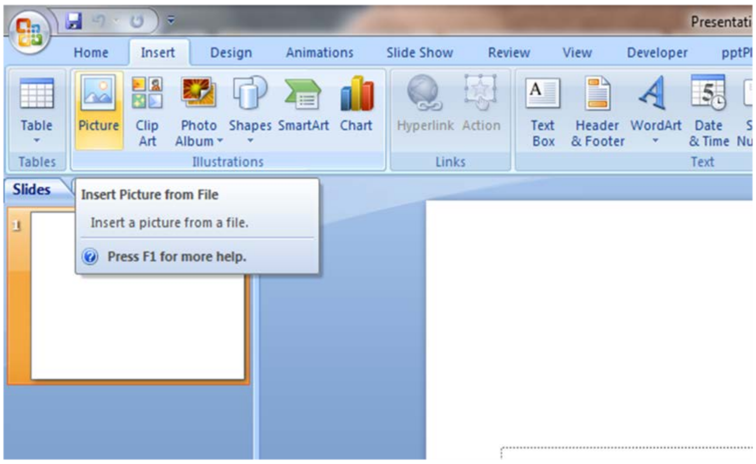

Figure2. *Insert picture from file in PowerPoint presentation*

"A picture speaks a thousand words," and therefore to the text of the presentation must be installed images, animations, video, or sound files (Fig. 2) All these embedded elements will attract more attention to students. They will enable the students to remember the exposed material much faster and better than when slides containing only text. Of course, it should find a balance between the text and other elements of the slide. Effects animation should be used cautiously, otherwise their inadequate application can have negative posledeci. Lindstromberg (2004) finds that interesting lecture should include some of the following elements:

- diversity (4-6 different types of activities),
- use non-linguistic material (images, music)
- activities with elements of games, fun and humor,
- occasional surprises.

Practice has shown that well-designed PowerPoint presentations, which contain all of these elements, but inevitably improve the quality of teaching.

Creating a PowerPoint presentation requires additional time and a certain level of computer literacy of teachers. However, lectures supported by multimedia Power Point presentations are far more efficient and more interesting than the traditional lecturing. The effectiveness of classroom use of PowerPoint presentation may be partially determined by professors' teaching styles (Brock et al., 2011). Compared to other traditional methods of teaching, PowerPoint presentations provide a range of benefits (Gal, 2007):

- time savings (no writing on the blackboard, dictation),
- possible reuse,
- can change the on-site,
- simultaneous use of text, images and sound,
- the ready availability of web site,
- slides are kind of teaching materials, which supports different learning styles,
- slides can be printed.

In the main, the results reported in journal articles indicate that students like to be taught using PowerPoint (perhaps because of its novelty and the availability of printed handouts of PowerPoint slides) and think that PowerPoint presentations are entertaining, enhance clarity, and aid recall of subject matter (Craig et al., 2006).

2. METODOLOGY OF RESEARCH

Training teaching is an important link in the education and upbringing of young people. The main objective of the research is to analyze the application of PowerPoint presentations in higher education. In accordance with the research, the process of the research was conducted using an anonymous survey. The research was conducted on 165 students of the fourth (final) year of Faculty of Education in Sombor. The sample is representative and given the size of the sample, some generalizations are possible.

The reaserch used a poll of five questions, which are defined to be clear and understandable. Students were asked questions by circling one of the multiple choice answers. Questions are set to refer exclusively to the objective to be achieved.

This research should contribute to the quality of teaching. First of all, should point to the use of PowerPoint presentations in teaching in order to facilitate the work of professors and students.

3. RESULTS OF RESEARCH AND DISCUSSION

Question 1 Are professors use PowerPoint presentations in teaching?

a) never

b) rare

c) often

All students responded that professors often use PowerPoint presentations in teaching. This shows that the teachers are aware that young people spend most of their time they spend front of the computer, not the end of the book. Therefore, teaching should be directed toward the computer..This is the only way for students to quickly and efficiently accept the teaching material, which is usually grossly unreasonable.

Question 2 Assess the level of competence of professors for use PowerPoint presentations?

a) bad

b) median

c) good

The largest number of students 60% of them believe that a median level of competence of professors for the implementation of PowerPoint presentations, 27% said it was good, and only 13% of that is bad (Fig. 3). It is generally known that the professor should apply computer in teaching and harmonize their practices innovation in education. Regardless of the results, today must be a systemic approach to professional training of professors for use of computers in teaching.

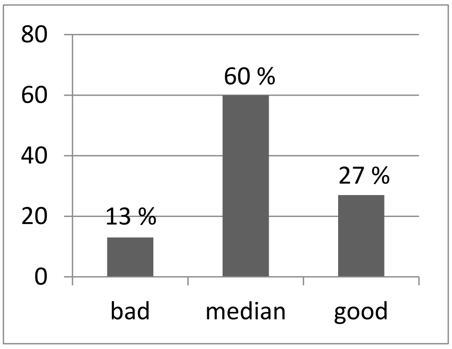

Figure 3. *Competence of professor*

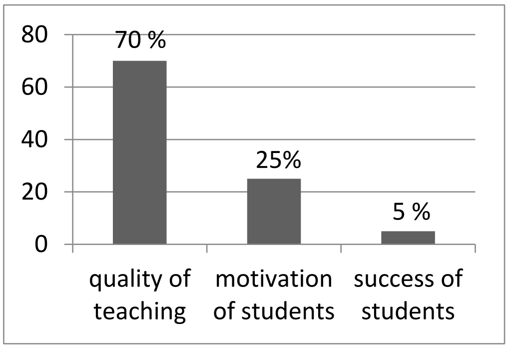

Figure 4. *Contribution of PowerPoint*

Question 3 Which aspects of the major contributor to the application of PowerPoint presentations?

a) quality of teaching

b) motivation of students

c) success of students

Slightly more than two-thirds of the students, 70% believe that the application of PowerPoint presentations largest contributor to the quality of teaching, 25% of students' motivation, but only 5% of the success of students (Fig. 4). All this suggests that modern teaching, using PowerPoint presentations, in every respect has become better and better. Unlike traditional classes, student is now active, more motivated to work more easily adopt new content and progressing in accordance with their abilities. Multimedia PowerPoint presentation has provided a wide range of options to make it more effective monitoring of teaching (Topalovic, 2014).

Question 4 What is the biggest barrier to the application of PowerPoint presentations?

a) lack of technical support

b) lack of competence of professors

c) lack of willingness of professors

Just over half of students, 55% said it was the biggest barrier to the implementation of PowerPoint presentations lack of competence of teachers, 35% of the lack of willingness of professors and 10% lack of technical support (Fig. 5) Average knowledge professors iy field of information comes down to knowledge of the program for writing text, e-mail communication and Internet content search. Working in PowerPoint program requires greater competence for digital teaching materials and optimal use of specific computer equipment. Although there is a great desire professors to broaden their knowledge, teachers are still not sufficiently prepared to cope with all the possibilities of PowerPoint program. For most of these seminars and courses to create PowerPoint presentations are still inaccessible due to the difficult economic cont'd. This usually compensate for lack of experience exchange with more experienced colleagues.

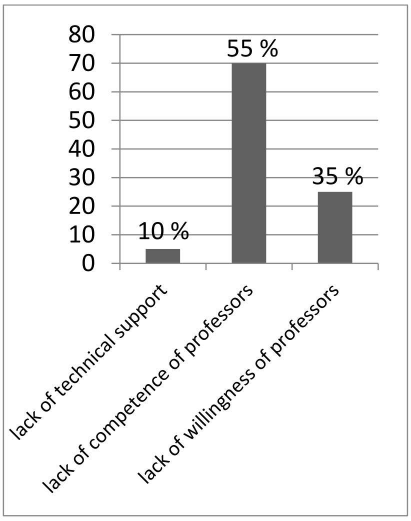

Figure 5. *Barriers for PowerPoint*

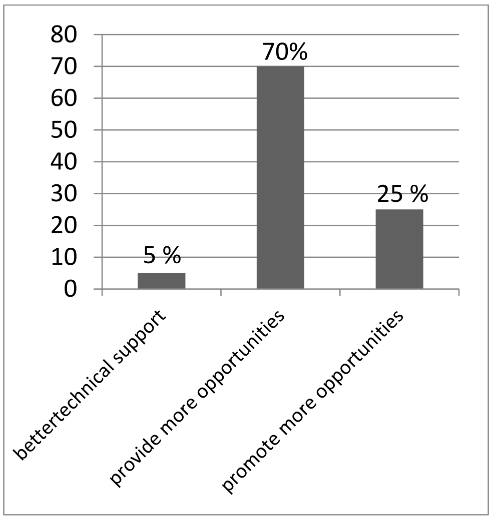

Figure 6. *Level of competence of professors*

Question 5 What should be taken for greater use of PowerPoint presentations in teaching?

a) provide better technical support in educational institutions

b) provide more opportunities for competence development professor

c) promote more opportunities available to improve the quality of teaching

Most students 75% said it should be provided with more opportunities to develop competencies professor for greater application Powepoint presentation, 20% to be more promotion opportunities available to poboljđanje quality is teaching, and only 5% said it should provide better technical support in educational institutions (Fig. 6).

It is often heard in everyday life "Computers are just tools, fale us masters." All this shows that the need to create better conditions for the development of the competences of the application PowerPoint presentations in teaching. One way of organizing internal training, which will provide an opportunity to gain practical knowledge and skills to work in the PowerPoint program. It is good, because its duration and tempo can be adapted to the level of knowledge of the individual. Regardless of all this, in practice, rarely meets internal training aimed at demonstrating the successful application of PowerPoint presentations in teaching different subjects. Following a good way to extend the competence of professors are on-line courses, especially when the weather is not conditioned. The selection of on-line seminar is rich and varied, but it is still present insufficient number of those who provide information on the practical application of PowerPoint presentations in teaching specific subjects. All this suggests that we should provide as many professional seminars on proper and creative use Powepoint presentations in teaching by making trained and patient teachers with each teacher individually worked. Today, we should pay special attention to the promotion of opportunities PowerPoint program, but Ii all other options to improve the quality of teaching. It should work through all available media, using television or the Internet daily press. In parallel with these activities needs to work on procurement of new and bbetter technical support in educational institutions.

4. CONCLUSION

Today, the use of PowerPoint presentations in the classroom has become an indispensable part of modern education. PowerPoint presentations can receive information through different senses, because it represents a combination of different visual and audio elements. It increases the motivation of students and activates them to participate actively in class to enable you to master the material.

Classes can be performed in the traditional manner using chalk and blackboard, but it does not suit a time when students are overwhelmed by the developments in information technology. Students with much greater attention to follow the instruction when using PowerPoint presentations, because it is a rule interesting and curious.

For use PowerPoint presentations in teaching requires a certain level of computer literacy, which requires constant monitoring of the professors and learning informatics. In order to do that successfully implemented, should provide a variety of seminars and courses, as well as better and more accessible information technology literature. Today is a professor in the preparation of teaching can not rely solely on the textbook as the main source of information than constantly be up to date with trends in education and implement new forms of teaching that will best suit their students.

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The mobile learning classroom potential

Ivan Jovanović[1] and Veljko Aleksić[2]
[1] OŠ „Svetozar Marković“, Kraljevo, Serbia
[2] Faculty of Technical Sciences Čačak, University of Kragujevac, Čačak, Serbia
e-mail ivanjovanovic17@gmail.com

Abstract: *Mobile learning construct has been present in the field of education for more than a decade. Intuitively, it was expected that the mobile technology development as one of its basic characteristics will directly influence the teaching practice. However, trend of implementation to large extent does now follow social changes.*

Keywords: *implementation; mobile learning; teaching*

1. INTRODUCTION

Generations of students who are now in one of three levels of formal education were born during the existence of mobile technologies and the Internet, so today they are proficient and effective users of computers, mobile phones and a variety of modern communication devices. Mobile learning (M-learning) involves using of portable devices for educational purposes, and to many teachers is still unknown. It is based primarily on the wireless Internet and online access to information. It can be viewed through the prism of the e-learning-based learning in different contexts by using mobile devices. Students may use their mobile devices anytime and anywhere, thus gain a new and interesting learning experience. Introducing students to the techniques of using mobile devices in education is valuable, especially for the professions where these devices has become indispensable.

Traxler and Dearden [12] criticize the view on m-learning exclusively in accordance with its technical orientation, and point out that it should be based on the perspective of the user who is taught in the context of the communication. Brown and Green [1] stated that the m-learning is the natural expansion of e-learning and categorize it as a subset. However, through the implementation, researchers realized that it has different characteristics. According to Keegan [7], there is continuity in the functionality of the devices used for e-learning and m-learning, so he does not see a clear boundary between these two approaches, and considers that the proper identification should be based on mobility, not functionality.

By analyzing the mobile learning approach, we have identified certain important features. M-learning can be implemented anytime and anywhere, while preserving the interaction between teacher and other students so that it integrates a multitude of resources into the process of learning. It is commonly used as a complement and support to other types of learning, not as a replacement. The technologies used for its implementation are cost-effective and widespread. Giving students the responsibility for managing the process of learning, it raised motivation and self-confidence.

M-learning should be seen as a support for lifelong learning and facilitates digital literacy of the population that uses it [6]. It is not sufficient to train students for independent information retrieval. They also need to manage and analyze information in order to turn it into useful knowledge. Digitally literate individual understands the role of the computer as a collaborator in the process of searching and processing information, but is also aware that the success of this process depends mainly on itself and not by the technology that is used. By actively using mobile technology they acquire specific knowledge and skills. Students have the opportunity to attend programs that interest them, even if they are not offered by the educational institutions in the places where they live or work.

Is not always necessary to design and use specific application for learning and distribution of educational content on mobile devices. Usually it is enough to adapt it to the basic functionality of the devices and to adjust it to the display limits.

The modernization of educational technology as an integral part of the teaching process is inevitable in this technological moment. The concept of knowledge is changing. Modern education requires transformation towards a model of active knowledge construction. Teachers and students are becoming partners in building the knowledge base.

2. GOOD PRACTICE AND TEACHING PERSPECTIVE

One of the drawbacks of traditional teaching is restraining the individual characteristics of students. The teacher is not able to give equal attention to each student individually within a class with limited duration. Students are forced to gain knowledge at a pace that often does not match their abilities or desires, and must catch up with the curriculum. M-learning allows students to bridge this gap.

Technical equipment of most of the Serbian schools is far below EU standards, but almost every student has a mobile device that can be a new source of knowledge. This new "book" is a comprehensive, information is easy-to-find and it is practically free.

When we talk about the possibilities of m-learning in the creation of new content and sharing them with the broader community, we must emphasize podcast technology [13]. It is a mode of communication that allows creating audio files and its global distribution so that everyone can access them anytime and anywhere. Podcast is often present in the practice of teaching foreign language, but can be used in the context of any other subject. Especially important and useful lessons can be recorded via mobile devices and uploaded online.

Application of new communication technologies in the educational process involves continuous monitoring and acquisition of new knowledge and experience in these areas. IT and digital literacy is essential mainly to teachers, who are expected to achieve interaction with students in the modern technological environment.

The results of PISA and TIMSS tests clearly indicate that the teaching process in Serbia must improve, innovate and adapt to the needs and interests of modern students [4]. Classes in Serbia are still traditionally taught, related to the blackboard, chalk and frontal mode. Despite the desire to place student at the center of education, the focus is still on teachers.

There is practically no application that cannot be used for m-learning. The only limiting factor is the technical characteristics of the mobile device. For example, modern geography lessons are inconceivable without using modern technologies, such as Google Earth [11]. Thanks to the Google Drive and Kingsoft Office applications, electronic notebooks have been developed, so that each student can access information when and where needed on the mobile phone or tablet instead from a backpack packed with books.

Two leading popular free aplications for the implementation of m-learning are Pear Deck (https://www.peardeck.com/) and Nearpod (https://nearpod.com/). They allow teachers to present controlled content via their laptop, tablet or smartphone on student devices [2], and currently represent the most quality solution for synchronous classroom use of mobile devices. Schematic view is presented in Figure 1. A teacher can show a prepared presentation while the students monitor it on their devices and meet the interactive content in the form of short examination, or other forms of open questions, drawings, etc. Further, the teacher receives direct feedback from students. Using these applications, we are able to dictate the pace of learning by changing the content of the slides which motivates students, and focus them on interactive, dynamic and interesting lectures.

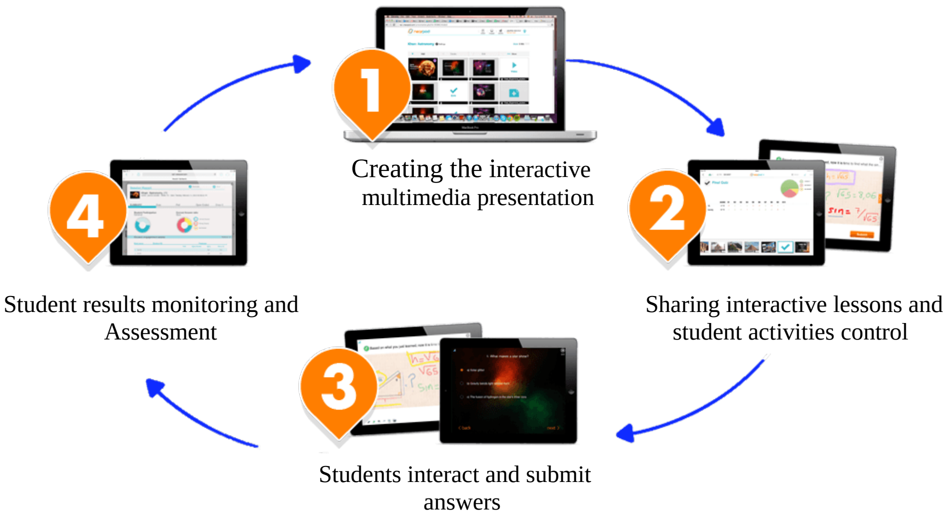

Figure 1. *Syncronious classroom mobile devices usage*

Pear Deck application is closely related to Google services, making it more functional. Its trial implementation began in March 2016 in the primary school "Svetozar Marković" in Kraljevo (Serbia) within the required elective course “Informatics and Computing” in 8th grade, and in the period of the first month of use gives encouraging results. The results analysis and application possibilities are topics of future research.

An overview of current projects aimed at the development of m-learning is the first step of the analysis of m-learning possibilities. *MOBIlearn* is a project that demonstrates the latest achievements in the research of new generation paradigms and interfaces for technology-assisted learning in a mobile environment [10]. The new architecture of m-learning supports the creation, delivery and monitoring of educational content using personalization, multimedia, instant communication messages (text, video) and distributed databases. The aim of the *HandLeR* project is the development of personal handler of mobile technology for learning, based on the understanding the ways in which people learn in different contexts. Questions that are explored are the concepts of mapping, sharing knowledge, lifelong learning and wearable technology learning [5]. The *mGBL* (mobile Game-Based Learning) is developed by the organizations from UK, Italy, Croatia, Austria and Slovenia. It is aimed at development of a platform for the educational content presentation on mobile devices using digital games [9].

3. CONCLUSION

Research [3] [8] show that students are satisfied in the process of m-learning, do not have objections to uneven criteria, while the grades that they received are higher on average. In order to follow the trend of innovative technology the educational system must introduce mobile devices in the daily classroom practice. M-learning in Serbia is still underrepresented, nor is developed. It is necessary to educate teachers about the possibilities of m-learning in order to change their attitudes and accept that it may be productive as the traditional approach, if not more. The introduction of m-learning in the school system involves the realization of a few basic conditions: the organization of support systems, training teachers and staff for technical support, and strategic commitment to the systematic introduction of information technology in teaching.

It can be expected that the educational process will be significantly improved by the creation of new learning materials with a visually appealing multimedia content including interactive and contemporary information that can be used multiple times. New technologies open the door to alternatives to classical teaching methodology that passivated pupils which often were not sufficiently motivated.

The problems of m-learning development and implementation in Serbia is not just about the educational system, but the society at large. The question is how much the social environment is ready for the influx of new technologies in education. Parents generally support the introduction of new technologies in education, but often carry the belief that the way in which they were taught is also suitable for their children, so that any alternative approach is wrong.

M-learning started its life as an experiment, but the development of new technologies cramps its way for future implementation. It is only the matter of time when the m-learning will become one of the recognized and identified tools in the production of modern educated individuals.

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Informal learning via Internet forum

Miloš Papić[1], Nebojša Stanković[1], Boris Jevtić[2], Nenad Pantelić[1]
[1]University in Kragujevac, Faculty of Technical Sciences, Čačak, Serbia
[2]RAF Faculty Belgrade, Serbia
e-mail milos.papic@ftn.kg.ac.rs, nebojsa.stankovic@ftn.kg.ac.rs,
boris.jevtic10@gmail.com, nenad.pantelic@ftn.kg.ac.rs

Abstract: *This study examined students' attitudes about general issues related to internet forums, as well as about their advantages and disadvantages. The questionnaire, consisting of three parts, was specially prepared for this research. The study included 165 students from the Faculty of Technical Sciences Čačak, of which 150 said they used the internet forum, so their estimations were relevant for this study. It was found that the students are well informed on what internet forum is, that a large percentage of students use it and that the internet forum has more advantages for learning than disadvantages.*

Keywords: *internet forum; informal learning; discussion; participant; survey*

1. INTRODUCTION

Formerly, in the Roman era, forum was a square where people used to gather and exchange views. Today forum represents the place on the Internet where people who are interested in a topic or have a common interest, gather and exchange their views and opinions (http://informatikazaos.blogspot.rs/2015/11/3_45.html).

Internet forum is a web 2.0 tool for organizing public discussion "at a distance" whose contents is created on a certain theme by the discussion participants. In the literature, internet forums are also called: electronic forums, web forums, newsgroups, discussion forums, message boards, discussion boards, bulletin boards or simply – forums (Papić & Aleksić, 2015).

Discussion forums are the most significant applications of computer-mediated communication in E-learning environments (Kearslei, 2000 in Shana, 2009). According to Shana (2009), web discussion forums provide a way for students to extend the classroom discussions. It provides better cognitive and exploratory learning, increased student-to-student discussion and cooperation, superior learner empowerment, and upgraded critical thinking skills.

According to the estimations (Stefanović, 2014), there are currently over 110.000 internet forums on which a certain form of informal learning is conducted daily, by active participation of participants.

The authors therefore wanted to review the students' opinions regarding general knowledge about internet forums, the degree to which they use it and for what purposes. The authors also wanted to determine what the students think about internet forums in general, as well as about their good and the bad side.

2. ORGANIZATION OF RESEARCH

During the summer semester of 2015/16, 165 students of the Faculty of Technical Sciences in Čačak were anonymously surveyed. Questionnaire with mostly closed questions was used for the survey. The survey included students from the following study programs: Information technologies (IT) – first year, Technics and informatics (TI) – first year, Engineering Management (IM) – first year, Entrepreneurial Management (EM) – second and fourth year, Electrical and Computer Engineering (ECE) – second year. From a total of 165 surveyed students: 69 study IT, 22 TI, 24 IM, 24 EM and 26 ECE. Fifteen students never accessed an internet forum so their results were excluded from further processing.

The questionnaire consisted of three parts:

- *Part one:* A series of statements to which the students responded with YES or NO (table 1);
- *Part two:* A series of statements from which students choosen two answers at most (table 2);
- *Part three:* Assesment scale (tables 3-5) with a series of statements related to the use of internet forums (in general, good sides, bad sides). It was necessary to enter the answer into the table that matches the opinion of the surveyed students for the corresponding statement the most. Possible answers were in categories from 1 (strongly disagree) to 5 (strongly agree).

3. RESULTS AND DISCUSSION

Table 1 presents the answers of the surveyed students on questions in the first part of the survey – basic information about internet forums.

Table 1. *Percentual answers of students in the first part of the survey*

Question	IT	TI	IM	EM	ECE	All
	yes%	yes%	yes%	yes%	yes%	yes%
Do you know what the internet forum is?	97	95	96	92	92	96
Have you visited an internet forum?	94	91	87	83	92	91
Have you participated in discussions on an internet forum?	44,6	40,0	57,1	45,0	50,0	46,7
Are you registered on an internet forum?	63,1	65,0	57,1	75,0	58,3	63,3
Do you have a role of administrator on an internet forum?	4,6	5,0	4,8	15,0	4,2	6,0
Have you ever advised other participants on internet forum about a certain topic, or how to solve a particular problem?	40,0	35,0	38,1	45,0	29,2	38,0

Almost all the students who participated in the study know what the internet forum is (96%) and have once visited an internet forum (91%), with IM students to have the highest percentage of participation in the discussions. A large number of students are registered on a forum (63%), while the number of students who have the role of an administrators is negligible (6%). The highest percentage of students who in turn have the administrator role is among EM students (15%) –II and IV year students. The number of students who advised other participants through forum was 38%, while also EM students were the most active. This can be explained by the fact that they have more needs for internet forums than their younger colleagues while they are the oldest and that they spent most time studying so far.

In the second part of the survey, students answered two questions: *1. Why do you use internet forum? and 2. How often do you use internet forum?* with five and four offered answers respectevely. They could round up two answers at most in the first question, and only one in the second. Table 2 shows the percentage answers to above mentioned questions.

Table 2. *Percentual answers of students in the second part of the survey*

Question	IT %	TI %	IM %	EM %	ECE %	All %
Why do you use internet forum? (*2 answers max*)						
Out of curiosity.	49,2	25,0	28,6	35,0	45,8	40,7
I follow trends in the area I study.	15,4	35,0	28,6	20,0	29,2	22,7
I'm looking for information on how to solve a problem from courses I attend.	47,7	70,0	66,7	45,0	45,8	52,7
I'm looking for material for preparation of tests, exams and seminar papers.	36,9	45,0	33,3	60,0	12,5	36,7
Not for any of these reasons.	7,7	0,0	14,3	20,0	16,7	10,7
How often do you use internet forum? (*1 answer only*)						
Daily.	6,2	20,0	19,0	20,0	16,7	13,3
Few times a week.	30,8	10,0	4,8	15,0	12,5	19,3
Few times a month.	10,8	10,0	19,0	10,0	20,8	13,3
If necessary.	52,3	60,0	57,1	55,0	50,0	54,0

IT students mostly use internet forums out of curiosity (49.2%), TI and IM students look for information on how to solve a problem from courses they attend (70%, 66,7%), ECE students use forums equaly for two above mentioned reasons (45,8%), while EM students use forums to look for material for preparation of tests, exams and seminar papers (60%).

All surveyed students mostly use forums if necessary (54%), while only 13.3% of them visit forums daily, with only 6.2% of IT students to visit them daily.

The third part of the survey represent the students' assessments concerning the general knowledge of internet forums, as well as the pros and cons, ie the good and the bad sides of it. The assessments are expressed on a scale from 1 to 5: 1 (strongly disagree), 2 (disagree), 3 (indecisive), 4 (agree) and 5 (strongly agree). Figures 1-3 and tables 3-5 show the answers of the surveyed students on questions from this part of the survey. Figures show summary assessments of students, while the tables also show the assessments given by the study programs expressed in percentages.

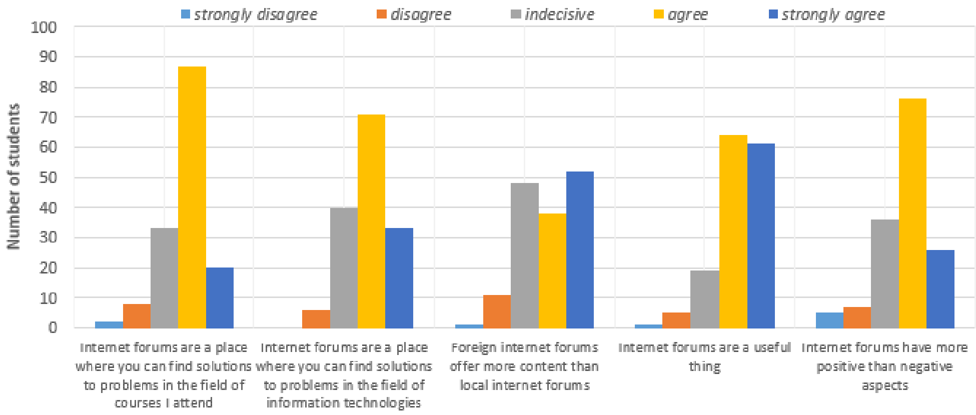

Figure 1. *Assessments of students concerning the internet forum in general*

Generally, the students believe that the internet forums are very useful thing. Students in equal number believe that the internet forums are places where they can find solutions for both problems in the field of teaching, as well as the problems in the field of IT. It is notable that students can not decide which forums are better and have more content. The biggest disagreement is with the statement that internet forums have more negative than positive aspects (of 8%).

Table 3. *Assesment scale (1-5) – General statements about internet forum*

GENERAL STATEMENTS ABOUT INTERNET FORUM		strongly disagree	disagree	indecisive	agree	strongly agree
Internet forums are a place where you can find solutions to problems in the field of courses I attend.	**IT**	3,1%	3,1%	26,2%	58,5%	9,2%
	TI	0,0%	5,0%	25,0%	60,0%	10,0%
	IM	0,0%	9,5%	23,8%	57,1%	9,5%
	EM	0,0%	5,0%	5,0%	65,0%	25,0%
	ECE	0,0%	8,3%	20,8%	50,0%	20,8%
	All	**1,3%**	**5,3%**	**22,0%**	**58,0%**	**13,3%**
Internet forums are a place where you can find solutions to problems in the field of information technologies.	**IT**	0,0%	7,7%	30,8%	43,1%	18,5%
	TI	0,0%	0,0%	45,0%	35,0%	20,0%
	IM	0,0%	0,0%	23,8%	47,6%	28,6%
	EM	0,0%	0,0%	15,0%	65,0%	20,0%
	ECE	0,0%	4,2%	12,5%	54,2%	29,2%
	All	**0,0%**	**4,0%**	**26,7%**	**47,3%**	**22,0%**
Foreign internet forums offer more content than local internet forums.	**IT**	0,0%	9,2%	30,8%	23,1%	36,9%
	TI	0,0%	0,0%	35,0%	15,0%	50,0%
	IM	4,8%	4,8%	14,3%	42,9%	33,3%
	EM	0,0%	10,0%	45,0%	30,0%	15,0%
	ECE	0,0%	8,3%	37,5%	20,8%	33,3%
	All	**0,7%**	**7,3%**	**32,0%**	**25,3%**	**34,7%**
Internet forums are a useful thing.	**IT**	1,5%	1,5%	12,3%	47,7%	36,9%
	TI	0,0%	5,0%	25,0%	40,0%	30,0%
	IM	0,0%	0,0%	9,5%	33,3%	57,1%
	EM	0,0%	15,0%	0,0%	45,0%	40,0%
	ECE	0,0%	0,0%	16,7%	37,5%	45,8%
	All	**0,7%**	**3,3%**	**12,7%**	**42,7%**	**40,7%**
Internet forums have more positive than negative aspects.	**IT**	1,5%	4,6%	32,3%	50,8%	10,8%
	TI	5,0%	0,0%	30,0%	50,0%	15,0%
	IM	0,0%	4,8%	9,5%	57,1%	28,6%
	EM	15,0%	5,0%	10,0%	50,0%	20,0%
	ECE	0,0%	8,3%	20,8%	45,8%	25,0%
	All	**3,3%**	**4,7%**	**24,0%**	**50,7%**	**17,3%**

90% of the oldest students (EM), declared themselve that they use internet forum for finding solutions in the field of teaching and information technology, which is 22.3% more than what IT students said. IM students are most familiar with the contents of foreign forums, because they are the least indecisive (14.3%). A quarter of the surveyed TI students is indecisive on the issue of the usefulness of internet forums. EM students have the most negative experiences on the internet forums, because 20% of them consider that internet forums do not have more positive than negative aspects.

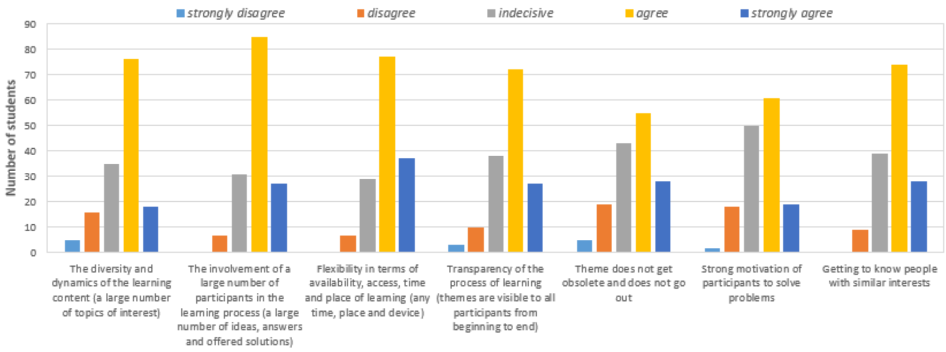

Figure 2. *Assessments of students concerning the good sides of internet forum*

As for the positive sides of the Internet forum, students mostly agree with all the above claims. The greatest agreements and the least disagreements were on the issue of forum flexibility and involvement of a large number of participants in the learning process – 76% and 74.7% agreed, while only 4.7% students did not agree with the above statements. Here we have the lowest percentage of indecisive students – 20.7% and 19.3%, respectively.

Internet forums are very flexible regarding the time and place of learning. Forums are active all day, every day of the year, thus enabling the learning to be achieved in the time that works best for the participants. Access to internet forums is possible with any contemporary communication device (PC, laptop, tablet, smart phone, smart TV, etc..) and any modern operating system (Windows, Linux, MacOS, Android, iOS, etc.). Therefore, learning is accessible practically to anyone, for example from home, school, work or any other place covered by the internet network. The advantage of this concept of learning is reflected in the fact that there is no loss of time and resources in coming and going of the common place of learning.

Table 4. *Assesment scale (1-5) – Good sides of internet forum*

GOOD SIDES OF LEARNING THROUGH INTERNET FORUM		strongly disagree	disagree	indecisive	agree	strongly agree
The diversity and dynamics of the learning content (a large number of topics of interest).	**IT**	6,2%	7,7%	23,1%	49,2%	13,8%
	TI	5,0%	5,0%	25,0%	55,0%	10,0%
	IM	0,0%	9,5%	23,8%	52,4%	14,3%
	EM	0,0%	35,0%	5,0%	50,0%	10,0%
	ECE	0,0%	4,2%	37,5%	50,0%	8,3%
	All	**3,3%**	**10,7%**	**23,3%**	**50,7%**	**12,0%**
The involvement of a large number of participants in the learning process (a large number of ideas, answers and offered solutions).	**IT**	0,0%	3,1%	15,4%	56,9%	24,6%
	TI	0,0%	5,0%	25,0%	55,0%	15,0%
	IM	0,0%	4,8%	9,5%	71,4%	14,3%
	EM	0,0%	5,0%	40,0%	50,0%	5,0%
	ECE	0,0%	8,3%	25,0%	50,0%	16,7%
	All	**0,0%**	**4,7%**	**20,7%**	**56,7%**	**18,0%**
Flexibility in terms of availability, access, time and place of learning (any time, place and device).	**IT**	0,0%	4,6%	16,9%	58,5%	20,0%
	TI	0,0%	0,0%	25,0%	50,0%	25,0%
	IM	0,0%	0,0%	14,3%	33,3%	52,4%
	EM	0,0%	15,0%	10,0%	60,0%	15,0%
	ECE	0,0%	4,2%	33,3%	41,7%	20,8%
	All	**0,0%**	**4,7%**	**19,3%**	**51,3%**	**24,7%**
Transparency of the process of learning (themes are visible to all participants from beginning to end).	**IT**	0,0%	6,2%	29,2%	43,1%	21,5%
	TI	0,0%	0,0%	40,0%	35,0%	25,0%
	IM	0,0%	14,3%	9,5%	61,9%	14,3%
	EM	15,0%	5,0%	10,0%	55,0%	15,0%
	ECE	0,0%	8,3%	29,2%	54,2%	8,3%
	All	**2,0%**	**6,7%**	**25,3%**	**48,0%**	**18,0%**
Theme does not get obsolete and does not go out.	**IT**	1,5%	12,3%	30,8%	38,5%	16,9%
	TI	0,0%	10,0%	35,0%	30,0%	25,0%
	IM	4,8%	23,8%	9,5%	23,8%	38,1%
	EM	10,0%	5,0%	25,0%	45,0%	15,0%
	ECE	4,2%	12,5%	37,5%	41,7%	4,2%
	All	**3,3%**	**12,7%**	**28,7%**	**36,7%**	**18,7%**
Strong motivation of participants to solve problems.	**IT**	1,5%	10,8%	26,2%	46,2%	15,4%
	TI	0,0%	15,0%	40,0%	30,0%	15,0%
	IM	0,0%	9,5%	42,9%	33,3%	14,3%
	EM	5,0%	20,0%	40,0%	30,0%	5,0%
	ECE	0,0%	8,3%	33,3%	50,0%	8,3%
	All	**1,3%**	**12,0%**	**33,3%**	**40,7%**	**12,7%**
Getting to know people with similar interests.	**IT**	0,0%	1,5%	29,2%	50,8%	18,5%
	TI	0,0%	15,0%	25,0%	45,0%	15,0%
	IM	0,0%	9,5%	19,0%	38,1%	33,3%
	EM	0,0%	0,0%	30,0%	55,0%	15,0%
	ECE	0,0%	12,5%	20,8%	54,2%	12,5%
	All	**0,0%**	**6,0%**	**26,0%**	**49,3%**	**18,7%**

Given that participation in internet forums is usually initiated by a specific need – informal learning of this character is distinguished by a strong motivation of participants. However, 13.3 percent of students did not agree. Also, 16% of students disagreed with the statement that the threads on forums do not expire even though it is one of the most important advantages of collaborative learning via the internet forum. Namely, the discussion flow on the forums remains permanently recorded, visible and accessible to everyone – forever. Even after the forum has been shut down, the contents remain recorded in so-called "web archives". This concept of learning is based on the assumption that the "knowledge" is public good and that it is not dedicated only to an individual in need of help at the moment. The idea is that the whole community benefits from a help given to an individual through a discussion on a certain theme. Forum and internet archives provide insight into the discussions that took place earlier, the methods used in solving problems, the problems which occured, ways to overcome them and so on. In such circumstances, "knowledge is based on knowledge," more ideas for creating new tasks are opened, participants enter in a subsequent realization of a theme with a certain degree of some basic knowledge, and can avoid the numerous errors that were identified in earlier projects.

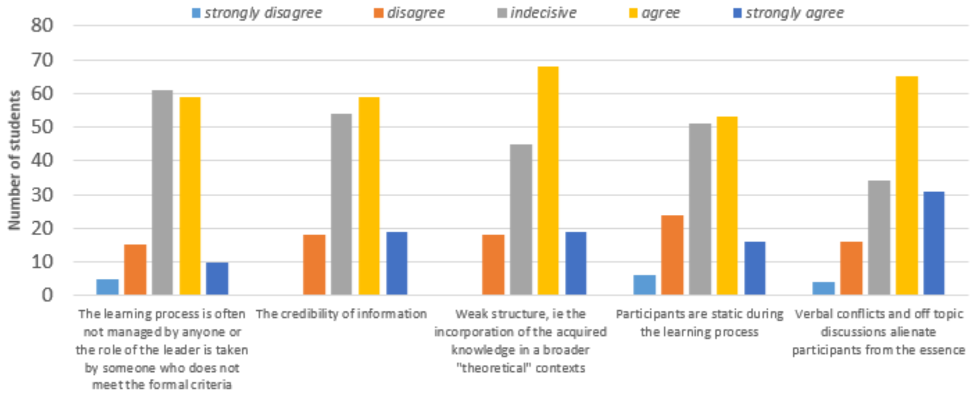

Figure 3. *Assessments of students concerning the bad sides of internet forum*

Characteristic about the claims about the bad sides of the Internet forums is that there is a large number of indecisive students for all the claims. If we exclude the indecisive students, the conclusion is that students agree with statements about the bad sides of the forum but to a lesser extent than they agree with the good sides of the forum.

Table 5. *Assesment scale (1-5) – Bad sides of internet forum*

BAD SIDES OF LEARNING THROUGH INTERNET FORUM		strongly disagree	disagree	indecisive	agree	strongly agree
The learning process is often not managed by anyone or the role of the leader is taken by someone who does not meet the formal criteria.	**IT**	3,1%	1,5%	44,6%	46,2%	4,6%
	TI	0,0%	10,0%	40,0%	30,0%	20,0%
	IM	0,0%	23,8%	38,1%	33,3%	4,8%
	EM	15,0%	15,0%	25,0%	40,0%	5,0%
	ECE	0,0%	16,7%	45,8%	33,3%	4,2%
	All	**3,3%**	**10,0%**	**40,7%**	**39,3%**	**6,7%**
The credibility of information (inability of clear assessment whether the information comes from a competent participants, or from participants who do not have the necessary breadth of knowledge on the subject matter).	**IT**	0,0%	6,2%	40,0%	44,6%	9,2%
	TI	0,0%	5,0%	45,0%	30,0%	20,0%
	IM	0,0%	0,0%	47,6%	42,9%	9,5%
	EM	0,0%	35,0%	25,0%	25,0%	15,0%
	ECE	0,0%	25,0%	16,7%	41,7%	16,7%
	All	**0,0%**	**12,0%**	**36,0%**	**39,3%**	**12,7%**
Weak structure, ie the incorporation of the acquired knowledge in a broader "theoretical" contexts (learned how to do things, but not why).	**IT**	0,0%	10,8%	38,5%	36,9%	13,8%
	TI	0,0%	5,0%	25,0%	50,0%	20,0%
	IM	0,0%	23,8%	9,5%	57,1%	9,5%
	EM	0,0%	15,0%	25,0%	45,0%	15,0%
	ECE	0,0%	8,3%	33,3%	54,2%	4,2%
	All	**0,0%**	**12,0%**	**30,0%**	**45,3%**	**12,7%**
Participants are static during the learning process (neglecting other sources of information and knowledge - books, textbooks, tutorials ...)	**IT**	3,1%	13,8%	33,8%	36,9%	12,3%
	TI	10,0%	15,0%	20,0%	40,0%	15,0%
	IM	0,0%	19,0%	28,6%	38,1%	14,3%
	EM	0,0%	15,0%	35,0%	45,0%	5,0%
	ECE	8,3%	20,8%	50,0%	16,7%	4,2%
	All	**4,0%**	**16,0%**	**34,0%**	**35,3%**	**10,7%**
Verbal conflicts and off topic discussions alienate participants from the essence.	**IT**	3,1%	10,8%	27,7%	43,1%	15,4%
	TI	5,0%	10,0%	15,0%	55,0%	15,0%
	IM	4,8%	4,8%	9,5%	42,9%	38,1%
	EM	0,0%	0,0%	15,0%	60,0%	25,0%
	ECE	0,0%	25,0%	33,3%	20,8%	20,8%
	All	**2,7%**	**10,7%**	**22,7%**	**43,3%**	**20,7%**

The oldest among the surveyed students (EM) disagree the most with the statements that The learning process is often not managed by anyone (30%) and The credibility of information (35%). Also, they are most bothered with verbal conflicts (85%).

These disagreements can again be attributed to their experience, because as far as the disorganization of management of learning process, it does not mean the absence of any criteria at the same time. The criteria in such cases are usually promoted by the community where learning is conducted. The role of the head of learning is informaly taken by the forum community members, who stood out in the past with quality answers and positive attitude towards other participants.

When we talk about the credibility of the information, or the impossibility of a clear assessment whether the information comes from "authority", ie. competent participant, or the participant who lacked the necessary breadth of knowledge on the certain issue – the forum members therefore need to be constantly aware of it and need to learn how to cope with this phenomenon and make the right decision. Usually in such cases, the number and quality of responses of participants in the learning process who deliver information is compared, and if the tendency that the participant continuously provided useful and accurate information, the chances are that it is once again the case. Even then (when serious issues are in question), it is desirable to seek a "second opinion" - in other forums, on the internet in general, in literature or in other ways. Distinguishing information from misinformation placed on the Internet and the risks that may arise from it, is one of the essential skills that every user of information and communication technologies should be familiar with.

4. CONCLUSIONS

With the development of the Internet there was a change in the way we are looking for solutions for our personal problems. Whereas the students earlier discussed about their problems with their colleagues at university libraries, hallways, cafeterias, and their rooms, today they do it from their armchairs with a much larger number of colleagues from around the world who are dealing with similar issues.

Students consider internet forums very useful and they believe that forums have more positive than negative aspects. In addition, on the basis of the study, the following general conclusions can be derived:

- 9% of all the students examined, never visited an internet forum, but only 4% do not know what it is;
- A large number of students are registered on the internet forum (63%);
- The number of students who have the role of administrator is little (6%);
- The number of students who advised other participants through forum was 38%;
- Students of all courses usually go to forums if necessary (54%), while only 13.3% of students visits internet forums daily;
- The highest percentage of students use Internet forums for seeking information in order to solve some problems related to courses they attend (52,7%).

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The University Library Information System Adaptability in an Intelligent Based University Environment

Vanco Cabukovski[1], Riste Temjanovski[2] and Roman Golubovski[1]
[1] Faculty of Natural Sciences and Mathematics, Ss Cyril and Methodius University, Skopje, Macedonia
[2] Faculty of Economics, "Goce Delcev" University, Stip, Macedonia
e-mail cabukv@hotmail.com, riste.temjanovski@gmail.com, roman.golubovski@t.mk

Abstract: *Agent-based (intelligent) systems technology has generated lots of excitement in recent years because of its promise as a new paradigm for conceptualizing, designing and implementing software systems. Multi-agent systems are designed as a collection of interacting autonomous agents, each having their own capacities and goals that are situated to a common environment. An information system is very important part of the contemporary university. Adaptation as a new trend in the modern e-Learning concepts aimed to produce more effective learning curve by tailoring a course's curriculum to individuals' specific preferences. In this paper, presented is an AeLS (Adaptive e-Learning System) successfully implemented as an advancement from the previous agent-based eLS IABUIS (Integrated Intelligent Agent Based University Information System). The main point of interest would be an ULIS (University Library Information System) adaptability as a part of AeLS.*

Keywords: *Intelligent University Information System; Library Information System; Adaptive e-Learning System*

1. INTRODUCTION

A model of an Integrated Intelligent (Agent-Based) Univesity Information System - IABUIS with an embedded multi-agent infrastructure has been developed at the Faculty of Natural Sciences and Mathematics with the University Ss. Cyril and Methodius. It is designed to control University's administration and education system. Many procedures related with educational and non-educational programs in a university environment are supported by the outcomes of this project. With the very first steps in development of this system one could be introduced in [12]. The IABUIS main structure was described in [7], [8] and [9]. It is an integrated intelligent e-university environment in a provision of multi-agent infrastructure, agent-based e-learning concepts, technology and digital content unification, digital library's standardization and information management integration. Some of these aspects are discussed in [1], [11], [16], [17].

Adaptation is the new trend in the modern e-Learning concepts (Adaptive e-Learning System - AeLS) aimed to produce more effective learning curve by tailoring a course's curriculum to individuals' specific preferences. These individual student preferences are evaluated by the AeLS in an automated manner, by following student's activities in the formal e-Learning system (lecturing material) and in complementary informal Content Management System (CMS) containing carefully gathered supplement material (multimedia supplements). An AeLS is able to keep track of usage and to accommodate content automatically for each of the users, for the best learning result, which in turn is supported by a student model built from student’s goals, preferences, and knowledge. Per (Brusilovsky 1999), (Brusilovski, 2001) and (Brusilovsky & Peylo 2003) the student model is used to adapt the interaction mode of the e-Learning system according to the user’s needs. The AeLS is based on adaptive selection of alternative supplements of course material. A methodology for development of additional low-budget digital content as an additional alternative fragments of course material for adaptive selection and composing of the course to individual users in accordance with their knowledge and behavior is given in [10].

In this paper, presented is an AeLS successfully implemented as an advancement from the previous agent-based eLS IABUIS (Integrated Intelligent Agent Based University Information System). The main point of interest would be an ULIS (University Library Information Sysetm) adaptability as a part of AeLS which attempts to propagate faster individual learning curves by employing agent-based system consisted of agent-based algorithms for adaptive interaction with the consumers (students), and adaptive content/course selection and delivery of appropriate material (supplements) intended for improved knowledge acquisition, thus better learning results - subject of official examination.

An AeLS ULIS adaptability is developed based on adaptive selection of alternative (fragments of) course material developed as low-budget content with a main goal alternatively to give the students additional material in order successfully to gain and implement the knowledge as well the automatically proposing the literature from the ULIS.

2. THE IABUIS MULTI-AGENT MODEL

The model of IABUIS includes four processes: student administrative information management, library information management, e-learning information management and university administrative information management process. In Fig. 1, the communication of these processes with the “external world” is given.

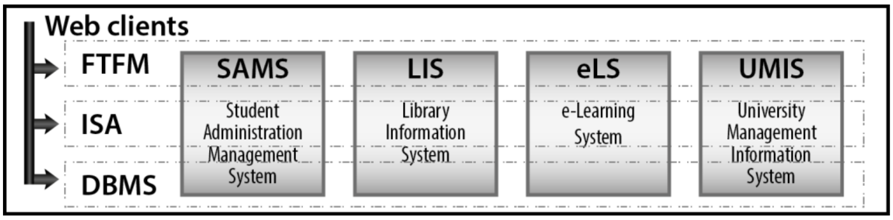

Figure 1. Communication of the IABUIS processes with the “external world”

Special web-based segments serve the connection with the IABUIS elements: the free text, files and multimedia management system (FTFM); the data base management system (DBMS) and the independent software applications (ISA).

The FTFM management system is consisting of portals, www pages, questionnaires, forms, output reports, images, servers (like e-mail and ftp), etc. The DBMS is consisting of databases, advanced indexing and retrieval database engines (ORACLE and MySQL). The third segment (ISA) contains different software applications developed for special purposes, like accounting, warehousing, books and education material circulation, e-learning management systems, etc.

The Student Administration Management System (SAMS) keeps track of the students educational records. The Library Information System (LIS) is developed in ORACLE. It is UNICODE based and it is supporting the MARC format and the dialects UNIMARC and MARC21. This module would be described in a next section. The e-Learning System (eLS) is based on ORACLE iLearning and SAKAI management systems providing complete infrastructure to manage, deliver, and track learning in both online and classroom based environments. The University Management Information System (UMIS) is designed to enhance the efficiency of the administrative and managerial aspects of the institution.

3. THE UNIVERSITY LIBRARY INFORMATION SYSTEM (ULIS)

Globalization is a very real phenomenon that is transforming information services and the library systems into e-library, digital library and semantic digital library according to the evolution of information technology. The library information systems in present day have rapidly evolved into the digital library aiming to realize integration and interoperability of information resources under distributed computing environment based on the Internet and computer networks. Since the main business objects of the library are knowledge resources, the library information systems are heavily influenced by means of the evolution of information. On the proliferation of electronic resources such as audio, images, videos and texts, electronic library (e-Library) has been appeared to manage electronic resources effectively [13].

The University Library Information System (ULIS) which is part of IABUIS is standardized library information system, intended to cataloge, update, search, borrow book and non-book materials (artwork, audio recordings, video recordings, cartography, educational materials, etc.) in academic, school, popular and public libraries, archives, museums, film archives, etc. This complex information system, can also perform automation of daily operations as well as documents archives of ministries, government offices and public enterprises who need a modern and powerful UNICODE based (multilingual) library system compatible with the standard MARC [1] and its dialects UNIMARC, MARC21 and others. ULIS is based on ORACLE database engine, fully protected and secure system with the possibility of networking and web access to the data.

Despite the full compatibility with other library systems based on the MARC standard - an internationally accepted standard for bibliographic / catalog processing of library material, ULIS offers and the following:

[1] https://www.loc.gov/marc/ [17.03.2016]

- Multilanguage based on UNICODE standard text-editor;
- Automation of procurement of new library materials (requests for procurement, seeking approval, approval of procurement, order procurement acceptance, financial records);
- Automated Cataloging (monographs, serials, non-book materials, articles, books, educational materials), signing, enumeration and recording, inventory and book of records, indexing, annotation, the main catalog card, analytical catalog card UDC catalogs ABCDE catalogs, bibliographies;
- Automation of the circulation of library materials (lending, return, reservation loss, withdrawal of damaged samples, interlibrary loans, financial records);
- Automatic control and review the state of the library;
- Automatic generating of periodic reports and statistical surveys;
- Basic and advanced searching supported by the Z39.50 / ISO 23950 ;
- Classification by UDC, DEWEY and other world classification schemes;
- Full web access to library materials.
- Import / Export of UNIMARC records in ISO 2709.
- Import / Export of records in MARC and other internationally accepted standards.

The web and its associated technical standards continue to dominate, although within a framework of much more use of mobile devices, data protection take primarily place in system's platform. ULIS covers such limited access to the data protecting their integrity in all domains and sources to access. In the next time, ULIS will be moving towards cloud computing technology and taking advantages of cloud based services especially in building digital libraries, social networking and communication. The use of cloud based library management systems has increased drastically since the rise of cloud technology started [14], [15].

4. THE ULIS ADAPTABILITY AND THE AGENTS COOPERATION

The eLS had successfully been upgraded from a classic e-Learning System to an Adaptive eLS (AeLS) by employing the multi-agent environment of the IABUIS aiming to improve the educational process.

The system presented is based on adaptive selection of alternative supplements of course material. This AeLS is successfully implemented at the Faculty of Natural Sciences and Mathematics with the University Ss. Cyril and Methodius, as an advancement from the previous agent-based eLS IABUIS. The general idea behind this concept is to provide the students with supplemental material in support to steeper learning curves, submitted to the AeLS via the CMS, and approved by the lecturers. The CMS is constantly monitoring through SAMS the overall progress of all students with their semestral courses and updates the supplements ranking list accordingly. Students are also evaluated periodically through test examination and ranked accordingly. Adaptation is then implemented with an algorithm which basically suggests higher ranked supplements set to lower ranking students, and more relaxed content to higher ranking students.

In addition to the 'informal' multimedia supplements, the AeLS implemented within the IABUIS had recently been integrated through its CMS with the ULIS - the library being the source of adequate and recommended text books and related scientific journals/articles. This new quality required structural and functional rearrangement of the multi-agent driving the follow-up of both - the individual students progress (based on SAMS data) as well as the appropriateness of the suggested learning material by the AeLS (within the eLS). The logical integration of the CMS and the ULIS is organized through a complex DBMS based repository consisted of the relevant portions of the both, and suitable software is developed to interface them to the users and agents/applications.

By integrating ULIS with the IABUIS the AeLS is able to implement its proven agent strategies facilitating the required adaptation of the learning material, consisted of both the more formal text books and the less formal low-budget supplements.

The multi-agent environment (MMAS - MATHEIS Multi-Agent System) is based on a former eLS called MATHEIS (MATHematical Electronic Interactive System) - an educational system for learning mathematics and informatics for pupils and students [5], [6], [12]. This system had been successfully integrated into ORACLE iLearning management system at the Faculty of Natural Sciences and Mathematics in Skopje and extended into SAKAI e-learning environment. The MMAS component structure is given in Fig. 2.

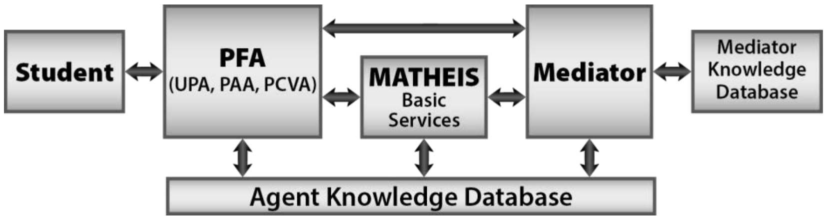

Figure 2. *The agent-based structure of MATHEIS*

The functional structure of MMAS is consisted of four conceptual subsystems: The User Agents Community; the Level Maintenance Subsystem; the Supervisory Subsystem and the Fuzzy Expert Subsystem. Detailed description of the structure of MMAS as well as relations between agents in MMAS is given in (Cabukovski 2010a).

The system is able to adaptively assist into filtering of the educational ULIS material according to the UPA (User Profile Agent) and student's activities in the communication with MATHEIS basic services recorded by the PAA (Personalized Activity Agent). The Personalized Content Viewing Agent (PCVA) is responsible for the adaptive interaction and adaptive content/course delivery – this enhances the usability of material and thus make the e-Learning system more effective, which improves the students' acquisition of knowledge and lead to better learning results.

The Mediator is responsible for the student learning model, database of the student's grades, degree levels, preferences, abilities, aptitudes, etc. This agent communicates with the Mediator knowledge database.

This adaptive aspect of the eLS (AeLS) is implemented by the PFA agent subsystem which follows the student's activities. It is responsible for the adaptive selection and display of the content (of both supplements and text books/articles) and adaptive interaction. The PFA is trained for each student to make the right content selection appropriate to the student's abilities and aptitudes.

The fundamental task of the PFA agent is to continuously evaluate both, the individual knowledge level of each student as (s)he advances through the course's curricula on one hand, as well as the "most appropriate" supplement material that had proved to be most helpful for that particular student level, on the other hand. So basically, parallel ranking lists of students (by level) and ULIS supplements (by significance) are maintained and used for matching against each other, in direct support of the adaptation process itself.

The ULIS just like any other DBMS software archives every single action within its working domain in detailed log files containing: the action itself (upload, download, approved, etc.); the user who performed it (student, lecturer); the content (supplement, book, article) affected; timestamp of the action, etc. These detailed logs allow for the PFA to keep track of what content had been downloaded by which student within a certain course. PFA can also use the SAMS system to keep track of which students had passed certain exams and with what grades. By combining these DB entries with the ULIS logs the PFA can easily calculate a precise contribution of every single supplement to students' success of its corresponding course. Calculated contribution of all pieces of content belonging to same course allows the PFA to build and maintain a content's list ranking highest those that contribute most, i.e. downloads that helped most students to pass examination and/or with highest grades. The rank lists for all courses are updated on semestral basis - after the semestral exams. Adaptation is then implemented with an algorithm which basically suggests higher ranked supplements set to lower ranking students, and more relaxed content to higher ranking students.

The PFA agent follows all student’s activities and among other things performs the adaptive selection of supplements to suggest to individual students for particular course. In order to be able to adapt supplements' curricula to the student, the PFA has to evaluate student's skill level periodically by test examination. The nature of the level estimation process logically requires a fuzzy approach, which is the job of the Fuzzy Expert System.

5. CONCLUSION

An Integrated Intelligent (Agent-Based) University Information System (IABUIS) consisted of the default administrative modules (among which the student SAMS) as well as of the formal e-Learning System (eLS) is upgraded with an adaptation functionality in support to steeper student learning curves. The novel integrated system can be considered as an Adaptive e-Learning System (AeLS). And it utilizes the rich and comprehensive University Library Information System (ULIS).

ULIS is used as knowledgebase supporting the AeLS in providing tailored content (books, journals, proceedings, and related material) to the students. The core of the AeLS is an existing agent-based interactive context (MMAS) which defines additional roles to the Expert Agent to perform: ranking of the available supplements and librabry content within a certain course by determining their individual impact (and thus usefulness).

All the fuzzy processing and inference is performed by the PFA module and already shows positive results and acceptance by the student community. Further advancement is being worked on and expected as improvement in the adaptation algorithm, as well as in the fuzzy reasoning for the suggestions inference.

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Library information system and graduates

Vladimir Radovanović[1], Bojana Marinčić[2] and Dragoslava Rodaljević[2]
[1] Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia
[2] The Public Library of Uzice, Uzice, Serbia
e-mail bokyue@gmail.com

***Abstract**: The role of libraries in modern society is changing and gets greater role in supplying information resources, because users will be informed and equipped to perform bibliographic research outside the library. "They will look for information that is immediately accessible to internet, consult their favorite sites and access the library catalogs which are available on the network." [1] By raising the level of media and information literacy of secondary school pupils it will make their professional development easier. At the same time we will set the foundation for the development of knowledge society. Modern scientific achievements in our country as well as in the world are easily accessible to young people due to the use of library information system and new resources within the Virtual Library of Serbia. This is especially interesting for graduates who wish to continue their formal education. Since this is an area that is constantly changing and supplementing a continuous systemic education students is needed.*

***Keywords**: secondary school pupils, media and information literacy, library and information system, Virtual Library of Serbia, graduates.*

1. INTRODUCTIONS

According to the principle of the librarianship and information field: " Libraries are at the heart of development of information society because they are essentially important for informing the citizens, for their improvement and individual development. They are necessary for the development of education, science and culture. They are initiator of overall progress of free democratic civil society. [2] Library information system of Serbia aims to successfully implement this principle in practice in order to make knowledge accessible to everyone. For that purpose, a series of services aimed to all categories of the population are developed, with special attention to the needs of the education system. Virtual Library of Serbia and the most important electronic sources and databases that occur within it will be presented in the work as well as availability of scientific information from the world through Kobson service with special emphasis on expertise of graduates in the mentioned sources. Since today's secondary school pupils are to be leaders of society development, it is important to train them for life-long learning. Libraries, as the gate of knowledge, are the main pillar in the process, as these perform the dissemination of reliable information. To make the process complete it is necessary to work on the development of media and information literacy of children. This allows them to develop a critical thinking in order to reach reliable information.

According to IFLA (International Federation of Library Associations), Internet manifesto, in addition to providing resources for customers the libraries need to teach how to use them the most effectively. “Besides many valuable information sources available on the Internet, there are those that are untrue, unpleasant, offensive, which can lead to misconceptions. Libraries must actively promote and facilitate responsible access to quality information networks for all their users, including children and young people.” [3] In their daily work public libraries notice that library information systems are not known to most pupils and growing need for their use is in period of the graduation papers. It is when graduates begin to recognize the importance of virtual, library catalogs and other databases that can be accessed from the library and from home. The need to find reliable information increases during period of the continued education at institutions of higher education and further work. All public libraries conduct daily individual user training, with special emphasis on the training of graduates, the search of electronic resources and databases. In addition to the individual trainings, librarians continually are devising a variety of activities (projects, workshops, seminars,) which are intended to graduates, whether they are target group or indirectly through teachers and school librarians who will implement the knowledge acquired in the teaching process and extracurricular activities . In order to meet the mentioned needs the National Library of Uzice realized the project "Find and use information", co-financed by the Ministry of Culture and Information of the Republic of Serbia in 2014. One of the target groups were graduates of secondary schools to whom Library Information system of Serbia was presented with special emphasis on virtual library.

2. INFORMATION NEEDS OF GRADUATES

Librarianship in our country is not recognized as an essential factor in the development of society, but it is developed at an accelerated pace in this period. Metadata, collections of digital documents, electronic services are to follow and present our scientific community. The rapid development and great variability of media distribute scientific knowledge, making new demands of information literacy. Search in databases that have several million records becomes meaningless if we get a large number of hits. The skills are needed for forming a complex search expressions and for use of Boolean operators which should be certainly covered in teaching of informatics in secondary schools.[4] Secondary education should enable children to develop the necessary skills and knowledge to successfully function in the information society, speaking on globally. It was believed that scientific information is outdated by an average of 10 years, but today, some of technologies are obsolete for 5 years. Economic environment of the modern global world is in a constant process of change and therefore for successful functioning in such environment the most important is ability of continuous professional training and system support for lifelong learning.

We have already stated that the current high school pupils will be bearers of the knowledge society, and as such represent the target group in education for the use of library information system. It is believed that generation born after 1993 is *Internet generations* and that is more natural to them to type on keyboard with screen in front of them then to write in notebooks and look at the paper. It is generation that wants to be permanently connected to internet, to get answers quickly and as short as possible, that believes more peers than authorities such as parents, teachers, and librarians. We can say it is generation of social networks. This is confirmed by data of the Republic Institute for Statistics of

Serbia for 2015 which show that 65.3 % of people use the Internet, and young people aged 16-24 years to 99%.[5] The question is how much people use the internet for gaining knowledge and which resources they find on the Internet for this purpose. In fact, if they are media and information literate enough to recognize the need for information, to find reliable information to meet those needs, critically evaluate (valorize) and present them in an ethical and satisfactory manner. These four elements are the essence of definition of media and information literacy. [6]

Our education system recognizes the need for development of media and information literacy among school pupils and strives to incorporate all school subjects as given objectivities to be achieved in this process. According to the law, among other objectivities it is stated that the goals of education are “ development capability of finding, analyzing, implementing and communicating the information , through skillful and effective use of media and information and communication technologies ; training for problem solving, integration and application of knowledge and skills in further education and everyday life.”[7] The achievement of the mentioned goals is more effective with the adoption of necessary knowledge of information systems in our country and in the world. Library and information system in the developed societies of knowledge has a central place in the development of media and information literacy. It is generally accepted that the libraries-public, university, school and special, are indispensable factor for successful lifelong learning and professional development. Is it so, do graduates have the right skills to help them acquire necessary skills for successful professional development or to continue formal education? Today we talk about the information universe. Information sources are more readily available and information is multiplied at various levels. It is real ability to cope in such an environment and efficiently find reliable information. In accordance with mentioned requirements, National Library of Uzice pays a great attention to the development of media and information literacy in local community. In order to enrich the knowledge of secondary school graduates in this field, it designed the project “Find and use information” approved by the Ministry of Culture and Information in 2014. Library Information system of Serbia is promoted through a series of presentations.

Teaching staff is presented information to improve acquired knowledge about relevant library information resources and their implementation in design of strategy for development of media and information literacy in the teaching process. The experience is exposed, gained in the UNESCO/IFAP,IFLA e-workshop “ Information and media literacy-educating the educators”. [8] The presentations were aimed at pupils containing information about databases: COBISS/OPA, SCIndeks, Doi Serbia, KOBSON, digital library collections, ASK (Anthology of Serbian Literature), Europeana, Coursera, edX, Udacity and others.

3. VIRTUAL LIBRARY OF SERBIA AND ITS SERVICES IN SUPPORT OF KNOWLEDGE SOCIETY

Following the development of information technology, since 2000 the National Library of Serbia has started the development of the Virtual Library of Serbia (VLS). Central VLS project is Mutual cataloging where today are more than 170 public, special, high school and university libraries. Thus COBIB.RS database arose that can be accessed through network COBISS/OPAC. COBISS/OPAC is available, searchable and free from any browser to all internet users. Currently, there is no an application for android devices in Serbian language that can be especially installed.

On the development of mutual cataloging system in our country it has been worked intensively since the eighties. In 1987 the National Library of former Yugoslav Republics adopted a mutual cataloging system as a common ground for the library information system and system of the scientific and technological information of Yugoslavia. Institute of Information Science (IZUM) from Maribor was determined as holder of the development of organizational solutions and software. After the disintegration of Yugoslavia in 1991, the libraries continued to work in their already formed bases. Connecting in unified mutual cataloging system in our country began in 2003. Cataloging in COBISS (Co-operative Online Bibliographic System and SERVICE) develops in the COMARC/B for the basic bibliographic description and COMARC/H for state fund that are consistent with the IFLA’s UNIMARC (Universal MARC format- Universal machine readable format) bibliographic format for data exchange. Record can be exported in the structure of ISO 2709 (MARC21, COMARC) or XML (Dublin Core, MODS, MARC21, COMARC).

The application of these standards enables the exchange of data between the bases, although they are base on many different MARC (machine-readable format) formats and are created in different applications. COMARC/B is adjusted to our national cataloging rules and standards for cataloging library materials (ISBD) and so allows the exchange of data with catalogs of national libraries in the world. It is possible to download the bibliographic records from WorldCat and ISSN- base (International Database serial publications) in Paris through OCLC (Ohio College Library Center- Online Computer Library Center) server Z39.50. Records can be downloaded on the bases of contract signed between National library of Serbia and OCLC. [9]

The first databases were established primarily to meet the needs of researchers. The basic step in the research is data about literature from which reliable data will be used for the work. In addition to knowledge of relevant printed sources, the researchers should be trained to search various databases, but certainly the research should begin by search of shared catalogs and other electronic resources offered by Library system of Serbia. Virtual library of Serbia is consisted of more connected bases and services:

- **COBISS/OPAC –** mutual bibliographic catalog database was formed in 2003 from catalog of the Matrica Srpska Library, National Library of Serbia and University Library “Svetozar Markovic” in Belgrade. When establishing it had around 1.300.000 records. Today, 175 libraries participate in shared cataloging and catalog contains 2.946.583 entries with a tendency of constant growth.

  Besides the shared cataloging system in parallel the other bibliographic services are formed in order to improve education system and facilitate flow of information. The bibliographic description of part in shared catalog contains links to full text if available in the Internet.
- **SCIndeks** (**Serbian Citation Index**) - it is the first introduced national index in Europe and first introduced public base in the world that represents a full hybrid database of full text and citation index. To date it refers 67911 articles of which 31059 are available in full text. This base includes the domestic professional journals published from 2000 onwards.
- **Doi Serbia –** Doi is a unique alphanumeric string assigned to a single digital object (article, book chapter, etc.), the establishment of permanent links to Internet sites where

original document is located. Data connectivity about article, DOI number and Web address is done via CrossRef (www.crossref.org) service [10].

- **E-CRIS -** Research information system activities. The University Library "Svetozar Markovic" in Belgrade is in charge for the work of this base in Serbia. Records are kept in this base about research centers and researchers, projects in which they participate. Also, code of researchers is assigned here. When bibliographic processing the work of an author in mutual catalog COBISS the researcher code is entered on what bases it is possible to write their bibliographies from the site of base E-CRIS. SR. Also, through this base it is possible to create the bibliographies of institutions.
- **KoBSON -** Serbian Library Consortium for coordinated acquisition is a new form of organizing the libraries of Serbia in order to provide foreign scientific information. The acquisition is completely determined by the needs of research institutions in the country and it is funded by the Ministry in charge for science. In 2016 over 35.000 titles of foreign scientific journals in full text are available, close to 160.000 book titles as well as several indexing databases. Institutions such as universities, institutes and main libraries that have academic network have access to these data via their computers. If a researcher in Serbia wants to join this service from home computer it is necessary to receive password and access code from Centre for Scientific Information at the National Library of Serbia with signing the contract on use.
- **Digital collections** - are digitized print publications that have to be protected from further deterioration or are part of the national cultural heritage. In recent years, most public libraries create their own digital collections. The largest collection of digital documents is in possession of the National Library of Serbia, which is available at http://www.digitalna.nb.rs/. The Serbian bibliography of books from 1868-1944 is set in this collection as well as ten volumes of the printed catalog of the National Library of Serbia 1868-1972 which is searchable on website.

In addition of the mentioned bases the two bases are in preparation and in the future will be available to users of the system, they are:

- **CONOR –** normative base of the authors from which data on authorship will be downloaded in order to balance the entry of author in the cooperative catalog. This base is important because of records of accepted forms of author names and entry of variant forms in order to get all records on the author works by searching any variant form. Cataloguers from institutions founders of corporate catalog are privileged to fill this base.
- **CORES –** database of serial publications that are to be filled at the request of author or editor, in order to find data from E-CRS base when author was managing editor and editorial board member in a professional and scientific journal since these activities are scored in acquiring professional and scientific titles.

After the nineties and disintegration of Yugoslavia, it was ending of the Yugoslav Bibliographical Institute that issued the printed bibliography of monographs and bibliographies of articles of current issues. Current bibliography in Serbia was taken over by Bibliographical Department of the National Library of Serbia. From creation of VLS until 2005 the bibliography of monographs, serial publications, non book materials and analytic bibliographies are published in print and electronic form. Since 2005, all kinds of current bibliographies are printed only electronically and are available on the website of the National Library of Serbia. With the introduction of the given database graduates are directed to the way of collection of bibliographic data required for graduation papers and research papers in further education and work.

4. HOW DO THE MOST SUCCESSFUL UZICE GRADUATES USE INFORMATION FROM INTERNET AND SEARCH THE ELECTRONIC LIBRARY CATALOGS

While working on education of graduates as part of this project, the graduates of Uzice secondary schools were interviewed on the use of library and information resources. There were 757 respondents, a sample was separated from the 306 excellent students, because it is assumed that they will continue their education, therefore a need to search reliable database will be necessary. Results show that computer literacy is far beyond information literacy of graduates. Most of them never search the electronic library catalogs and not even the shared catalog, the most significant asset in the library and the education system in our country. The largest number of graduates sometimes uses information from the Internet while learning, and in a free conversation it is concluded that these data are mostly downloaded from Wikipedia, without checking the reliability of the offered texts content.

Table 1. *Results of the survey on the use of information from the internet and search electronic library catalog with the excellent final year pupils of secondary schools in Uzice*

Question:	Answers:		
	always	sometime	never
Do you use data from internet in everyday learning?	56 (18,30%)	231 (75,49%)	19 (6,21%)
Do you get desired results when you search the Internet?	104 (33.97%)	194 (63,39%)	8 (2.64%)
Do you download content from the internet when making homework?	38 (12.42%)	159 (51.96%)	109 (35.62%)
Do you search library catalogs on the internet?	17 (5.56%)	101(33,00%)	188(61.44%)

Knowledge of relevant information is a key element of acquiring knowledge and they are just stored in the library resources, it is evident that these sources are unknown to a large number of graduates. "Graduates in their libraries can still expect some help with literature needed for graduation papers, but freshmen are from the perspective of academic libraries quite unrecognizable and unmet category, drowned in the student user population and treated in the same way as final-year students." [11] By not knowing how to search library and information resources the freshmen are placed in a very difficult situation. So that many of them are forced to look for help with the search of reliable database in public libraries. Librarians then conduct an individual's training of user.

5. CONCLUSION

Library and information system of Serbia strives to ensure adequate support for lifelong learning to all categories of the population and recognizes the specific information needs of secondary school graduates considering that that is a generation that continues further education. During secondary education, it is necessary to master certain skills and achieve a satisfactory level of media and information literacy in order to be trained for lifelong learning and successful functioning in modern society. I should be aware of the rapid social, economic and technological changes, and that it is necessary to enable the young generation to follow the development and quality of innovation. The theme of media and information literacy cannot be adequately treated through project activities and needs a systemic solution. Without a specific concretization through the contents of the curriculum the significant progress in practice cannot be achieved. It should consider the idea that, through computer teaching in the form of specific themes or subject from primary to secondary schools, the structure of library information system in Serbia and the world is discussed. In designing the program, it would be necessary to consult eminent experts in this field. The educational and library and information system should continue strong interconnectedness and provide adequate support to the processes that relate to their interaction.

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Some of text analytics applications in higher education institutions

Predrag Stolić[1], Snežana Stolić and Aleksandra Milosavljević[2]
[1] Technical faculty in Bor, Bor, Serbia
[2]Mining and metallurgy institute Bor, Bor, Serbia
e-mail pstolic@tfbor.bg.ac.rs

Abstract: *Previous knowledge of the institution environment were based on the use of structured data. In recent years, unstructured data are more used by predictive analysis. The impact of unstructured data is a dominant in different types of texts, so the one of the leading approaches to analysis and obtaining the necessary information is based on the use of text analytics. A real use-value text analytics is shown in this paper with particular emphasis on some of the possible aspects of text analytics using in the area of higher education institutions.*

Keywords: *competence; teachers; modern media*

1. INTRODUCTION

The common characteristic of all higher education institutions in the world is the realization of study programs in a very dynamic environment. Mentioned dynamism is a result of the various parameters combination, starting from sociological, via technical and technological, all the way to economic. Unlike higher education in a traditional sense, where all the improvements carried out periodically and with a certain delay due to the tendencies that expressed the society then, modern higher education implies continuous improvement in all parts of its processes in order to keep competitiveness.

Modern Higher Education set the goal of modernization of study programs as a continuous process that ensures excellence in achieving the expected learning outcomes and necessary competences for future graduates at all levels of academic and professional studies [1]. As the education of students performed in order to qualify students for future tasks that will be done within the framework of qualification, the modern study programs must be designed to respond to the demands issued by the current labor market in the economic, technological, social and scientific sense. In order to achieve the set goals in terms of compliance between study program and current market, in processes of creation, design, reform, verification and validation of study programs must be included hierarchically all relevant national authorities, scientific and research community, employees within the higher education institutions, but also students and, as a very important component, those who will absorb the final product of higher education, employers as end users.

Data sources that can be used in a previous analysis in order to achieve competitive study programs at all levels of study are found everywhere within the eco-system in which higher education institutions achieve their work. The question is how to extract relevant and useful data from large volumes of data which are generated on a daily basis at high speed and how that data processed in the shortest possible period of time so that forehand analysis could carried out in order to provide instruments for defining new directions of development and improvement of study programs. Traditional analysis and appliances that were used until recently gave certain results but still some delay is observed in adequate reactions to the more volatile labor market.

In recent years in the context of the development of information and communication technology a set of techniques known as Big Data are appeared which allows the processing of large amounts of information in a reasonable period of time with adequate resources and relevant data recognition, forehand analysis and the corresponding presentation of the results of completed analytical actions. In the following chapters will be presented one of those techniques known under the name text analytics and the possibilities of its application to developing institutions within higher education.

2. UNSTRUCTURED DATA

For years, the world of information systems and information technology relied on a strictly structured data stored in databases. Almost all of the data which the computer systems encountered, from raw data that were the result of some type of data acquisition till the results of the data processing, regardless of the type, quantity and usability, were subordinated to a some kind of database management system. The most common type databases were relational database, based on well-known mathematical postulates of relations and collections. By information technology improvement, an approach based on relational databases proved to be very limited and in certain moments inadequate for modern challenges which the world of new information technologies brings to customers in the near and distant future [2].

In accordance with the mentioned above, opposed to strictly structured data, the process of using unstructured and semi-structured data is initiated. It can be said that for the expansion of unstructured data using, instead of traditional structured, responsible three highly coupled, important factors: the mass computer communications, the explosion of social networks using and the tendency of man to express himself in a world of two previous using a way close to the everyday expression and natural speech. Data are generated by enormous speed with appereance of extreme number of data sources (blogs, comments on sites, social networks, various documents in the cloud, etc.), but due to unstructured mode of presentation, the most of the data seems irrelevant or inappropriate for further processing over them.

By further analysis can be determined that the corresponding sets of unstructured data, which are considered to carry irrelevant data, can lead to significant, relevant findings depending on the ways in which data is treated. Therefore, it is necessary to change approache to data analysis. Traditional techniques and technologies used in the analysis and processing of data must be abandoned in whole or modified to allow actions to be performed on the domain of unstructured data.

3. TEXT DATA MINING AND TEXT ANALYTICS

Expansion of the use of information and communication technologies in carrying out tasks aimed to the modern business, texts of various types, shapes and lengths are beginning to be more importance as carriers of information in the form of various reports, letters, memos, or the whole brochures, instructions. Therefore, the essential value of the possibility to obtain data from various types of texts is recognized and searching for implementation methods of mentioned is started.

At the beginning, data extraction from text consisted of a simple counting words, or the appearance of given words in a text. Over time, tasks become much more complicated and the complex analytical operations on the text itself are perfomed, which led to the creation of new computing discipline marked as text data mining (often in the use is the term text mining). Text data mining means the data relevation from the text or processing of unstructured text information [3] in order to be able to use information from the text in further flows of data processing such as importing relevant data to the database, processing in the statistical and machine learning algorithms and similar [4]. Typical tasks that are accomplished by text data mining are various types of marketing analysis through processing questionnaires and forms, automatic classification of text, such as automatic detection of unwanted messages (spam messages) [5], the analysis of user behavior on social networks via sentiments [6], the analysis of information published on web sites, blogs, pages on the social networks and similar [7].

Text analytics means a consolidated set of linguistic, statistical and machine learning methods for extracting information from text sources purposes. Obtained information using text analytics, are intended for use in the context of Big Data systems, business intelligence, various statistical analysis and processing, prediction of behavior and future events [8]. Today in the use prevails the term text analytics as a synonym for text data mining, although there are some differences in the use of these two terms. However these differences are becoming lesser and common characteristics are much more emphasized so text analytics, in the world of modern business, are more notable as the dominant term.

4. TEXT ANALYTICS FOR THE PURPOSES OF HIGHER EDUCATION INSTITUTIONS

4.1. Detection of potential forgeries

The use of text analytics in terms of higher education institutions in the world and in our country is based primarily on an analysis of various types of documents (scientific papers, theses, doctoral theses, etc.) in order to identify potential forgeries and their authors. If we consider that, a few years ago, the average number of published scientific papers per year is several million worldwide, and that most of these papers now available at some of the ways in text format, the use of text analytics in this segment is necessary link in the whole process [9,10]. In this way, the integrity of the institution strengthens through raising the quality of scientific papers and reducing incidence of possible forgeries.

Fig. 1 shows a schematic view of the system that uses text analytics to analyze the scientific content in order to detect possible forgeries. This system could be fully applied in the analysis of the content of textbooks and other supporting materials which are used in the context of study programs implementation. However, due to laws in the field of copyright and related rights, system would be limited in work because it could analyze only those issues which are not protected by copyright, or could analyze only parts of the editions that the publisher made publicly available. Functionality of the system will be questionable so these systems are for now still rarely used in the field of analysis of textbooks and other similar literature.

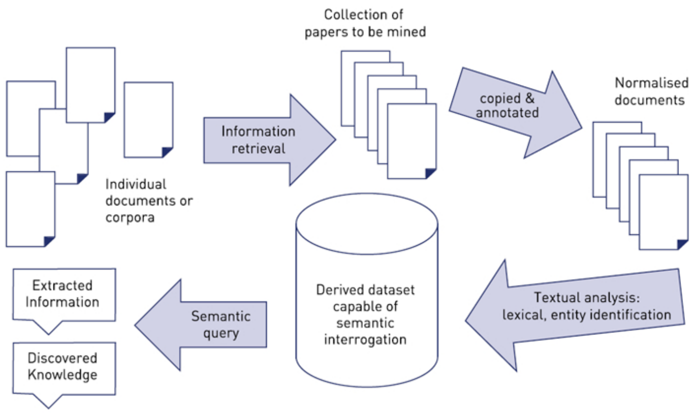

Figure 1. *Schematic representation of the processes involved in text analytics for scientific content [9]*

4.2. Analysis of the market environment

Today's higher education institutions achieve their goals in terms of a very variable market environment. Mentioned changes are very dynamic and it is necessary to develop mechanisms to monitor and identify them in order to students, after completing their education on these institutions, could fit into the corresponding market trends. Traditional techniques for market monitoring and segmentation for projection purposes and harmonization of higher education programs give certain results, but there is a large degree of inertia that has manifestation after the application of the results to higher education programs in terms of their modernization and harmonization. Again, we have a certain amount of obsolescence and non-compliance with current situation in the market.

By application of text analytics in domain of market environment analysis, minimization of the traditional approach characterized problems is performed. Neutralizing these factors is realized by converting the text data into the data of outstanding organizational and business value that can be automatically accessed and then perform analysis and interpretation, understanding them and act in accordance with the information detected from the electronic texts that are the subject of accession and analysis [11]. This approach does now, during various daily analyzes, that advantages could be taken from the resources of social networks, electronic questionnaires, communications made through e-mail and also from hidden resources in the form of stored information in the portfolios of companies, job ads, labor markets and similar domains which, in the traditional sense, did not reveal much, or reveal only in some kind of indirect contact with them [12]. Now, these resources are directly accessed by text analytics and seemingly hidden information becomes a valuable tool in the identification of all the advantages and potential problems which could have influence in sphere of higher education by market changes.

4.3. Evaluation of students satisfaction

During the last years, there is a expressed focus of higher education in the Republic of Serbia to monitor student satisfaction, especially after the forming of the Commission for Accreditation and Quality Assurance. Various types of surveys, external evaluation and self-evaluation have become a key segment and tool for improvement of higher education institutions. However, in practice, real problems have occurred in the form of obtaining data whose reliability and usefulness are debatable. For example, in the evaluation of subject teachers appeared expressed preference that the students get a lower grade to teacher who focuses on discipline, and opposed to that, high score will receive a teacher who tolerates extremely frequent absences from lectures, delays and so on. Also, students continue to express doubts about the anonymity of each survey conducted by higher education institutions.

On the contrary, students expressed a preference to objectively assess the condition and work of higher education institutions in the context of less formal communication which take place, for example, in various forums and social networks segments. It is believed that this kind of data and information can lead to a more realistic and comprehensive look to all potential problems that students encounter in the context of higher education institutions and thus, after identification, appropriate mechanisms could be made to improve the work of institutions themselves [13-15]. In this case, the text analytics is a way to process these information for the purpose of allocation larger set of data and knowledge about the satisfaction of students and obtaining a more authentic and better picture about state in institutions of higher education, and in higher education in general [16].

Fig. 2 provides a simplified (generalized) schematic representation of text analytics phases which are processed when analyzing student satisfaction on the basis of a separated text regardless of the source of the text (social networks, forums, email, etc.).

Figure 2. *Analysis of students opinions using text analytics*

Certain text are analyzed and, after the separation of sentences, further analysis of each sentence partially is processed in order to identify all the parts of each obtained sentence [17]. Clearly defined analytical procedures are processed over obtained parts in order to characterize and evaluate each of the parts [18]. The objective of analytical processing represents an isolated opinion from the initial text. This procedure is known as sentiment analysis [12] and it presents one complex process that beside text analytics, as a core of the procedure, includes natural language processing (NLP) and computational linguistics.

The advantage of this approach will be presented by a short example based on evaluation of subject. Within some evaluation survey, student can evaluate the subject with the grade B (very good). This kind of assessment can be used for the purpose of further statistical analysis and evaluation. However, a far better conclusion about the subject matter can be obtained for example from the text about the subject written by a student at a forum. For example, a student explained to another student on the forum fundamentals of the subject, what is learned, what is tested, how the matter is innovative, how the subject is modern and similar and at the end of posted item wrote the text using slang "In a word this subject is awesome!!!". Using text analytics from this post we can obtain information, for example, that a student who wrote the text is feeling enthusiastic about the subject, that it is encouraged him, that recommends the subjet to other colleagues and a whole other set of relevant information. As was mentioned above, we get the whole set of information which can be used for measuring the success of the subject through the student satisfaction, as opposed to an initial one grade from the survey (B - very good).

5. CONCLUSION

Higher education institutions achieve their activity in conditions of highly variable and dynamic environment. Traditional methods of analysis can not fully follow the latest trends which are currently presented in the field of higher education and the immediate environment that surrounds it. To ensure further competitiveness it is necessary to introduce modern methods in all aspects of higher education institutions work.

Text analytics is a method that can give tremendous contribution to the analysis of higher education institutions work. This paper presents a few aspects of the use of text analytics in the field of higher education, while the real use is practically unlimited. Essentially, as a man almost all processes in a particular language and in the form of a text, the text analytics can be shaped into an essential tool in various segments of work.

The use of text analytics in the field of higher education will constantly growing. That projections presented primarily the use of text analytics in forehand analysis of the factors that affecting the work of higher education institutions, and using that analysis will be possible to predict future trends and to form a correct answer to this trends. Therefore text analytics as a tool of the future will enable better segmentation, better results, better positioning of higher education institutions.

It is expected that the introduction of text analytics in domain of higher education lead to the significantly reducing of time required for performing analysis. Economically analysis will become more acceptable and accessible to a variety of higher education institutions. Organizationally, the analysis will be applicable at all levels of the organizational structure, from departments within the faculty to the university senate under almost identical conditions.

There is no doubt that future higher education will apply text analytics, through the different scope of action, in almost all segments of its work.

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Influence of English language on Serbian language in the context of computer terminology

Nenad Marković[1] and Jelena Rajović[1]
[1] Polytechnic School of Professional studies Urosevac with temporary seat in Leposavic, Leposavić, Serbia
e-mail nen.mark74@yahoo.com

Abstract: *Due to its topicality and frequent novelties, computer terminology is very interesting and dynamic field. Since the majority of technological innovations come from English speaking countries, domination of English terms is evident in computer terminology. The paper represents the results of research conducted at Polytechnic school of professional studies Urosevac with temporary seat in Leposavic in order to determine to what extent the students are familiar with computer terms, how and in what form they use them compared to the source terms in English language, in relation to the fact that majority of students have sufficient background knowledge both of English language and computers. Thus, the aim of this paper is to determine whether the knowledge of English language, as a foreign language, is in correlation to the knowledge of computer terminology.*

Keywords: *computers; English language; terminology, students*

1. INTRODUCTION

In addition to the knowledge of English language, computer literacy is another prerequisite without which the fulfillment of any profession today cannot be imagined. Information revolution in the 20th century, which is still in progress, has made computers to become an irreplaceable part of our lives, both on professional and personal level. Much has been said about the importance and the role of computers today. However, IT profession is in somewhat different position than other scientific and professional fields.

The expansion of experts in the field of information technology imposes the expansion of computer users who use it for communication within the scope of different vocations and professions, or use it for personal needs or other purposes. It is, therefore, understandable that computer technology, except for communication in the IT professional circles, has domesticated among users who necessitate it for basic operation and communication through the computer [1].

Based on the aforementioned, the question rises to which extent the terms from the area of computer terminology in general can be considered the narrowly specialized terms [1], [2], [3], [4], since they are not used only by the narrow groups, but become a part of daily lexical repertoire of an average speaker, with which children come into contact in a very early age [5].

The development of science and technology has conditioned the emergence of new words and terms to designate the inventions and developments. As the majority of innovations originated in the English speaking countries, therefore the majority of the terms in the field of computers have English names. This trend is also present in our country, provided by the fact that this topic is actual for past 30 years, namely from the first definition of JUS standards in 1985 in the field of Information Technologies.

Computer terminology enhancements and changes almost daily, and, therefore, computers have an increasing impact on our everyday lives- the computer terminology is increasingly becoming a part of the general public vocabulary. Computer terminology is a leading field within which the impact of English language is a really significant [6], [7], [8].

However, Information technology gives rise to numerous international exchanges of both an intellectual and a material nature. These exchanges often become difficult, either because of the great variety of terms used in various fields or languages to express the same concept, or because of the absence or imprecision of the definitions of useful concepts. To avoid misunderstandings and to facilitate such exchanges, it is essential to clarify the concepts, to select terms to be used in various languages or in various countries to express the same concept, and to establish definitions providing satisfactory equivalents for the various terms in different languages [9].

How much the knowledge of computer technology is significant and, we can freely say, necessary today, is confirmed by the fact that an increasing number of children comes into contact with the computer technology [10] from early age, whether by playing games on computer, social networks or researching for the sake of learning.

In the paper we tried to determine how the students of Polytechnic School of Vocational Studies Urosevac with temporary seat in Leposavic (VTSSS Urosevac in Leposavic) are familiar with the terms of computer technology, and to which extent and in what way they use it, given that the English language and computer technology almost all of them have been learning since the first grade of Primary school.

2. DISTRIBUTION OF SUBJECTS ENGLISH LANGUAGE AND COMPUTERS IN THE EDUCATIONAL SYSTEM OF THE REPUBLIC OF SERBIA

Since the school year 2003/2004, English language is being learned in Serbia from the first grade of primary school. According to the Institute for Advancement of Education of the Republic of Serbia [11], in the first cycle of the elementary education (from the first to the fourth grade) English language is distributed with two classes per week, that is, 72 classes per year. Along with the English language, according to same resource [11], there is another subject “Od igracke do racunara” (From toys to computers) (1 class per week, 36 per year), as an elective course. In the second cycle of the elementary education (from the fifth to the eight grade) along with the English language is the subject “Tehnicko i informaticko obrazovanje” (Technical and Information education) (1 class per week, 36 per year).

There are opposite opinions on whether the number of classes of English language and number of classes of computer science is sufficient to master basic issues these subjects are dealing with respectively. Markovic V. et al (2014) argued that primary school pupils acquire more vocabulary using the web electronic books with computer games based on reasoning than what they have learned through traditional methods (paper-delivered tests, kinds of words or questions with multiple choice answers) [12]. This topic is certainly worthy of attention, and we will deal with it in one of the future papers.

In secondary vocational and grammar schools in the Republic of Serbia, obligatory subjects according to curriculum [11] are English language and Computer science (1 class per week, 37 per year). After 12 years of parallel learning of English and computers, somehow implies that the students have mastered the basics of aforementioned subjects and that they acquired sufficient language and computer literacy for some elementary communication- both language and computer.

3. DISTRIBUTION OF SUBJECTS ENGLISH LANGUAGE AND COMPUTERS AND PROGRAMMING IN VTSSS UROSEVAC IN LEPOSAVIC

Following the current trends in teaching and education and with the aim of obtaining qualified personnel, VTSSS Urosevac in Leposavic strives to offer their students the highest quality education. Thus, at this school a lot of attention is given to English language and computer teaching. As our students educate for professional occupations, their language and computer literacy is of great importance, given the growing developing trends in the world in the field of science and technology.

Students at VTSSS Urosevac in Leposavic as a obligatory subjects have English language I (2+2) and English language II (2+2), which are taught at the first year of study, in the first and second semester, at all study programs; and Computers and programming (3+3) that is also taught at all study programs. All three subjects are obligatory.

4. RESEARCH METHOD

A questionnaire survey was conducted at VTSSS Urosevac in Leposavic. The questionnaire was composed by combining the existing questionnaires which dealt with the similar subject [1], [5] [13], [14], [15] and is complemented with a few questions we found relevant for our research and which were not included in previous questionnaires.

Research was conducted on the total sample of 102 respondents- students of all three years of basic professional career studies, from all study programs and their modules. Students of specialist professional studies of VTSSS Urosevac in Leposavic are not included in the research.

Questionnaire is composed of two parts. The first part covers the student's general information like gender, age, secondary school completed, year of study, study program. The second part is composed of questions that specifically relate to the use of language and computer by the student. Then the respondents were asked to choose from the offered corpus one of the given terms in relation to their original meaning in the English language. This part of the questionnaire examines the frequency of use of the following 18 computer terms: *Computer*, *Monitor*, *Printer*, *Font*, *File*, *Download*, *Format*, *Print*, *Save*, *Forward*, *Reset*, *Paste*, *Cut*, *Copy*, *Folder*, *Update*, *Insert*, *Delete*. The corpus was selected due to the fact that given terms students usually encounter, and in accordance with Serbian standard SRPS ISO/IEC 2382 [9]. However, due to the technical limitations of the scope of the paper the number of items was reduced to 18.

Although most of the Serbian language information technology dictionaries are of descriptive nature, here we used entries given in the online computer dictionary Mikro knjiga [16].

5. RESULTS AND DISCUSSION

The survey included 102 respondents- students of VTSSS Urosevac in Leposavic. Three questionnaires were incomplete. From the total number of respondents, 76 (76,77%) were males and 23 (23,33%) females aged between 18 to 28 years and above. 42 (42,42%) respondents were from the first year of study, 32 (32,32%) from the second year of study and 25 (25,5%) respondents from the third year of study. Overall analysis of above parameters is shown on the Figure 1.

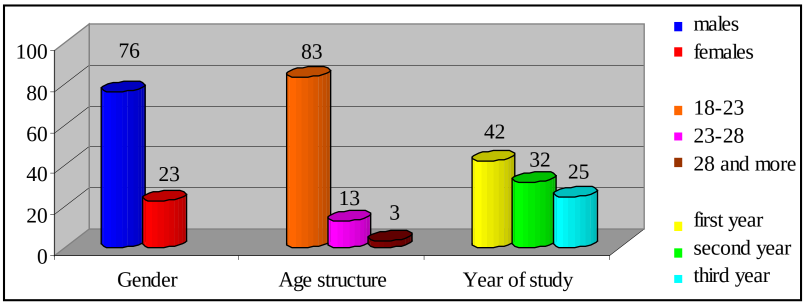


Figure 1. *Gender, age structure, and year of study of respondents*

Regarding the completion of secondary school, 13 (13,3%) respondents stated they had completed grammar school, 56 (56,57%) technical school and 30 (30,30%) stated “other”, that is, agricultural, economic and medical secondary school. Respondents from all study programs and modules from the basic professional studies (except specialist professional studies) participated in survey as follows: Road Traffic 55 (55,56%) respondents, Production Engineering 10 (10,10%), Engineering Informatics 3 (3,03%) and Occupational Safety 31 (31,31%) respondents; Figure 2.

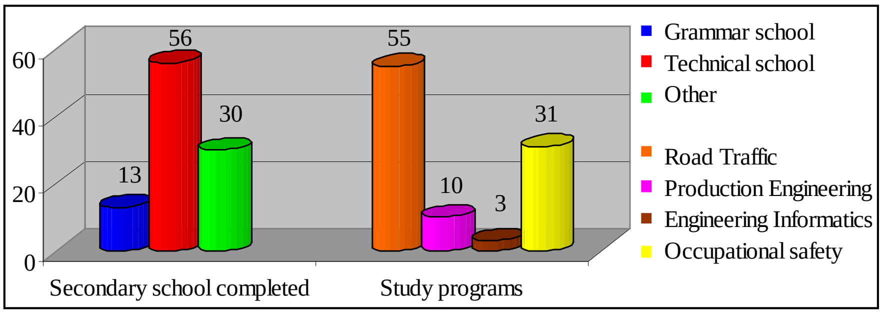


Figure 2. *Secondary school completed and study programs of respondents*

When asked “Have you attended any English language course?” of the total number of respondents, only 5 (5,05%) gave an affirmative answer. Based on this data, we have concluded that the English language course does not affect the goal of this paper due to a small percentage of respondents who attended a course.

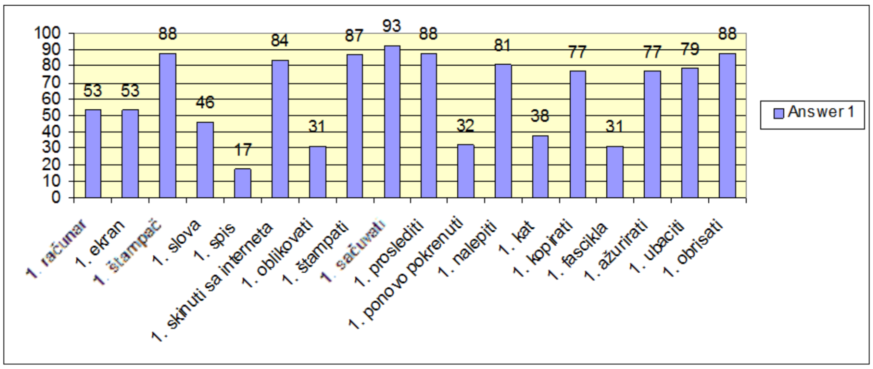
From the total number of respondents, 41 (41,41%) respondents use computer less than an hour per day, 35 (35,35%) respondents use computers up to three hours per day, while 23 (23,23%) respondents use computer more than three hours per day. The time spent at the computer is not relevant to the knowledge of computer related terms.

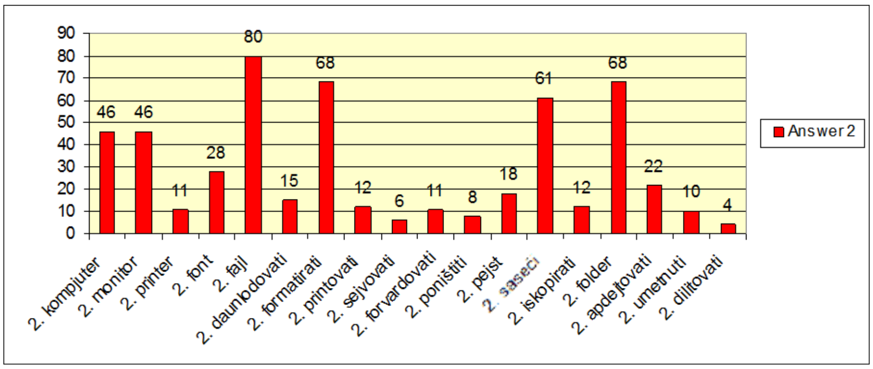
When asked “To what extent the knowledge of English language helps you while using the computer?”, 7 (7,07%) respondents stated that it does not help, 44 (44,44%) respondents stated that it partially helps, and 48 (48,48%) respondents stated that it helps a lot. Although the obtained results suggest that the knowledge of English language facilitates the use of computers to majority of respondents (48,48%), based on the results of the analysis of the 18 items listed below, we can conclude that respondents in most cases opt for the term in Serbian language.

The list of 18 items is composed as follows: on the left side of the list are given computer terms in English language and right side of the list offers terms in Serbian language. Serbian translated equivalents and anglicisms are offered:

1. Computer *računar/kompjuter*
2. Monitor *ekran/monitor*
3. Printer *štampač/printer*
4. Font *slova/font/vrsta slova*
5. File *spis/fajl/fajla*
6. Download *skinuti sa interneta/daunlodovati*
7. Format *oblikovati/formatirati*
8. Print *štampati/printovati*
9. Save *sačuvati/sejvovati*
10. Forward *proslediti/forvardovati*
11. Reset *ponovo pokrenuti/poništiti/resetovati*
12. Paste *nalepiti/pejst*
13. Cut *kat/saseći*
14. Copy *kopirati/iskopirati/kopi*
15. Folder *fascikla/folder*
16. Update *ažurirati/apdejtovati*
17. Insert *ubaciti/umetnuti/insertovati*
18. Delete *obrisati/dilitovati/dilit*

Figure 3 shows the results of the frequency of use of computer terms in regard to English term.





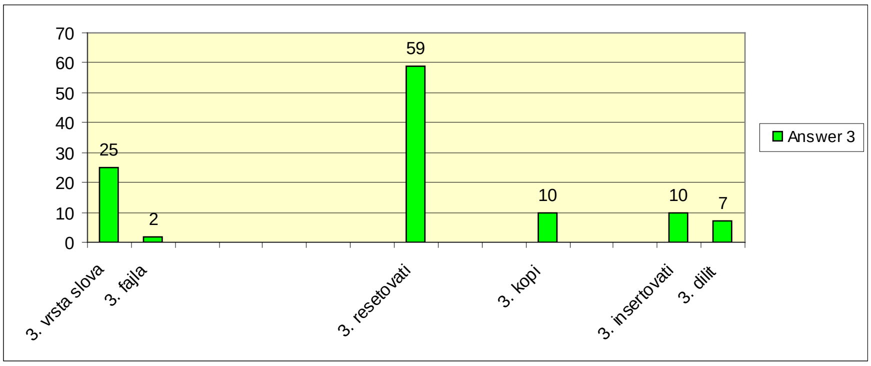


Figure 3. *The results of the frequency of use of the terms offered in regard to the terms in English*

Based on the presented results we can conclude that respondents give priority to domestic terms compared to anglicisms. Anglicisms are used more only in 4 of 18 cases.

6. CONCLUSIONS

English language and Computer technology are certainly going side by side supported by the fact that majority of computer terms originated form English language.

The rapid development of science and technology itself imposes the development and upgrading of specific skills and abilities. This certainly includes good computer skills and knowledge of English language.

Given the fact that majority of respondents have background knowledge of English language and Computer technology, based on years of learning in primary and secondary school, our goal was to determine how much the respondents are able to apply previously acquired knowledge in mentioned fields, that is, to determine which term respondents prefer: the one in English language or the one in Serbian language.

In this paper we have specifically dealt with the issue of use of computer technology related vocabulary by the students of VTSSS Urosevac in Leposavic. Corpus was narrowed to the terms which are considered elementary and which are taught at an early age. Therefore, our research has been focused only to this target group.

Results of the questionnaire showed that respondents have good command of the English language and that they are familiar with computer terminology, since they were able to identify all 18 items. This goes in favor to the fact that respondents' primary profession is not English language, but that they can apply English language skills in their profession while using the computer.

The results indicate a good outcome, given that the respondents- future professional engineers are expected to contribute to the development of science and technology.

Good knowledge of English language and computer literacy are certainly one of the prerequisites for achieving good results in their future career.

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UDK: 004.42+004.738.12]:371 Review paper

Introduction of computer algebra systems in electrical engineering education using Wolfram language on Raspberry pi

Vladimir Mladenović[1], Miroslav Lutovac[2] and Sergey Makov[3]
[1] Faculty of technical sciences Čačku, Svetog Save 65, 32000 Čačak, Serbia
[2] University Singidunum, Danijelova 32, 11000 Belgrade, Serbia
[3] Don State Technical University, Shakhty, Rostov Region, Russian Federation
e-mail vladimir.mladenovic@ftn.kg.ac.rs; lutovac@gmail.com; makovserg@yandex.ru

Abstract: *This paper introduces the innovative use of symbolic calculation in field of computer science on low cost computers Raspberry pi with free software in education and engineering design. A new approach is presented for acquiring of basic knowledge in the field of solving electrical circuits using symbolic tools by applying computer algebra system. As an example of rapid learning, the analysis and solving of transient response in electrical circuits are illustrated. For this, it is needed a good knowledge of differential equations and set initial conditions. Solving can sometimes be exhausting when done by hand, but in complex circuits are almost impossible. Many numerical-based software tools can provide a graphical interpretation of the transitional response, but cannot provide an analytical result in close form solutions. The new methodology provides a way for students to learn faster solving of transient response of electrical circuits, and engineers gain a better insight into the processes that are running.*

Keywords: *symbolic computation, computer algebra system, transient response, software tools*

1. INTRODUCTION

Traditionally, for successful learning the field of computer and engineering sciences it is needed an excellent knowledge of mathematics. In particular, it is necessary to know solving of the integral, systems of linear equations, complex numbers and differential equations. Those learning it think it is disconnected, hard and uninteresting. Those trying to employ them think they do not know enough. Teachers are constantly striving to improve the methodology for the study of the mathematics' application in their fields. Yet using math is more important to the world than at any point in human history. So at one end we have got falling interest in education where math is applied, and at the other end we have got a more mathematical world, a more quantitative world than we ever have had. Today, there are numerous mathematical software tools such as Matlab and Mathematica, which students and engineers in computer science can be used to solve complex mathematical problems [1], [2]. Instead of exhausting the students to acquire routine in solving mathematical problems, they are taught the basic theoretical concepts, and explain to them how to use this knowledge in setting problems that can meet in practice. Although the traditional orientation, such as electronics, telecommunications, energy and automation, are based on hardware solutions and components, the needs of companies, which employ engineers, are primarily in the fields of programmable hardware and the computer's application. Therefore, it tends to the basic courses are adapted for successfully mastering the skills necessary for engineer's competences. From the above facts, this paper introduces a methodology that the students apply software based on mathematics in faster and deeper understanding, and solving the electric circuits, without high level of mathematical knowledge. Relying on the classical approach in learning and applying mathematical tools in engineering sciences, distinguished four stages in learning methodology [3], [4]. The first one represents the formulation of the problem. The second involves the transfer of settings from a position of real-world problem into a mathematical problem. Third stage is followed by calculating. Finally, obtained answer in a mathematical form should be returned to the real world. Third step spends the most of time teaching students to do it by hand. However, it is a step that computers can work better than any man after many years of practice. Instead, it is necessary to use a computer for this step, and force students to be more assiduous in learning of the first, second and fourth steps - problem conceptualizing, its application, and force teachers to teach them how. In this sense, a variant of low cost computers, named Raspberry Pi [5], are appeared on the market, recently. Its performance satisfies the characteristics of a medium PC and allows access to each person to use. Free software is installed, and to the software package Mathematica which is one of the best programming language for symbolic computation, named Wolfram language [1]. All together, the Raspberry pi, operating systems on the Raspberry pi and Wolfram language are implemented in one entirety, making the integrated computer algebra system. So far, the computer algebra system included only software support on whose platform the mathematical tools are used. Now, it becomes an integral part of the hardware, especially with the aforementioned low-cost computers with free software.

2. MODELLING OF ELECTRICAL CIRCUITS AND SYSTEMS

To analyze the properties of the elements or system, mathematical models are used often. Modelling is the process of presenting a physical elements or system in a manner that enables the use of mathematical expressions [6]. Simplification of the model is carried out by adopting a number of assumptions that do not affect the essential properties of the element, a single analysis gives good results that show the essence and the most important features [7]. The electrical circuit represents the connection of two or more elements. Connecting element is made conductive. The most often, the resistances of conductives are ignored. Node of circuit shows that the two connections are short-circuited and represents the connecting point of two branches and two or more circuit elements. The loop is any closed path through the circuit so that through one node can go only once. The term of contour is used for loop that does not contain any other loop.

2.1. Circuits with variable currents

Changes connections between the elements in electrical circuits are modelled by opening and closing a switch very often. Theoretically, analysis of circuits means that the phenomenon known from infinity to the observed moment, for example, if the element is modelled by integral. To avoid too complicated mathematical apparatus, the appearances in electrical circuits are modelled from a certain moment. It represents switching on an element that connects with branch of circuit, and from that moment to observe what happens to the voltages and currents in the circuit. Practical significance is the phenomena that occurs from the moment of change, but until all the voltages and currents cease to change, i.e. reach a value that is practically unchangeable. This paper introduces a new approach in solving of electrical circuits with transient response using mathematical models, which are based on current changes. In practice, these changes gradually changed from one value to another [8], [9].

Such an analysis makes easier calculation and the essence of the changes that are occurred still reasonably accurate. In the analysis of transient response, two passive elements, capacitors and inductors, have a dependency on the voltage and current that are proportional to derivation and integral, while the third element, the resistor, has a constant relationship between voltage and current. All three elements are linear, because the relation between voltage and current is represented by the linear differential equations.

2.2. Differential equations of second order

For successful solving of voltage and current circuits with one resistor, one capacitor and one coil, in situations when voltage or current independent sources are changed, it is necessary to know mathematical equations solving of differential equation of second order.

It is understood that the second order differential equation has constant coefficients:

$$\frac{d^2x(t)}{dt^2} + a_1\frac{dx(t)}{dt} + a_2 x(t) = f(t) \tag{1}$$

Generally, it is needed to find solutions of previous equation x (t). The variable can be represented by the sum of two solutions, one of which is called a forced solution, and another natural solution. The coefficients a_1 and a_2 are constants and the function $f(t)$ can be any function of time. For the current and voltage in a transitional response, the function $f(t)$ is constant and can be equal to zero. For both solutions, it is necessary to implement a number of steps and eventually write the final solution based on the analysis of specific cases.

3. SERIAL CONNECTION OF COIL, RESISTOR AND CAPACITOR

When capacitor and inductor are present in the same time in the circuit, then circuit that is more complex is obtained. These are circuits composed by sources, resistors, capacitors and inductors. Consider now the circuit in Figure 1. This circuit represents a serial connection of voltage sources, coil, resistor and capacitor. Now of t_0 there is a change switch position, so that the value of the DC voltage source changes. Up to the moment of t_0 sufficient time has elapsed to steady state, and there are no changes of voltages or currents in the circuit. Since the capacitor is serial linked with other elements, the current through all of the elements is zero. Since the voltage on the resistor and the coil is zero, the voltage on the capacitor will be equal to the voltage by the independent source. Accordingly, the initial value of the coil current is zero, and the initial value of the voltage on the capacitor is V_0. At the moment of t_0 the switch is switched from position 1 to position 2, and then the resistor and the coil between two nodes are on a different potential, on the one side this is voltage of the new voltage source, and the other side this is voltage on the capacitor, which can not to change the value immediately. In addition, the current through the coil, which is the current through all the elements, cannot be changed immediately.

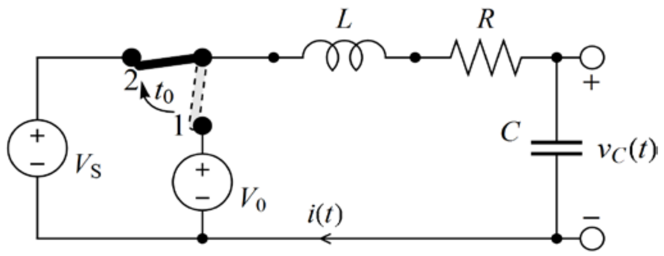


Figure 1. *Electrical circuit of second order with serial link of coil, resistor and capacitor.*

In this case, solving of the transient response is done by writing the general form of differential equations in Wolfram language. The symbol x represents the current through all elements of circuits by applying equation (1). Square brackets **`[]`** are used to highlight the independent variable, it is the time **`t`** in this case. Designation **`f`** is any function, but in this analysis, it is constant or, more often equals zero. The first and second copy (**`'`** and **`''`**) to denote apostrophes immediately after the symbol for the time function **`x`**. Blank sign between the expressions is used instead of a sign for multiplication, double equality (**`==`**) is used to emphasize that the left side is equal to the right, and one equal sign (**`=`**) is used to assign some expression to a symbol - in this case it is the **`eq1`**, which assigns the entire expression that describes the differential equation:

```
eq1 = x''[t] + a1 x'[t] + a2 x[t] == f
```

Constants (**`a1`** and **`a2`**) are assigned in the equation in accordance with the established equations:

```
a1 = r/L;
a2 = 1/(L c);
```

Resistance, capacitance and inductance are marked with symbols **`r`**, **`L`** and **`c`**. The initial condition **`x[0]`** is assigned to the symbol of **`cond1`**.

```
cond1= x[0]==0;
```

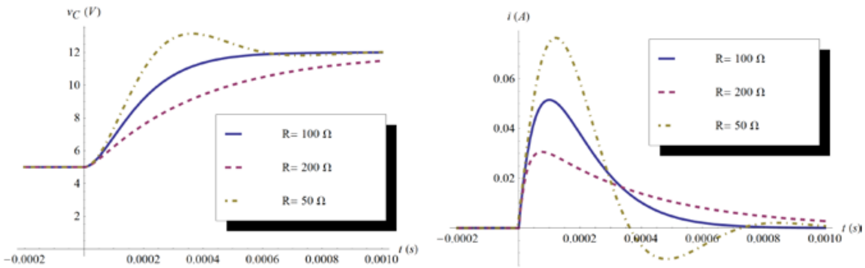
The command that finds the solution of differential equations is **`DSolve`**. Arguments of this command are the symbols that contain a description of the differential function **`eq1`**, if the initial conditions are known **`cond1`**, symbolic code for a function that is obtained by solving the differential equation **`x[t]`** and the symbol for the independent variable **`t`**:

```
DSolve[{eq1,cond1},x[t],t]
```

In this example, the solution will contain one specific constant defined as a symbol of **`C[1]`**. In order to determine it is needed to do integration of current according to the formula for the voltage of capacitor, to determine limit when the independent variable tends to infinity. By equating the limit with the value of voltage of capacitor with end of all changes, unknown constant **`C[1]`** is easily determined. For all three cases, the software determines the symbolic solution, where values of components are L=5 mH, C=2 μF, R=100 Ω for critically dimmed solution (R=200 Ω to dim the solution, R=50 Ω for undimmed solution) V_S=12 V, V_0=5 V. The response of the close form in Wolfram language is shown as follows:

```
{1400 e^(-10000 t) t}
```

In Figure 2a) shows a change in voltage on the capacitor, and Figure 2b) shows current that flows through all elements of the circuit. Current has been zero to the moment of change of the switch, and current asymptotically approaches zero. The current is approximately equal to zero already after 1 ms. It seems that undimmed solution has an oscillatory character, and that is likely to approach zero when the resistance value is equal to dim critical condition.



a) b)

Figure 2. *Voltage on capacitor a) and current through elements of circuit b) for C=2 μF, L=2mH, V_S=12V, V_0=5V.*

The voltage on the coil can be determined when the voltage of the voltage source subtracted voltages across the resistor and capacitor. This example demonstrates that it is enough to know the basic laws of electrical engineering (Ohm's law, Kirchhoff's first law, Kirchhoff's second law, the expressions that define the relationship between the voltage and current of passive elements), the limit value when there is no changes of voltages and currents in the circuit (the coil is replaced by a short connection, the capacitor is replaced by an open connection).

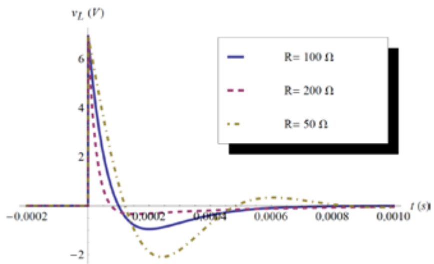


Figure 3. *Voltage on coil and capacitor a) and current thought elements of circuit b) for C=2 μF, L=2mH, V_S=12V, V_0=5V.*

Differential equation should be entered in the manner as was done in this case, and the software will find a solution in close form as if the execution carried out by hand (software will determine which of the three cases is really happening). All figures are drawn based on the derived expressions of software in this paper.

4. CONCLUSION

Application of new technologies in education aims to speed up the learning process. This is especially important in engineering sciences because of the great needs of the economy in information technology to quickly obtain expert. Concerning this, teaching materials, which are studied and where mathematics is present, have aim a deeper and faster understanding of engineering fields by students. Since much of the time spent in learning to perform derivation of formula, it can have a consequence that the student makes a mistake or do not understand the problem solved. This paper introduces the use of symbolic calculation in the field of computer science at cheap Raspberry Pi computers with free software. A new way for the acquisition of basic knowledge in the field of solving electrical circuits using symbolic tools using computer algebra system is presented. As an example of rapid learning presents the analysis and resolution of transient response in electrical circuits. Illustration of writing equations in the software package using Wolfram language to write code skips the part of the calculation that takes the most of time. Thus allowing the student to quickly get ready-made solutions.

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UDK: 004.6:811.163.41`342.4 Professional paper

Serbian language speech database "Phonemes_1.0": Design and application

Branko Marković[1], Vladimir Milićević[1], Dragana Petrović[1], Dejan Nešković[1] and Gordana Marković[2]
[1]Čačak Technical College, Čačak, Serbia
[2]Technical School, Čačak, Serbia
e-mail brankomarko@yahoo.com

Abstract: *In this paper we explained how to create Serbian speech database called "Phonemes_1.0" and how to use it for pattern match tests. This database contains a list of all 30 phonemes that cover the Serbian alphabet called "Azbuka". The database is divided in two parts: vowels and consonants. For vowels we applied an initial DTW comparison.*

Keywords: *Serbian speech database; vowels; consonants; DTW algorithm.*

1. INTRODUCTION

Automatic speech recognition (ASR) systems are very popular nowadays. They are based on different approaches. Some of them are related to isolated phonemes, syllables or words and some of them are related to continuous speech. Also they are divided to speaker independent and speaker dependent systems.

In order to do comparison between speech patterns some referential data must be provided. So, this paper is related to problem how to create a database [1] [2] with speech patterns. In this case the question is: "How to collect phonemes for Serbian language speech and how to organize them in the database?"

The phonemes of "Azbuka" is recorded in a special acoustic room where noise is suppressed. For this project 20 volunteers (students from Cacak Technical College) are participated. All recordings are labeled on specific way ease for later use. On some elements of database (vowels) initial DTW (Dynamic Time Warping) test is conducted and results are presented here.

This paper is organized on the following way: Section 2 explains how data are recorded, and what kind of equipment is used. Section 3 explains how data are labeled and how they are stored in "Phonemes_1.0" database. In section 4 we presented some initial test of vowels recognition based on pattern-matching technology. The last section is Conclusion and there are remarks related to this project.

2. RECORDING DATA

The "Phonemes_1.0" database was recorded in a quiet laboratory room by using an Optimus omni-directional microphone with good frequency response up to 16 kHz. (Figure

1.) and lap-top computer Fujitsu-Siemens Esprimo Mobile with Adobe Audition 1.5 software for speech recording.

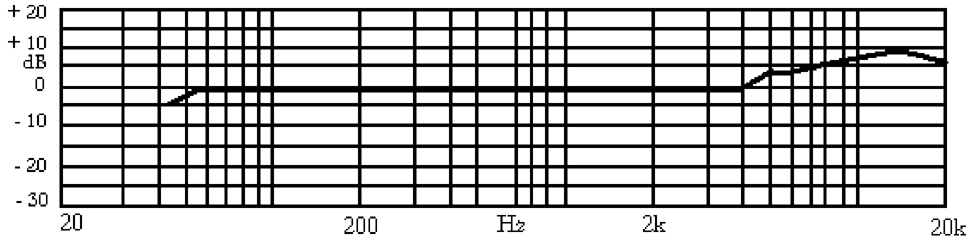

Figure 1. *Frequency characteristic for Optimus microphone*

The microphone was at a distance of about 25 cm from the mouth of a speaker. The speech was digitized by using the sampling frequency of 22.050 Hz, with 16 bits per sample, and stored in the form of Windows PCM wave files.

The sessions of recording were organized four times so as to collect a sufficient number of good quality representatives (two of four were eliminated). During a single session speakers had read 30 phonemes of “Azbuka” two times. Then the whole set of recordings was segmented manually and the quality control applied to it. If the examined patterns was satisfactory, it was labeled and stored in the “Phonemes_1.0” database; otherwise, it was eliminated. It is on this basis that a collection of more than 1.200 phonemes was generated, but only 1.200 of them were stored in the “Phonemes_1.0” database.

The quality control of recordings found various type of error. Some of them were related to an incorrect articulation, a wrong pronunciation, blown microphone etc. Multiple new recordings were sometimes required to solve these problems.

The patterns stored in the database were divided in two sub-corpora: vowels (5 patterns) and consonants (25 patterns). They are presented in Table 1 [4] with the IPA notation for each of them.

Table 1. *Phonemes captured in “Phonemes_1.0” database (with IPA notation)*

Type	Phoneme	IPA	Type	Phoneme	IPA
vowel	/а/	/a/	cons.	/љ/	/ ʎ /
vowel	/е/	/e/	cons.	/м/	/m/
vowel	/и/	/i/	cons.	/н/	/n/
vowel	/о/	/o/	cons.	/њ/	/ ɲ /
vowel	/у/	/u/	cons.	/п/	/p/
cons.	/б/	/b/	cons.	/р/	/r/
cons.	/в/	/v/	cons.	/с/	/s/
cons.	/г/	/g/	cons.	/т/	/t/
cons.	/д/	/d/	cons.	/ћ/	/ tɕ /
cons.	/ђ/	/ dʑ /	cons.	/ф/	/f/
cons.	/ж/	/ ʒ /	cons.	/х/	/h/
cons.	/з/	/z/	cons.	/ц/	/ ts /
cons.	/ј/	/j/	cons.	/ч/	/ tʃ /

cons.	/к/	/k/	cons.	/џ/	/ dʒ /
cons.	/л/	/l/	cons.	/ш/	/ ʃ /

From the aspect of speech recognition the vowels are more interesting then consonants because they are more frequent in speech and they can stay alone.

For one particular speaker we provided waveforms for each of five vowels in Figure 2.

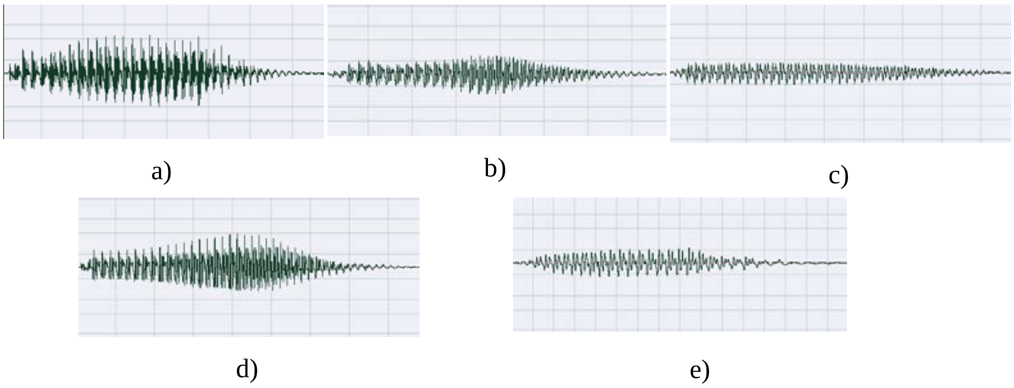

Figure 2. *Waveforms for vowels a) for /a/, b) for /e/, c) for /i/, d) for /o/ and e) for /u/*

From this figure we can see the most shapes of waveforms are similar. But when some methods for spectral analysis are applied the specters will appear different for all of them.

3. LABELING DATABASE

In order to make easy and automatic way for test with this database appropriate labeling must be performed. The labels are chosen to be self-descriptive. So, for vowels all wave files are labeled in the following way: ***vn_m_p.wav***. Letter "***v***" indicates vowel and "***n"***, "***m"*** and "***p"*** are numbers with the following meaning:

- ***"n"*** is a number which indicates an order of vowels (1 - means /a/, 2 - means /e/ etc.)
- ***"m"*** is a number which indicates speaker (1 - means the first speaker, 2 - means the second speaker etc.)
- ***"p"*** is a number that indicates the number of utterance of the same speaker (1 - means the first utterance, 2 - means second utterance etc.)

Using this principle we also generated labels for consonants. So, consonants have the following names: ***cn_m_p.wav***. Meaning of "***n"***, "***m"*** and "***p"***is identical as it explained for vowels.

4. AN INITIAL DTW TEST

In order to evaluate data in this database some initial tests are conducted. The goal of these tests is to see how this database can be used for automatic speech recognition (from the aspect of phonemes) and what will be the recognition rate for vowels.

As a front-end for this ASR the LPC (Linear prediction coding) features are used [5] with the order of autocorrelation ***p=12***. As a back-end for this comparison the DTW algorithm is used [6].

The DTW algorithm is based on dynamic programming and the goal is to find an optimal path between the starting and ending points of two pattern representations. The speech patterns are represented by a set of vectors. The first set of patterns (5 vowels) is used as a reference, and the other patterns (nine sets, each consisting of 5 vowels) are test data. For local constraints the type I proposed by Sakoe and Chiba [7] is used where a diagonal step is preferred. Global constraints are not used. The system was not trained.

The results in form of the word recognition rates are given in Table 2. The diagonal of this matrix shows a number of successful recognition.

Table 2. *Word recognition rate for vowels with confusion matrix*

Ref/Test	/a/	/e/	/i/	/o/	/u/
/a/	7				1
/e/	2	5	1		
/i/		4	7	1	
/o/			1	6	
/u/				2	8
Average	77.78	55.56	77.78	66.67	88.89
Summary	**73.33**				

Based on result from Table 2 vowels /e/ and /o/ had lower scores. The best result is for vowel /u/ . The average recognition rate was 73.33%.

5. CONCLUSION

This paper gives one of ways how to create speech database in this case it is for Serbian language and for phonemes from “Azbuka”. Using appropriate techniques and labeling the database should be well organized, easy for access and convenient for use.

For test purposes different algorithms can be applied. Here, with LPC as a front-end and DTW as a back-end we showed how to do a particular test and how to obtain the word recognition rates for vowels. Similar scenario can be used for consonants and can be applied to whole words.

Further work will be focus on these areas.

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Grails application in entrepreneurship

Katarina Mitrović[1], Danijela Milošević[1], Nenad Stefanović[1] and Marjan Milošević[1]

[1] Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia
e-mail katarina.mitrovic@ftn.kg.ac.rs, danijela.milosevic@ftn.kg.ac.rs, nenads@kg.ac.rs, marjan.milosevic@ftn.kg.ac.rs

Abstract: *The subject of this paper is the development of applications in the field of entrepreneurship using the Grails framework. This study describes some of the most important Grails features and its architecture. The demonstration application, which was created for the needs of this papers, is based on Grails framework and it is developed for the company's Sales subsystem. The goal of this work is analyzing the use of Grails framework in the field of entrepreneurship and providing an overview of the results of the analysis, as well as the advantages and disadvantages that have been proved during the research. Also, in this paper the overall impression of whether Grails meets the software requirements set by today's complex business environment or not is presented.*

Keywords: *Grails; Entrepreneurship; Framework*

1. INTRODUCTION

An aspect of life that is mostly changed with the invention of computers is the business aspect. Computers have made it possible to accelerate business processes and provide space for the expansion and development of business. Most of the administrative tasks that were once performed manually can now be performed through a computer program. The creation and processing of data and documents, accounting programs, programs for calculation of salaries, programs for virtual meetings and sending e-documents, ERP software, and e-commerce applications, are just some of the computer programs with whom a big part of any enterprise business can be covered.

In order to meet increasingly extensive and complex requirements of companies in the software sense, combining multiple programming languages is necessary. Beside the basic functionalities required by users, providing of fast, secure and flexible software is necessary. The team of programmers that created the program for the company must be available to maintain and upgrade the software, in case of errors, system crashes or expanding user requirements. It is very important to perform a thorough evaluation of all criteria in the selection of appropriate programming languages and frameworks for application development.

Most of the frameworks combine multiple programming languages, where each functionality is developed with most adequate language. Many well-designed application benefits can be achieved by choosing the right framework, because a variety of mechanisms for creating sustainable, concise and secure applications are integrated in frameworks.

In past few years, several authors presented their research of Grails application development in entrepreneurship. The paper [1] summarizes the advantages of Grails framework in developing the enterprise-level application by utilizing current Java resources. The paper [2] studies and designs Office Automation System based on Grails. The authors in [3] discuss domain oriented development of enterprise web application, and also a procedure of domain oriented development using Grails is showed in detail. The work from Szymajda and Zabierowski in [4] demonstrates how to use Grails and Groovy languages in creating schedule manager. Also, the paper [5] presents a comparison of Web frameworks, including Grails, in order to establish the best practices for Web development. The autors in [9] analyse the development of plugin for RDFa semantic information exposing using Grails. The paper [10] describes the experience of implementing Grails in textual analysis software building. The autors of paper [11] explore Grails implementation in area of web-based 3D collaborative virtual environment for distance learning. The work [12] presents a rich internet application for remote visualization and collaborative annotation of digital slides in histology and cytology developed in Grails and concludes that proposed web software is generally applicable and its methodological choices open the door for large-scale distributed and collaborative image annotation and exploitation projects. The research [13] proves that Grails can be used in area of distributed system with service resource oriented architecture development. The autors in [15] studies an enterprise framework for computational chemistry based on Grails framework.

In this paper, Grails framework will be discussed. In the next section, the basic features and architecture of Grails frameworks are described. In the third section, the demonstration application is described. In the fourth section, the use of Grails frameworks in the field of entrepreneurship is analyzed and an overview of the results of the analysis are provided. At the end of this research, the overall impression of whether Grails meet the requirements set by today's complex business environment or not, is presented.

2. ABOUT THE GRAILS FRAMEWORK

Grails framework is an open source web framework based on Groovy and Java programming languages. It was designed to combine the advantages of existing Java technologies under a simple interface [6].

The Grails framework architecture is shown in Fig. 1. Grails implements ***MVC*** architecture and is based on ***Java virtual machine***. It combines multiple technologies such as Spring, Sitemash, Hibernate and Quartz. Programming code in Grails can be written either in Java or Groovy programming language.

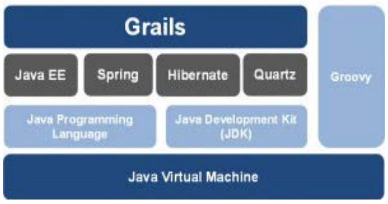

Figure 1 – *Grails architecture* [7]

Grails framework integrates an important rule - "***convention over configuration***", meaning that all of the configuration files are already set in Grails and that developers can immediately start developing the application, which significantly shortens the time needed for development. Convention over configuration in Grails is achieved with the tools that perform automated configuration - Tomcat and HSQLDB.

Some of the dominant technologies applied in Grails are ***GORM*** (technique for mapping created on the model of Hibernate ORM), ***RAD*** model for quick application development, embedded domain-specific languages (***DSL***), asynchronous programming, run-time and compile-time metaprogramming etc.

Grails frameworks became very popular in short time and some of the worlds most famous companies which uses this framework for its business improvement are Netflix, BestBuy, Cisco, Google, IBM, LinkedIn, MasterCard, MTV, Commerzbank, NCI, Nestle, Oracle, Sony, UBS, Vodafone and many others.

The following section describes an explorative application developed in Grails for company's sales process.

3. DEVELOPMENT OF SALES MODULE APPLICATION IN GRAILS

3.1. Bussiness Aspect

Enterprise business consists of a complex and extensive set of processes, such as procurement, sales, production, marketing, finance, human resources, etc. When the enterprise business software is developing, for each subsystem should be created matching module, such as: marketing module, sales module, production module, etc.

In this paper, explorative example is implemented for the Sales module, based on the following example. Client sends request for an offer to the Sales Department, which contains information about products that are necessary for the client. Based on this request, the offer/pro forma invoice is created, which includes information about the characteristics of the required products and conditions of sale. The offer is submitted to the client. Afterwards, the sales order is created by client and sent to factory. Upon that, the request for the production of ordered products is created and sent to the Production Department. After completion of the production, products with product receipt are delivered to warehouse. Then, the warehouse creates consignment note in four copies. These documents are sent to the client together with products, whose signature confirms that the products are delivered. One copy of the consignment note is created for the buyer, while the remaining three are for warehouse, Bookkeeping and Sales Department.

In exploratory application one simple (entry, modification and deletion of products) and one complex (entry, modification and deletion of orders) use case that occurs in previously described Sales module are implemented.

3.2. Technical Aspect

The demonstration application is developed in NetBeans development environment using Grails framework. Two main programming languages are used for the implementation of exploratory web application - Java and Groovy. Besides, two more important languages were used - HTML programming language for the presentation layer and the SQL programming language for constructing database queries. One of the application's functionality is implemented as REST service in Maven, with the Grails at the client side.

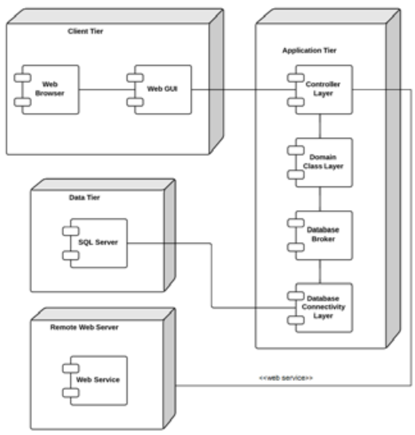

Figure 2 – *Deployment Diagram*

A deployment diagram of demonstration

application is shown in Fig. 2, where application software, hardware and architecture can be seen. The application implements a three-tier architecture, consisting of a client, application and database tier. Database tier is implemented in SQL Server and associated with the application in the Grails database connectivity layer. Database connectivity layer is connected to the database broker, which has access to the domain classes. Domain class layer is connected to the presentation layer trough the controller layer. Presentation layer consists of a user interface that can be accessed to with a web browser. The application uses the remote service, implemented in Maven.

3.3. User Aspect

Grails user interface is a dynamic web interface, which is developed with HTML, CSS, JavaScript and other programming languages. Grails can provide very easy and fast integration with Bootstrap, which results in rich user interface with modern and accessible content, with minimal programming effort.

The home page (Fig. 3) contains a menu with implemented functionalities - input, editing and deleting of products or orders.

After the implementation and descriptions of explorative Grails application, the performance analysis can be made, which is described in next section.

4. RESULT ANALYSIS

Grails is the framework that combines multiple programming languages, i.e. it requires the use of different programming languages, depending on the part of the application that is being implemented. HTML, CSS, and similar languages are used in the presentation layer of application, Groovy is used in the logic layer, and SQL query language is used for communication with the database. For Grails applications development, knowledge of at least three programming languages in different domains is necessary, which means that it requires at least basic knowledge of polyglot programming. Also, Grails offers the possibility of combining other programming languages, because even though the Groovy programming language is inseparable part of Grails framework, Grails can execute the code written in another programming languages. Grails can have plug-ins, with which interoperability with other programming languages like Clojure, Scala and Ruby can be achieved. These plugins represents the Java implementation of the aforementioned programming languages on the Java virtual machine. In controllers, domain classes and the broker database, Groovy and Java programming languages can be combined, in order to obtain maximum benefit from both languages.

Figure 3 – *Explorative application home page*

Grails framework provides a great flexibility in writing code, and different programming language features can be combined within it. The quality of implemented functionalities can be significantly raised without time or other losses if programming languages are properly used, ie. used in those parts of the application where they reach the best performance. Thus, as one of the biggest advantages of Grails, the possibility of ***creating polyglot applications*** with maximum performance and minimum investments and losses can be indicated.

Entrepreneurship is a very extensive and serious area that requires constant ***system maintenance and improvement***. In this sense, Grails can be very convenient, but some disadvantages may occure. Grails code is very concise, simple, clear, flexible, scalable and each folder has a precise purpose, so new programmer can easily understand existing application and make adjustments which client needs. However, if the developer applied a large number of programming languages for creating Grails application, it is necessary that the developers who maintain the application also have knowledge of all these languages.

As another Grails advantage, mentioning of "***convention over configuration***" is crucial. This principle allows developers to immediately start with development, which significantly shortens development time and accelerates application programmer productivity.

Grails framework represents the ***synthesis of some of the best technologies*** in the world of programming. Grails integrates their advantages and eliminate their defects, which is why high quality and performance applications can be developed. Grails applications are easy to use from the perspective of developers and users. Configuration is not required, scalability and reusability are at the highest level, development time is shortened, and a modern and easy-to-use web-based application is provided.

Grails is very flexible in terms of the ***additional technologies integration***. In order to maximize use of its potential it is necessary to learn a new programming language - Groovy and to know additional programming languages and technologies, as well as the possibilities of their integration. Some of the technologies, which are built into Grails, cannot be changed, so, for example, Grails does not support any ORM technology except GORM technology that is embedded [8].

Using only ***Groovy programming language*** in Grails application layer development can result with simple and short code, but the possibility of pattern applying is reduced to a minimum. Some Groovy functionality have its downside - *def* data type is difficult to maintain, when creating multi-threaded applications some problems may occur with GORM functionality, etc [8].

Grails has a ***large and constantly active community***, so developers who choose this framework for application development can get online tutorials and answers to questions anytime.

After a detailed analysis of Grails application development in the field of entrepreneurship, overall conclusion and suitability assessment of Grails application in the mentioned area can be made.

5. CONCLUSION

This paper aims to present a new technology, which can be applied in complex enterprise software solutions. The exemplary web application and obtained results showed that Grails framework is modern and comprehensive framework offering flexible and fast applications. From this study, we can conclude that Grails is highly suitable for use in large and complex business environments. This paper proves that Grails applications are very convenient for developing programmers, maintainance team, target users, and for the enterprise as a whole. Features such as improved maintainance, convention over configuration, additional technology integration etc, characterize Grails as a popular framework, which have spread across software community in just several years and found its place in large number of business applications. After analyses of Grails framework made in this paper, it can be concluded that Grails could be hard to master, because it integrates many technologies, but once learned, it offers developers a comprehensive tool that can solve complex problems and deliver automatization of business processes. At the same time, end users get simple and elegant software that meets their higher needs.

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The importance of programming languages in education

Olga Ristić[1], Danijela Milošević[1] and Vlade Urošević[1]
[1]Faculty of technical sciences Čačak, University of Kragujevac, Serbia
e-mail olga.ristic@ftn.kg.ac.rs, danijela.milosevic@ftn.kg.ac.rs,
vlade.urosevic@ftn.kg.ac.rs

Abstract: *This paper presents the importance of learning programming languages in schools and colleges in Serbia. The main purpose of programming languages is to create different types of applications that help people in their ordinary activities. What programming language should be learned depends on various factors. This paper presents a proposal for programming languages that should be learning in schools, so that students get the basic knowledge for further learning. TIOBE index provides an overview of the most popular programming languages in the world. In Serbian high schools in the last years are opened experimental education profile of Electro technician of information technologies. The main reason is increasing need for IT experts who will find job in short period when graduate this school. They will be educated to become desktop and web programmers, database developer or network administrators or they continue to study in faculties or collages.*

Keywords: *programming language; programming; learning;*

1. INTRODUCTION

The first general-purpose programming language was Fortran, which was created in 1954 [1]. Until the nineties, it was usually the first programming language learned in schools and colleges in Serbia. Basic and Pascal are also studied in that period. This programming languages are used to develop application for different calculation.

Object oriented programming languages are widely used in 21st century. Object oriented programming languages such as C++, Java and C# are the most frequently learned programming languages in schools and universities.

There are a large number of schools in the world which educate students in the field of Information Technology, where is studding programming languages and their application in various scientific fields. Knowledge of programming languages enable to find well-paying jobs. This is the main reason why this profession is attractive for future students.

2. WHICH PROGRAMMING LAGNUAGE SHOULD BE LEARN?

The question "Which programming language should be learn the first?" This question cannot get a one answer. The study of programming languages in Serbia starts in some primary schools within the subject of Technical Education and Information in the seventh or eighth grade or in the context of elective courses. However, some elementary school students have the opportunity to studying any programming language, so that programming languages learned only in some secondary schools. Table 1 provides a proposal of programming languages that should be first learning at the elementary or secondary schools.

Table 1. *How to choose first programming language [2]*

Programming language/Software	Description
Java/Alice	This programming language is the default language for those students who intend to learn programming in Java. It is recommended that this tool has to be used for teaching in secondary or primary schools [3]. The software can be downloaded for free from the website: http://www.alice.org/
Scratch	Scratch is a new programming language that is used to create simple animations, games, as well as any application that can be shared on the web. Scratch was designed for children aged 8 and older who want to learn basic programming skills. Website for download: http://scratch.mit.edu/
Logo/ KTurtle	KTurtle is a Logo programming language interpreter. Logo programming language is simple, so that younger children can be learned. The commands or instructions in this programming language can be translated into the programmer native language. This is the main reason why this programming language is ideal for initial learning programming, and can be used for learning math and geometry. This language is interesting for children because turtles (the icon that is used for programming and moves around the screen) using simple commands and can be programmed to draw objects. Website for download: http://edu.kde.org/kturtle/
StarLogo	StarLogo is program which create applications using the "turtle" and remind of the Logo. StarLogo allows programming of hundreds and even thousands of turtles. It is used mainly for modeling systems that do not have leaders. Some of the examples that can be modeled in this software, for example: a flock of birds, traffic jams, ant colonies, etc. Website for download: http://education.mit.edu/starlogo/
KDevelop	KDevelop is a development environment that is used for programming in any programming language. Website for download: http://www.kdevelop.org/
Java/Eclipse or NetBeans	Eclipse and NetBeans are free tools for programming and consist of a development environment for creating software. Using these tools can be developed and programmed applications in the Java programming language. It is possible to test the application, the formation of intelligent business tools, etc. It is not suitable to be used for teaching in the lower grades. Website for download: http://www.eclipse.org/
Python/ DrPython	DrPython is a simple tool for developing applications that are written in the Python. It is intended primarily for teaching in schools, while other tools are used for programming advanced EasyEclipse, PyCharm, PyScripter, Koding, etc. It can be downloaded from the website: http://drpython.sourceforge.net/
Smalltalk /Squeak	Squeak is a free tool that is suitable for creating multimedia applications using the programming language Smalltalk-80 which is based on object-oriented programming. The whole program is written in Smalltalk and has a very fast virtual machine that translates code in C. It can be downloaded from the website: http://www.squeak.org/

In secondary schools different programming languages were learning. As a first programming language in high schools previously are learning Basic and Visual Basic, then Pascal and Delphi, while in secondary technical schools C, C++ and C# are learning depending on the educational profile [3]. For all of these programming languages can be found free development environments (for example Microsoft Visual Studio Express 2015 [4]). It often happens that programming lessons in schools performed without writing code and testing programs. Students are drawing algorithms and writing programs on the paper if schools don’t have enough computers.

Pascal was the best programming language for the initial learning earlier. However, modern computers do not support old versions of the operating environment such as Turbo Pascal, Borland Pascal and Turbo Pascal for Windows. It is impossible to compile code written in this programs. Nowadays, the implementation of this programming language is not suitable for learning because it must be solved complex tasks.

Modern object oriented programming languages are very well developed, so that it should not ignore their implementation of learning programming in primary schools. Console applications that were previously only used, but they are not sufficient in future programming. Console applications are not interesting to learn programming because children everyday are surrounded with graphical contents (cartoons, movies, games, etc.). That is main reason why children are interesting for creating an application with graphical user interface (GUI).

The learning requirements that programming languages need to be satisfy are as follows [5]:

- Programming language and development environment that is used should include basic programming concepts and structures.
- Programming language should represent new programming concepts and create necessary skills that are required for programming.
- Structure of educational programming languages must satisfied modern requirements of programming. That means if someone learn basic principles of one programming language, another programming language will be learned very fast.
- The syntax of a programming language should be as simple as possible, in order to easily read and understood written program.
- Problems relating to memory management could be specially consider because they are important for learning of dynamic data structures.

3. SELECTION OF PROGRAMMING LANGUAGES FOR LEARNING

Programming languages are learning in order to apply later knowledge in the development different types of applications. Programming languages such as C#, Java, Python, C++, Objective C, PHP, JavaScript are used to create applications for different purposes such as: system programming, Web applications, desktop applications, mobile applications, Web-client applications [6]. It can be concluded that some programming languages are multi-purpose. That is main reason for learning these programming languages.

The company *Tiobe Software* [7] gives an overview of the most commonly used programming languages in the world for each month. TIOBE Programming Community index is an indicator of the most commonly used programming languages for the analyzed month. The assessment is done according to the data obtained by well-known searching engines such as Google, Bing, Yahoo!, Wikipedia, Amazon and YouTube. TIOBE index is determined in which programming language is written the most lines of code for the given month. This can be a good indicator of which programming language should be learned and to choose right programming language for building application.

Figure 1 [7] gives an overview of the most commonly used programming languages in 21st century for programming in different areas. It can be concluded that the most widely used programming languages are Java, C and C++. The Faculty of Technical Sciences in Čačak, this was the starting point that in recent year's students who study Information Technologies learn these programming languages.

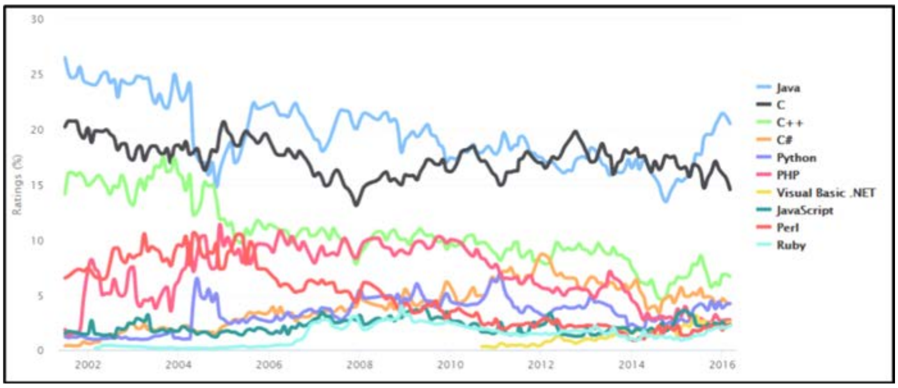

Figure 1. *The most commonly used programming language in the 21st century [7]*

Figure 2 [8] shows the algorithm that determines the reason for learning programming languages. The most common reason for learning programming is finding a well-paid job. Programmers salary in Serbia is much higher than the average, so that in recent years, many high school students study computer science.

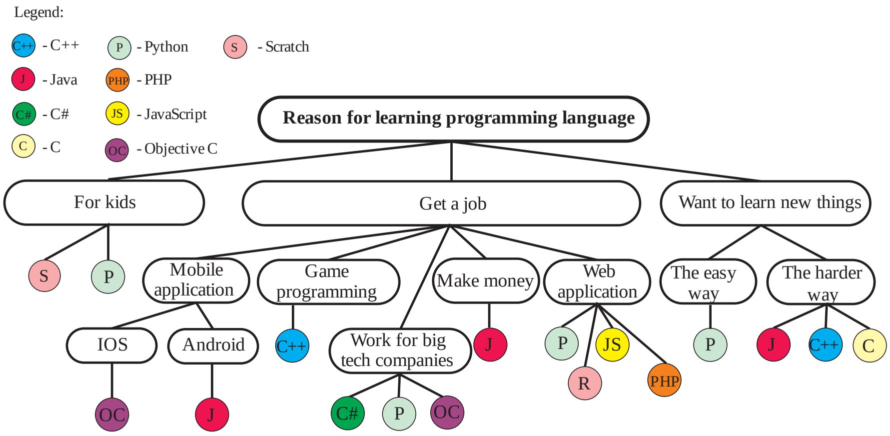

Figure 2. *Algoritm for choosing programming languages [8]*

Java is not easy to learn, but with good knowledge it is possible to apply for it for development different types of applications. What is significant for this programming language is learning object oriented programming principles that can be applied to other programming languages such as C++ or C#. Java is one of the most used programming language for developing Android applications.

Different programming languages are learning at most faculties of computer science. It is necessary to have prior knowledge of programming for studing in some faculties, while the other starts from the basic knowledge necessary for the development different types of applications.

4. IT EDUCATION IN SECONDARY SCHOOLS

One or two programming languages are learning in many secondary school with two hours per week. That is not enough to become good programer. Many high school graduate students study information technologies and this is on of the most popular studes in Serbia. Students who graduate this educational profile will faster find job. The aim of this educational profile is to improve the quality of the teaching and learning of computer science in this computerized world [9].

In the risent years in Serbia is opening private high schools for education of IT experts. The most popular are:

- Information Technology High School (IHTS) in Belgrade,
- SMART ICT Gymnasium in Novi Sad,
- ICT Gymnasium in Belgrade,

where programming languages are learning four years. A large number of national technical schools opened experimental education profile of Electrical technician of information technologies. This is four-year educational profile and it exist in high schools:

- Technical School in Cacak,
- School of Electrical Engineering "Nikola Tesla" in Kraljevo,
- First Technical School in Kragujevac,
- School of Electrical Engineering "Mihajlo Pupin" in Novi Sad,
- School of Electrical Engineering "Nikola Tesla" in Nis,
- Electrical Engineering School "Mija Stanimirović" in Nis,
- Technical School in Zrenjanin,
- Technical School "9 maj" in Backa Palanka,
- Technical School in Bečej,
- Technical School "Ivan Saric" in Subotica,
- Technical school in Mladenovac.

Programming languages and technologies that are learning in the course Programming and Web programming are: C#, C/C++, HTML, JavaScript and CSS. Curriculum in [9, 10] is adapted to modern concepts of learning programming and programming application as seminars. The Programming course is learning four years. Total number of hours in the course are 447, where 140 hours are of theoretical lectures and 307 hours of exercises. Web programming course is learning in third and fourth grade and 198 hours of exercises.

After graduated this educational profile, high school student could find job as programmers, web designers and network administrators. Studies in the field of information technology can be continue at any university of collage such as on Faculty of Technical Science in Cacak, Faculty of Organizational Sciences in Belgrade, Faculty of Electrical Engineering in Belgrade, …

Programming languages are generally learning one year in educational profiles in Serbia such as Electro technician for computers, Electro technician for electronics, Technician for computer control, in Gymnasiums and so on. In these secondary school are learning one programming language which will be implemented for learning different application software for a certain educational profile. With this knowledge of programming these high school graduates can't find jobs as programmers because they don't have enough knowledge of programming.

4. CONCLUSION

Initial learning programming depends primarily of the person age and interests where acquired knowledge will used (development desktop or web applications, system programming, etc.). Python is a good programming language for initial learning. The syntax of this programming language is simple, and is widely used in education in the world, while in Serbia is not learning in schools or faculties.

Although in Serbia are learning programming languages in primary and secondary school, that knowledge is generally not enough to created complex applications. Due to the great interest of students to attend secondary schools in the area of information technology in Serbia in the last few years are opened experimental educational profile Electro technician of information technology in many high technical schools. The main reason for great interest in this educational profile in enrollment in secondary school is the possibility of finding jobs or continue to study.

In primary schools in Serbia programming languages are not learn as a separate subject. Basic knowledge of programming students should be gained at the end of primary school. In future school reforms should be consider the Programming languages as new subject. It can be used for solving mathematical problems or create simple educational games, which will be interesting in this age of the students. This case would impact on the future orientation of students to attend the secondary schools with educational profile of information technology.

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Innovation sources of knowledge for clustering standardized field of creativity[1]

Živadin Micić[1] and Vesna Ružičić[1]
[1] Faculty of Technical Sciences, University of Kragujevac, Čačak, Serbia
e-mail micic@kg.ac.rs, vesna.ruzicic@ftn.kg.ac.rs

***Abstract**: This paper presents a comparative analysis of global (ISO/IEC) and local (SRPS) knowledge sources in PDCA loop quality, with the ability to monitor innovation intensity in the standardized fields of creativity. The study refers to standardized fields of the first level of International Classification Standards (ICS1) grouped in clusters of innovation. The paper focuses on the latest trends in the knowledge sources, and trend lines of certain standardized field of higher (daily) intensity of innovation in the fields of technics and informatics: ICS1 = 25 Manufacturing engineering and ICS1 = 35 Information technologies. The aim is to monitor the intensity of knowledge innovation, trends, sources of knowledge by innovation clusters and update the knowledge base for quality improvement (on standardization platform).*

***Keywords**: knowledge sources; knowledge base (KB); trend; cluster innovation; standardization*

1. INTRODUCTION

Knowledge in education process often requires significant expenses. Therefore, establishing the mechanism or model of knowledge which will be applied in complex processes bears particular significance. However, the observation and implementation of international (ISO/IEC, [1]) and local standards (SRPS, [2]) are necessary both in education and bussiness processes. Creation of *Knowledge Base* (*KB*) provides automation solutions to the problem. *Knowledge* modelling forges a path towards the desired Information-Expert System (IES) in the PDCA *quality loop* [3]. The availability and access to knowledge sources provide more reliable basis for efficient development activities of knowledge base system, as in [4]. EFQM excellence model [5] offers an adequate frame for creation and analysis of the model for conducting *knowledge* management.

The starting point for monitoring *Knowledge Sources* Innovation is archiving information on quantity and value of the *Knowledge Sources* (KS) in all fields of creativity at the first level of (ICS1) classification. As in the paper [6] in which the clustering method was applied in one standardized field, this paper shows all fields at the first classification level (ICS1). Grouping into clusters was realized according to innovation intensity of knowledge sourses.

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1.1 Research objectives and initial hypotheses

The research gives insight into creation of *Knowlegde Base* (KB) and *Knowledge Base Systems* (KBS) in the standardized fields, according to the influencing factors for knowledge innovation, viewed from various prespectives. *KB* planning can be realized from various perspectives with the purpose to develop and apply IES, starting from *knowledge sourse.* On the basis of the defined comparative indicators, such as index of quality (Iq) and index of value (Iv), innovations are set in the observed *knowledge domains* DK1. The activities in the PDCA are analyzed.

In many scientific papers, PDCA methodology has proved to be a good example of quality development [7]. The initial hypotheses have been summarized, identified and quantified in PDCA concept, through the following questions:
1) *Plan* phase (P); Is it possible to plan resources for daily *knowledge* innovation in the specific fields on the standardization platform according to original trendlines starting from *knowledge sources*?

2) *Do* phase (D); Is it possible to define comparative indicators (indices) for all fields of creativity, in order to update *data base* and *knowledge base* in ICS1 fields?
3) *Check* phase (C); Is it possible to define clustering indices of innovation intensity at the same time in all fields of creativity?
4) *Act* phase (A); Is it possible to monitor *knowledge source* trends on the standardization platform?

1.2 Methodology and frame of research of standardized field of creativity

Methods Web research, statistical methods, multicriteria analysis and clastering have been used in the paper. Data were collected from the website of the International Organization for Standardization [1] and the National Institute for Standardization [2].

The selection and analysis of *data* have been completed in the form of clustering and determining level of innovation. Creating trends of *knowledge sourse* is followed by mathematical lines/trend relations.

Based on the frequent innovations expressed by quantities and values of *KB* units, grouping/clustering is performed according to standardization fields. According to the International Classification of Standards (ICS), all standardized fields of creativity are observed (ICS1 = 01, 03 to 99). Classified fields of the first level (ICS1) enable clustering (grouping) according to intensity of knowledge innovation into: daily, weekly, monthly and yearly clusters of innovation Clustering is closer to practical application than to theoretical and mathematical model of clustering [8]. Intensity of innovation is viewed according to the relation (1).

$$Ii_{/t} = Iqu_{/ISO/t} + Iqp_{/srps/t-1} \quad (1)$$

If:

$$Ii_{/t} > 250\text{, innovations are daily – daily cluster of innovation,} \quad (2.1)$$

$$50 < Ii_{/t} \le 250 \text{ – cluster weekly innovation,} \quad (2.2)$$

$$12 < Ii_{/t} \le 50 \text{ – cluster monthly innovation,} \quad (2.3)$$

$$0 < Ii_{/t} \le 12 \text{ – cluster yearly innovation,} \quad (2.4)$$

$$Ii_{/t} = 0 \text{ – no innovation.} \quad (2.5)$$

2. RESULTS AND DISCUSSION

2.1 Resource planning for (daily) knowledge innovation – *Plan* phase (P)

A significant number of fields belong to the cluster of daily intensity of innovation, as defined in Chapter 2.3. However, global intensity of innovation is higher than the local one in a greater number of fields. The trendlines of some standardized fields of technics and informatics with daily innovation intensity have been selected from the cluster of daily innovation intensity and they have been presented: ICS1 = 25 Manufacturing engineering and ICS1 = 35 Information technologies. A number of important details and the results of comparison of *knowledge* trends have been shown. Observed were parameters of local (SRPS) and global (ISO) sources of *knowledge*.

ICS1 = 25 Manufacturing engineering. The cumulative results of the field ICS1 = 25, for ISO and SRPS standards have been graphically presented both through the reveiw and trends of standardization:

a) including time-aspect of the research period, according to the year of publication, (ΣIv/year), from 2005 to early 2015, with a significant number of new projects in various stages of development (Iqu), Fig. 1a, and

b) trendlines (linear and polynomial) according to the data from the previous five years, and the created relations Iv/y_{ICS1}, Fig. 1b.

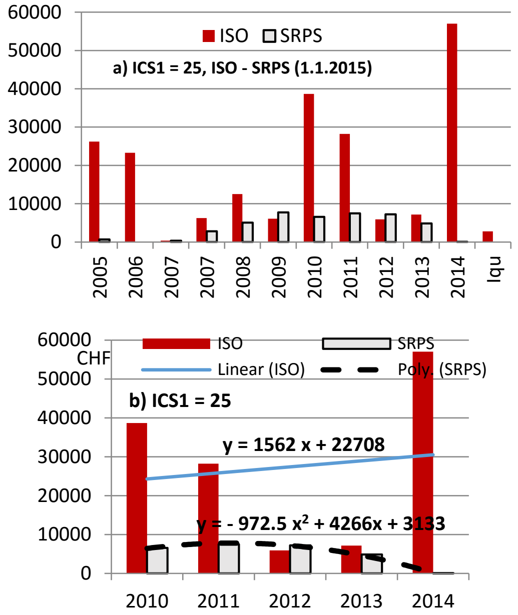

Figure 1. *Comparative analysis (ISO – SRPS) of knowledge source for ICS1 = 25 (Manufacturing engineering): a) Analysis of summary results, b) Analysis of trend lines*

$$Iv/y_{/25/ISO/2010\text{-}2014} = 1562\,x + 22708 \qquad (3)$$

$$Iv/y_{/25/SRPS/2010\text{-}2014} = -972.5\,x^2 + 4266\,x + 3133 \qquad (4)$$

A linear function (Fig. 1b) determines the growing needs trend on platform ISO standardization, which, according to relation (3) is $Iv/y_{/25/ISO/2015}$ = 32080 CHF in 2015.

<u>ICS1 = 35 Information technologies.</u> Analysed field of creativity classified through 12 standardization subfielsds (ICS2 = 35.xyz): 35.020 Generalities, 35.040 Protection, 35.060 Languages, 35.080 Software, 35.100 OSI, 35.110 Networking, 35.140 Graphics, 35.160 Microprocessor, 35.180 Peripheral, 35.200 Interfaces, 35.220 Memory, 35.240 Applications of IT.

The cumulative results of the field ICS1 = 35, for ISO and SRPS standards have been graphically presented through the review and trends of standardization:

a) including time-aspect of the research period according to the year of publishing, (ΣIv/year), from 2005 to early 2015, with a significant number of new projects in various stages of development (Iqu), Fig. 2a and and

b) trendlines (linear, logarithmic and polynomial) according to the data from the previous five years (Fig. 2b) and the created relations Iv/y_{ICS1}, (5) and (6):

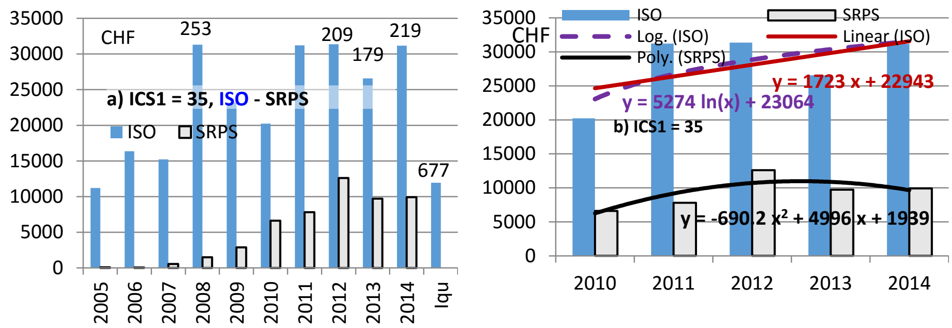

Figure 2. *Comparative analysis of knowledge source (ISO – SRPS) for ICS1 = 35 (2015.1.1): a) cumulative results, b) trends*

$$Iv/y_{/35/ISO/2010\text{-}2014} = 1723\,x + 22943 \tag{5}$$

$$Iv/y_{/35/SRPS/2010\text{-}2014} = -\,690.2\,x^2 + 4996\,x + 1939 \tag{6}$$

Given $Iqu_{/35/ISO/2014} > Iqu_{/35/ISO/2013}$, linear function (Fig 2b) specifies a growing needs trend, which, based on relation (5) amounts to $Iv/y_{/35/ISO/2015}$ = 33281 CHF in 2015, on platform ISO standardization. On platform SRPS standardization needs trend according to relation (6) amounts to $Iv/y_{/35/SRPS/2015}$ = 7067.8 CHF in 2015.

2.2 Comparative indexes number – *Do* phase (D)

The survey of the global (ISO) and lokal (SRPS) innovation index – Ii, is given in Table 1 (columns (6) and (7)), respectively *knowledge sources* (KS) fields of clusters daily intensity innovation. The measure of innovation is expressed through indices of quantity – Iq (columns (3) i (4)) and indices of the value – Iv, in CHF (columns (8) i (9)). Featured is the approximate ratio CHF = 100 RSD.

Table 1. *Indices of quantity and value ISO – SRPS (for fields of daily intensity, 2015/01)*

N	Field	Samples (KS)		$Iqp_{/SRPS}$	$Ii_{/2015}$		Iv	
		$Iqs_{/ISO}$	$Iqs_{/SRPS}$		$Iqp_{/SRPS/2014}$	$Iqu_{/ISO/2015}$	$Ivis_{/ISO/2014}$	$\sum Iv_{/ISO/1.1.2015}$
	ICS1	ISO	SRPS	SRPS	SRPS	ISO	ISO	ISO
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(8)
1.	01	2764	1218	899	88	218	5258	112860

2.	03	1078	541	410	82	188	7786	58376
3.	11	2130	1089	869	91	250	2712	74990
4.	13	2848	2863	2368	196	380	12028	154706
5.	23	1981	1588	1154	108	164	3474	75558
6.	25	4069	2423	1855	165	271	57040	275950
7.	35	6771	1721	1527	239	677	31172	365216
8.	49	1099	2344	2273	151	110	2740	49642
9.	75	1258	1070	793	103	161	4646	60640
10.	77	2061	1612	1084	101	152	5076	61716
11.	83	2876	1039	772	139	194	6816	71848
12.	91	1478	2823	2243	279	155	6512	66280

2.3 Creating clusters according to innovation intensity – *Check* phase (C)

According to the cumulative indices (indicators) of relations (1), as well as according to the clustering criterion (2.1), clusters with the greatest (daily) intensity of innovation are the following fields (Table 2).

Table 2. *Cluster fields with the highest (daily) intensity of innovation – ranking list*

N	ICS1	**Ii**	**Name of field**
1.	**35**	**916**	Information technology;
2.	**13**	**576**	Enviroment; Health protection; Security;
3.	**25**	**436**	Manufacturing engineering;
4.	**91**	**434**	Construction materials and building;
5.	**11**	**341**	Health care technology;
6.	**83**	**333**	Rubber and plastic industries;
7.	**01**	**306**	Generalities; Terminology; Standardization; Documentation;
8.	**23**	**272**	Fluid systems and components for general use;
9.	**03**	**270**	Services; Company organization, management and quality; Administration; Transport; Sociology;
10.	**75**	**264**	Petroleum and related technologies;
11.	**49**	**261**	Aircraft and space vehicle engineering;
12.	**77**	**253**	Metallurgy.

According to the intensity of innovation (1) and criteria (2.2-2.5) followed by the rest of the clusters (fields):

• Cluster weekly intensity of innovation, according to (1) and the criterion (2.2), belong to the following fields: ICS1 = 17 Metrology and measurement; Phisical phenomena; 19 – Testing, 21 – Mechanical systems and components for general use, 27 – Energy and heat transfer engineering, 29 – Electrical engineering, 31 – Electronics, 33 – Telecommunications. Audio and video engineering; 37 – Image technology, 43 – Road vehicles engineering; 47 – Shipbuilding and marine structures, 53 – Materials handling equipment, 55 – Packaging and distribution of goods, 59 – Textile and leather technology; 61 – Clothing industry, 65 – Agriculture, 67 – Food technology, 71 – Chemical technology, 79 – Wood technology, 81 – Glass and ceramics industries, 87 – Paint and colour industries, 93 – Civil engineering, 97 – Domestic and commercial equipment. Entertainment. Sports;

• Cluster monthly intensity of innovation (according to relation (1) and the criterion (2.3)) belong to the following fields: ICS1 = 07 – Mathematics. Natural sciences, 39 – Precision mechanics. Jewellery, 73 – Mining and minerals, 85 – Paper technology;

• Cluster annual intensity of innovation (relation (1) and criterion (2.4)) belong to two areas: ICS1 = 45 – Railway engineering and 95 – Military engineering.

Fields without innovations (relation (1), criterion (2.5)) do not exist within the first level of classification (ICS1) on an annual basis.

2.4 Monitoring trends of knowlegde source on standardization platform–*Act* phase (A)

Figure 3 presents the possibility to continuously and quantitatively monitor intensity of knowledge innovation, i.e. knowledge source trend on the standardization platform.

The results in the analyzed fields of daily cluster of innovation intensity in domain knowledge DK1 confirm the initial hypotheses by conducting the above mentioned research objectives in PDCA concept, and lead towards knowledge base systems, i.e. integration of several systems.

2.5 Discussion of the results of the PDCA

(P) Resourse Planning for Knowledge Innovation (daily, weekly or montly)

Bearing in mind the previosly presented trend analysis of the knowledge sources (Figs. 1 and 2), i.e. original trendlines, planning resources is possible on the basis of quantitative reviews of intensity of innovation (Table 2). As in the fields with daily intensity of innovation (weekly, monthly or yearly), it is also possible to plan resources based on trendlines, starting from knowledge source, in all fields of lower intensity of innovation.

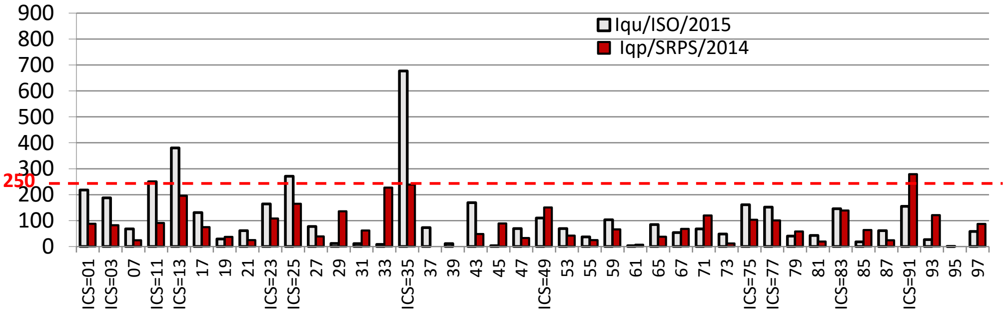

Figure 3. *Comparative review of quantities innovation ISO – SRPS sources of knowledge*

(D) Update of database and knowledge base in ICS1 fields

According to relations (3)-(6), for field *Information technologies* (ICS1 = 35) annual value $Iv/y_{/35/ISO/2014}$ = 33281 CHF. Value is comparable to other fields. For *Manufacturing engineering* (ICS1 = 25), the value amounts to $Iv/y_{/25/ISO/2015}$ = 32080 CHF. According to index of value, it is possible to plan resources for daily innovation of knowledge base, i.e. update of data base, with the aim of monitoring trends of knowledge innovation for improvement of quality product.

(C) Defining clustering indices, according to innovation intensity

Index $Ii_{/t}$, relation (1), determines the level of innovation intensity and it is assigned the values of periodical research checks (*Check* phase) for the use in practice (yearly, monthly, weekly or daily). By applying PDCA methodology, trend of knowledge innovation is checked and the future resources and financial demands in the standardized fields of creativity can be predicted, as well as innovation of knowledge base for users.

(A) Monitoring innovation trends for knowledge improvement on the standardization platform

As for the fields with the highest innovation intensity (ICS1 = 35) we determined and analysed the growing needs trend, $Iv/y_{/35/ISO/2015}$ = 33281 CHF in 2015, relation (5). By improvimg KB, predicting and providing resources, and developing information-expert system, trend of knowledge source can be monitored in all fields of creativity (ICS1 = 01, 03 to 99), on the standardization platform (Fig. 3). Thus, knowledge base can be developed by predicting and providing resources for KBS.

3. CONCLUDING REMARKS

On the basis of the results, the analysis and the proposed clustering methodology for all fields of creativity (according to ICS), the conclusions can be inferred in PDCA loop quality or in entirety, from many perspectives, with the purpose to develop IES. The conclusions are given according to the set hypotheses, respectively:

- Starting from *Knowledge Source (KS),* it is possible to plan resources for daily knowledge innovation in all ICS1 fields according to the original trendlines. The applied methodology, presented research results in KS trends and the analyzed fields of clusters of daily innovation intensity present an original, practical and safe method for determining the possibility of planning resources;
- On the basis of index parameters (index of quantity and index of value), significant and manageable possibilities to update data base and knowledge base occur in all ICS1 fields. This enables monitoring of trends of *knowledge* innovation for product quality improvement;
- The possibility to quantitatively determine clustering indices of innovation intensity is a prerequisite for grouping fields of creativity – clusters. Based on global (ISO) and local (SRPS) indices of innovation (of clustering), planned checks can be completed in all ICS1 fields of creativity, as well as innovation of knowledge base towards KBS;
- In *product* innovation, trends of knowledge innovation can be systematically and continuously monitor on the standardization platform by improving knowledge base into system – KBS. This can be achieved by predicting and providing resources, knowledge modelling, and development and application of Information-Expert System.

From the previously mentioned, we can conclude that in each PDCA cycle the application of IES brings forth improvement and expension of knowledge and availability of resources, aimed at solving problems in the target domain.

ACKNOWLEDGEMENTS

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http://www.mi.sanu.ac.rs/projects/projects.htm#Interdisciplinary.

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SECTION III:

PROFESSIONAL DEVELOPMENT OF IT AND TECHNICAL EDUCATION TEACHERS

TECHNICS AND INFORMATICS IN EDUCATION
6th International Conference, Faculty of Technical Sciences, Čačak, Serbia, 28–29th May 2016
TEHNIKA I INFORMATIKA U OBRAZOVANJU
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Comparisons of educational processes and students assessments in Spain and Serbia

Jovana Jezdimirović[1], Miloš Vučić[1], José Miró Julià[2] and Daniel Ruiz Aguilera[2]
[1] University of Belgrade, Serbia
[2] University of Balearic Islands, Palma de Mallorca, Spain
e-mail jezdimirovic.jovana@gmail.com

Abstract: *The aim of this paper is to explore how different education processes are in the terms of formal, informal and non-formal education shape and support student's assessments. Special attention is paid to the importance of complementary elements of official education which could influence values critical to a personal development of youth. Furthermore, the paper focuses on the role of information-communication technology (ICT) as an accessorial factor in different education processes which facilitates learning process, makes knowledge more accessible and less abstract. Recent reforms of settings and frames of educational policies as well as student's achievements in Spain and Serbia have been explored and contrasted. In essence, the paper gives insight into educational polices through the lens of the students assessments in order to outline the best practices and to point out preferably improvements in this matter.*

Keywords: *education policies; student's assessment; ICT*

1. INTRODUCTION

There is no doubt that the essential core of what education represents is highly complex process of learning. Therefore it is not surprise that motion pictures in 1920s, radio, educational television, computers in 1980s and nowadays smart devices and MOOCs (Massive Open Online Courses) have failed to revolutionize the education. Instead of that, these educational evolutions have strongly pointed out that we shouldn't be confused by learning process with devices itself and furthermore that educational technology won't instantly show significant difference in improving student's procedural reasoning skills, according to Crosier and Simeoni (2015). Especially, if we keep in mind the fact that social component has fundamental role in the process of learning. At the same time, it is more than obvious that technology will be ever present in the future, since the 'digital natives' live with it in every point of their lives. Therefore, instead of avoiding technology or overemphasizing its role in formal educationmore attention should be paid on using opportunities of informal and non-formal education which could foster students' knowledge, since a variety of educational medias as YouTube, blogs and so on has already been used by students on daily basis. In this way learning outcomes could be improved as well as self-directed learning which is crucial for student's assessments in general according to Mocker (1982). Definitions of each of them have been given by Coombs (1973):

"Formal education: the hierarchically structured, chronologically graded 'education system', running from primary school through the university and including, in addition to general academic studies, a variety of specialized programs and institutions for full-time technical and professional training.

Informal education: the truly lifelong process whereby every individual acquires attitudes, values, skills and knowledge from daily experience and the educative influences and resources in his or her environment – from family and neighbors, from work and play, from the market place, the library and the mass media.

Non-formal education: any organized educational activity outside the established formal system – whether operating separately or as an important feature of some broader activity – that is intended to serve identifiable learning clienteles and learning objectives."

At the same time, according to Kedrayate (2012), tendency of formal education to lead students to 'white-collar jobs' has unfairly neglected other forms of education, as for instance a non-formal education with a long lasting tradition and great influence to the children and youth. Moreover, Mocker (1982) recognizes individual's attitudes and interaction with society in general as essential parameters which give meaning to information. The last statement indicates that knowledge and academic assessments of each student depend exclusively on usage of diversity of educational processes.

We have been very interested in achieving deeper comprehension of what are the possibilities, crucial strengths and shortcomings of different educational practices both in Spain and Serbia. At the same time, data on informal and non-formal education was more than poor, which influenced that the paper became more focused on differences in formal education and students assessments in these countries.

2. EDUCATIONAL POLICY IN SERBIA

In order to contrast educational systems in Spain and Serbia, Eurydice network (Education Information Network in Europe) reports have been used. One of the most significant roles of this network is the support in providing relevant information on education systems and policies in European education systems. Its numerous reports are explaining, among all, how is each of the European education system organized and therefore represents significant guide for improvements of every and each of them.

When it comes to Serbia, according to Eurydice (2015) reports, 'Ministry of Education, Science and Technological Development bears overall responsibility for developing and implementing education policy'. At the same time, educational institutions are given high level of autonomy in planning and performing educational activities. Furthermore, education system is composed of:

- Preschool education and care (nursery, kindergarten and preschool preparatory program – which is the first part of compulsory education),
- Primary education (8-years-lasting compulsory education),
- Secondary education (3/4 –years-lasting education; grammar schools, vocational schools, art schools, etc.) and
- Higher education academic and profession-oriented studies; each academic year brings at least 60 ECTS and is divided into three levels:
    - Bachelor and undergraduate studies (3/4 years long)
    - Master and specialized studies (1/2 years long)
    - PhD studies (3 years long).

The potentials of informal and non-formal education in Serbia are underused and students are neither encouraged nor informed how to explore its benefits because of the lack of organized centers as socio educational services and educational associations. According to Jezdimirovic (2014), inadequate training for teachers in the usage of new technologies and not increasing number of useful web pages and programs in Serbian that could be complementary pedagogical tool (even if the students were encouraged to used them for the educational purposes) are contributing factors for not solving this matter.

3. EDUCATION POLICY IN SPAIN

The current Spanish education system relies on the Act on the Improvement of the Quality of Education from the 2014/15 school year and it is composed of:

- Pre-primary education (no compulsory education, up to 6 years of age),
- Basic education (10-years-lasting, compulsory education) consisted of two stages:
  - Primary education (6-years-lasting education) and
  - Compulsory secondary education (4-years-lasting education)
- Upper secondary education (2-years-lasting education): Bachillerato (general branch) and intermediate vocational training (professional branch) and
- Higher education comprises university and vocational studies and leads to the award of Bachelor’s, Master’s and Doctoral degree.

Mora et al. (2000) explains how Spanish educational system is more focused on knowledge than on student’s skills which further leads to the conclusion that Serbian education system is not the only one which has tendency to neglect or underuse potentials of informal and non-formal education. On the other hand, the same author, informs of the undertaken reforms which are leading to more empiricist and flexible curricula’ of the learning process. More recent research, for instance Cañameras and Giménez (2005), have reported numerous socio educational services and educational associations which have been making serious efforts to raise both their educational roles as well as public awareness about their activities in this area. Same authors, also claim that there are problems in informal and non-formal education as a law framework and how the activities are funded, but they also emphasize the importance and influence of educational centers as The Catalan Federation of Leisure Time Education (Federació Catalana de l’Esplai) that was created in 1996 and nowadays is composed by 104 centers, some of them with an experience over 30 years, with 11,000 children and young people and 1,400 educators and which are actively contributing in solving these issues.

4. STUDENTS ASSESSMENTS IN SERBIA AND SPAIN

For the purpose of comparing students’ assessments in Spain and Serbia, Program for International Student Assessment (PISA) test results from 2009 and 2012 have been used. This international study has been conducted by OECD in member and non-member nations since 1997. and repeated every three years in order to measure problem solving skills and cognition in daily life of 15-year-old school pupils. Therefore, similarities and differences in the students’ achievement in these two countries are viewed and contrasted in lenses of mathematical knowledge, reading competences and scientific literacy – all in accordance with above mentioned international test results.

4.1. Mathematical literacy

Looking at the average points for Organization for Economic Co-operation and Development (OECD) countries, of which Spain is a member, Serbian student's results show a difference of about 45 points in both PISA tests. This statement indicates that students from Serbia should be provided with the additional year of schooling in OECD school systems[1] in order to reach the assessments of their peers from Spain. Disturbing results for Serbia and yet favorable ones for the Spanish school system are reflected in the percentage of severity of functional literacy in the field of mathematics, where the most significant differences are shown in Figure 1.

	Proficiency levels in PISA 2009		Proficiency levels in PISA 2012		Change between 2009 and 2012 (PISA 2012 - PISA 2009)	
	Below Level 2 (less than 407.47 score points)	Level 5 or above (above 625.61 score points)	Below Level 2 (less than 407.47 score points)	Level 5 or above (above 625.61 score points)	Below Level 2 (less than 407.47 score points)	Level 5 or above (above 625.61 score points)
	%	%	%	%	% dif.	% dif.
Spain	23.7	8.0	23.6	8	-0.1	0
Serbia	40.6	3.5	38.9	4.6	-0.7	1.1
OECD average	21.9	12.7	23.1	12.6	1.2	-0.1

Figure 1. *Comparances of PISA's test results in mathematical literacy*

When considering talented students and those who can give more detailed explanations and apply methodological knowledge in real life, both countries are below the OECD average, but Spain, again, is in a better situation. Viewed in the context of mathematical competence Serbia is on par with Greece, Turkey, Romania and Bulgaria, while the fifteen-year-old Spanish students reached the same level as pupils from Portugal, Italy, Russia and the United States.

4.2. Reading Literacy

Reading literacy is one of the most important competencies in modern society because represents a person's ability to understand and use various types of texts, as well as to implement certain reading strategies and techniques of regulation. Looking through lens of PISA tests, Serbia has lower results than Spain by approximately 40 points on the PISA scale, which corresponds to a school year in the OECD countries. The difference between the average achievement in individual components and the average achievements on the reading literacy scale, shows that students from Serbia cope better in certain approaches than their peers from Spain, but achieve poorer results in the consideration and evaluation of a given text (Figure 2). At a time of very rapid development of science and technology, this could be outlined as one of the biggest issues in the Serbian education system and society in general.

[1] *Monitoring the results of PISA testing has been shown that one year of schooling in OECD countries is equal to increase of about 40 points on PISA tests*

	Proficiency levels in PISA 2009		Proficiency levels in PISA 2012		Change between 2009 and 2012 (PISA 2012 - PISA 2009)	
	Below Level 2 (less than 407.47 score points)	Level 5 or above (above 625.61 score points)	Below Level 2 (less than 407.47 score points)	Below Level 2 (less than 407.47 score points)	Level 5 or above (above 625.61 score points)	Below Level 2 (less than 407.47 score points)
	%	%	%	%	% dif.	% dif.
Spain	19.6	3.3	18.3	5.5	-1.3	2.2
Serbia	32.8	0.8	33.1	2.2	0.3	1.4
OECD average	18.5	7.7	17.9	8.5	-0.6	0.8

Figure 2. *Comparances of PISA's test results in reading literacy*

4.3. Scientific literacy

Contrasted to the OECD average points students from Serbia should be provided with a year and a half of the additional schooling in OECD school systems in order to reach their Spanish peers in scientific literacy assessments. Furthermore, this indicates that a majority of students in Serbia neither would be able to integrate knowledge from different disciplines nor will be able to apply them in everyday situations. The results related to the percentage of students in Serbia who are on the fifth level of scientific literacy or above, indicate that only 15 out of 1,000 pupils would be able to recognize, adapt and re-use the scientific elements in everyday life. This is the area where, Spain, and especially Serbia are stagnating in comparison to the countries that are members of the OECD.

5. CONCLUSION

For the purpose of investigation and outlining crucial educational practices which could easily facilitate students' skills and knowledge, this paper have contrasted recent reforms of educational policies and student's assessments in Spain and Serbia. Overall viewing of the PISA tests results, leads to the conclusion that Spanish educational system is much closer to the average of OECD countries than Serbian. Moreover, the tendency of European Union countries, concerning the decrease of percentage of students who are below the lowest level of competences in all areas, is achievable in Spain, which is not the case for Serbia – despite the fact that both countries have been going through educational reforms and changes in general. Although PISA tests are not concerned about foreign language literacy and ICT competences as necessary skills of modern society, it is more than obvious that educational processes in Serbia should adopt examples of better educational practices. For further consideration, it is left to monitor development of educational curriculum and student's assessments, in order to accomplish success in this issue. Besides the appalling fact that Serbia did not even participate in PISA 2015 tests, it is notable an increasing number of educational associations which have been making serious efforts to raise their educational roles– all its necessary is to draw public awareness about their activities in this area as well as the importance of proper education!

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ICT support to people with developmental disorders (specific learning disabilities)

Svetlana Obradović[1], Maria Papadopoulou[2], Georgia Moumou[3] and Dimitra Moumou[4]
[1] Center for special and professional education EEEEK, Katerini, Greece
[2] General hospital, Haematology Department, Katerini, Greece
[3] Student of the Faculty of molecular biology, Democritus University of Thrace, Alexandroupoli, Greece
[4] Student of the Faculty for preschool teachers, University of Thessaly, Volos, Greece
e-mail cecagrcka@yahoo.gr

Abstract: *Specific learning disabilities are one of the most common developmental disorders in inclusive education systems. For the formation of a "friendly" environment for these pupils within the school institutions, as well as for promoting and facilitating the learning process, correct application of ICT support is of great importance.The paper presents the basic principles and the positive aspects of using ICT support in work with students with specific learning disabilities, as well as practical problems that the education system in Greece is facing in this area of work.*

Keywords: *Specific learning disabilities, ICT support*

1. INTRODUCTION

Handicap or disability is traditionally observed through a medical model or approach. This effectively meant that every disability is seen as a personal flaw that causes limitations in the capabilities of the individual, which are diagnosed and treated within the medical institutions. In recent decades, this approach has drastically changed and revived a new, fundamentally different view of the handicap, which moves the focus of the difficulties in social environment. In a social approach, causing restrictions in the possibilities of a person with disability is mismatched environment, full of barriers, which may be of different types (physical, psychological, social, political, etc.). But certainly not insurmountable. For proper rehabilitation and normal life of people with disabilities is most important to remove these restrictions.

The shift from a medical to a social model has contributed to the development of inclusive educational system, within which it is necessary to adjust the maximum setting individual needs of each person with disabilities, regardless of the type and degree of manifestation of difficulties. For all kinds of difficulties it is necessary to establish a "friendly environment" within all, including educational institutions, which will help students with disabilities to function in the most efficient manner. In addition to systemic changes that are the basis for this shift, of crucial importance is educating teaching staff for these changes.

One of the most common categories of disability in student population is specific learning disability (SLD or just LD). This term is usually marked by a whole group of developmental disorders associated with mastering basic school skills (reading, writing and numeracy), but in many countries the term dyslexia has the same meaning. Manifestation of specific learning difficulty involves problems with characters (letters) and/or mathematical symbols and difficulties in connection with the phonemes and mathematical operations, slow, and difficult adopting of skills of reading and writing (inaccurate and / or nonfluent, slow reading and writing single words and text) and often difficulty in understanding the meaning of text or mathematical expression. This common clinical picture is not universal, nor is the degree of manifestation of these disorders the same in all persons; often accompanied by attention problems, delayed language development, motor skills and coordination etc. although these difficulties by themselves are not indicators of dyslexia (Rose, 2009; BDA, 2009). Visible problems are result of altered cognitive functioning, primarily related to deficient phonological processing, and insufficient working and short-term memory. There is relatively common comorbidity of dyslexia and attention deficit disorder; according to some findings (Pauc, 2005), 62% dyslexic have also and attention deficit disorder (ADD), while the 38% dyslexic present and complete hyperkinetic syndrome (ADHD).

2. PRACTICAL ASPECTS OF ICT SUPPORT IN WORKING WITH PEOPLE WITH SLD

The phenotype of these developmental disorders suggests that there is no universal support program that would fit every individual with the SLD, but it is necessary within each educational system to form a support programs that provide opportunities for the evaluation of individual educational needs of persons with SLD and then provide adequate support for each of them. Using ICT system provides additional opportunities for practice school skills and to improve concentration and attention control (Underwood, 2000), as well as to facilitate social interaction and communication among students, to develop motivation and self-confidence (Crompton & Mann, 1996).

Practically, the implementation of ICT systems in schools is used for forming a friendly and supportive environment in the learning process. Some of the important positive effects of ICT support for student with learning disabilities achievement are:

- controled environment reduces the distractors of attention in learning situation
- multimodal processing of information (a combination of acoustic, optical and kinesthetic) facilitate new learning and provides better material retention
- the possibility of unlimited repetition action allows a person with learning difficulties to master the new material in a manner and at a rate that is suitable to his personal needs
- helping to avoid the frustration caused by the failure (because no element of control involves social interaction), also an important element of the automatic control is currently corroboration (rewarding) the correct answer, which raises the level of motivation
- difficulties related to verbal and sequential learning can be reduced by using ICT support.

As a list of the positive effects of ICT on the achievement of people with SLD this does not exhaust (Bjekić, Obradović, &Vučetić, 2012), it is very important to know that the simple application of ICT system is not enough. Although worldwide developed numerous software to facilitate the acquisition of knowledge for people with learning difficulties, it is not enough to solve the problem. According to Florian & Hegarty (2004) ICT is very important in pupils' communication, interaction, cognition, and learning, as well as in their emotional and social development.

It is known that if we want to change the school reality as applying ICT support, teachers have to lead this change. There are three dimensions of the teachers' ICTcompetencies (Awouters et al. 2008, according to Bjekić, Obradović, Vučetić, &Bojović, 2014):

(a) the teacher knows what learning activities ICT can be used in teaching (ICT awareness),
(b) the teacher has the necessary skills for using hardware and software (ICT readiness), and
(c) the teacher knows the pedagogical-didactical elements of ICT (ICT drill and practice).

ICT integration in every day teaching and learning system is defined by three key components (Mishra and Koehler, according to Jimoyiannis & Komis, 2007: 153): knowledge of pedagogy that is applicable to the specific content; knowledge of how subject matter is transformed by the application of technology; knowledge of how technology can support pedagogical goals.

At the practical level, first of all, the choice of software plays a key role, since there are programs that do not enhance the learning process (Wilkinson -Tilbrook, 1995), so it is clear the necessity of continuous training of teachers, and test application of software by teachers to establish a realistic possibility for application of these tools in practice. Also, according to the findings of some researchers, the computer can not replace teachers, as direct human contact is of great significance to corroborate the positive form of learning for people with SLD, which is not given in the same way using the ICT support system (King-Sears, 2008), so teachers must have adequate knowledge in the field of psychology and pedagogy.

Ahead of all this, however, is the need for educating the teaching staff to recognize and use the weaknesses and strengths of the specific cognitive functioning of people with LD. This means that the teacher must be qualified for the evaluation of educational areas in which a person shows extreme hardship, but also, and in which areas is the best, sometimes even very talented (Heaton & Winterson, 1996); assessing the ability of expressive and receptive communication of oral and written speech of students; assessment of conditions that affect the achievement of learning (Griffiths, 2012) etc.

It is also necessary that the teacher, in cooperation with professional services (psycho-pedagogical) can find out every possible information about individual cognitive function of each student with a LD in order to know its capabilities and limitations. This cooperation is important so the teacher can organize classes in the best way to reduce distractors of attention, facilitate learning and to identify alternative learning strategies for each student individually, and in this process the computer can be helpful. Lewis & Neill (2001) recommended that teachers who work with students with LD always have a computer handy. It is significant that people with learning disabilities use the support system in the presence of teachers or parents, because it improves the learning process, but also reduces the risk of emotional withdrawal and isolation of students with LD. Therefore, the recommended practice is also to use small groups and workshops within the class in which the cooperative way comes to teaching a given objective. Teacher can facilitate learning of students with LD, and here are some examples of good practice:

- teacher creates a "word bank" for each topic dealt with, which are useful for students;
- elects software that make it easy for students to organize and develop ideas;
- commonly used diagrams, illustrations and demonstrations related to the topic and used graphic programs where there are prototypes;
- encouraging students to use different fonts;
- leaves notes on the board as long as possible, to give enough time to students with SLD;
- avoiding long sentence structures in assigning tasks, and expecting an analog answering from students; to concentrate only on the basic and essential information;
- at the end, takes into account the mode of expression, because teachers speech is the source of information, instructions, penalties and rewards for his students.

3. ICT SYSTEMS SUPPORT AND TEACHER TRAINING

Organized study the implementation and improvement of the ICT support in European countries is started decades ago. During this period there has been many different proposals and the number of system changes in order to provide equal educational opportunities for all participants in the educational process, including those who have special educational needs.

Among other things, the tasks that were set before the educational systems meant the training of teachers to enable them to identify specific development difficulties, provide insight into the nature of atypical cognitive functioning of LD and ways of forming a "friendly environment" for these people within the educational institutions, as well as the best ways to overcome difficulties in the learning process. Also, along with educators, support programs include education and preparing of all other participants who work with people with SLD (parents, psychologists, occupational therapists, speech therapists and social workers) to use ICT support systems.

Although the implementation of the ICT system does not develop at the same speed in all European countries, it is important to emphasize that in this field are working intensively and that, in most of these countries it has become quite common to further education of teachers carried out during the whole professional career.

Specifically in Greece (which in this area is unfortunately not the forefront), in the last decades were introduced special items related to the implementation of ICT systems in the curricula of university institutions, both at the basic and at the level of postgraduate studies. However, while in Greece are developed many software to support students with SLD, only in the universities that prepare future teachers and special educators are studied these special systems of support. Given the inclusive education system, there is a need for all teachers profiles to be adequately prepared to work with students with SSU, which until today has not been achieved.

During the professional development of teachers, they can attend accredited training programs related to the implementation of ICT systems if they wish, but it is not mandatory. This is one of the problems encountered in practice. In addition to these difficulties, there are other limitations in the application of the support system in Greece, which are primarily related to the lack of good technical equipment in schools.

4. CONCLUSION

We know that teachers often feel insecure and inadequate competence in relation to the use of support systems (Balanskat, Blamire, &Kefala, 2006) and the most common reason is lack of knowledge of ICT systems, and to a lesser extent, lack of psycho-pedagogical knowledge. This leads to the development of negative attitudes of teachers towards the implementation of support systems (Earle, 2002). This fact brings us back once again to conclusion that not only their education (theoretical and practical) is important, but also and possibilities for creative changes and freedom in achieving educational goals. It seems to be very difficult to achieve this goal, but at least we have to try. Removing barriers in the teaching process seems to be very complex and harder than it looks at first glance.

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Analysis of the results of the entrance exam and the first colloquium of Business informatics

Vladimir Kraguljac[1], Mladen Janjić[2] and Vera Lazarević[2]
[1] Faculty of Hotel Management and Tourism, Vrnjačka Banja, University of Kragujevac, Serbia
[2] Faculty of Technical Sciences, Čačak, University of Kragujevac, Serbia
e-mail vladimir.kraguljac@kg.ac.rs, mladen.janjic@ftn.kg.ac.rs,
vera.lazarevic@ftn.kg.ac.rs

Abstract: *This paper presents the analysis of student performance on the entrance exam and the first colloquium on the subject Business Informatics teaching in the school year 2015/2016 at the Faculty of Hotel Management and Tourism Vrnjačka Banja. The analysis is conducted through several hypotheses. For the implementation of analysis, appropriate statistics and data were used and an adequate interpretation of the results is given.*

Keywords: *hypothesis testing; entrance exam; business informatics; mathematical statistics*

1. INTRODUCTION

This paper analyzes the success of the students in the entrance exam and the first colloquium on the subject of Business Informatics in the academic year 2015/2016 at the Faculty of Hotel Management and Tourism in Vrnjačka Banja. Today, in the digital era, information and communication technologies have a great impact on daily life. Considering that the results of this study can provide new perspectives on the links between secondary school, knowledge shown in the entrance exam and the knowledge shown in the subject which is directly related to information and communication literacy.

The data analyzed in the examples are taken from the official records of Student Services at the Faculty of Hotel Management and Tourism.

2. METHODOLOGY

Data for 107 students were obtained, which represent a statistically large sample due to their number greater than 30. For the analysis the program StatSoft Statistica was used.

2.1. Testing the mean value hypotheses

In a large sample, which is the case here, the arithmetic mean of the sample $\overline{X}$ has a normal distribution $\overline{X} \sim N(\mu_x,\sigma_x / \sqrt{n}) \approx N(\mu_x,s_x / \sqrt{n})$. This, of course, holds for the standardized random variable $\overline{T} = (\overline{X} - \mu) / (\sigma / \sqrt{n}) \sim N(0,1)$, too.
If the hypothesis $H_0(\mu = a)$ is tested, ie. the assertion that the mean value does not differ significantly from the value of a, we do not reject it, with the confidence level of 95%, if $(|\bar{x} - a|$

$\sqrt{n}) / \sigma \leq 1.96$. If this is not fulfilled, then we reject the null hypothesis with a significance level of 5%. To reduce this risk to 1% it is necessary that $(|\bar{x} - a| \sqrt{n}) / \sigma > 2.58$ is satisfied.

2.2. Equality testing of the two main data sets mean values

Let $\bar{X}_1$ and $\bar{X}_2$ be the mean of large number of samples with n_1 and n_2 elements which are subject to normal distributions $N(\mu_1,\sigma_1)$ and $N(\mu_2,\sigma_2)$. If we test the null hypothesis $H_0(\mu_1 = \mu_2)$, ie. that the mean values of the two observed sets are equal, then $\bar{X}_1 - \bar{X}_2$ has normal distribution with parameters $\mu_{\bar{X}1 - \bar{X}2} = 0$ and $\sigma_{\bar{X}1 - \bar{X}2} = \sqrt{}(\sigma_1^2 / n_1 + \sigma_2^2 / n_2) \approx \sqrt{}(s_1^2 / n_1 + s_2^2 / n_2)$. For the standardized variable holds $t = (\bar{X}_1 - \bar{X}_2 - 0) / \sigma_{\bar{X}1 - \bar{X}2} \sim N(0,1)$. We verify $|t| < 1.96 = t_{0.05}$, and for the true inequality we do not reject the null hypothesis with the probability of 95%. Similarly, if we use $t_{0.01} = 2.58$ instead of $t_{0.05}$, the probability is 99%.

2.3. Testing hypotheses regarding the proportions of the main data set

We test the hypothesis that the probability of the observed characteristics of p (success) on the main set of elements is equal to a perceived value p_0, or $H_0(p = p_0)$. From the initial set we separate a sample of n elements, with condition that it is a large sample, i.e. $n > 30$. Let m elements have the required property. Now, the probability of their occurrence in the given sample is $\bar{p} = m / n$. Under these terms, the random variable $\bar{p}$ has a normal distribution, and holds that $\bar{p} \sim N(p,\sqrt{}(pq / n)) \approx N(\bar{p},\sqrt{}(\bar{p}\bar{q} / n))$.
We introduce standardized variable $t = (\bar{p} - p) / \sqrt{}(\bar{p}\bar{q} / n) = (\bar{p} - p_0) / \sqrt{}(\bar{p}\bar{q} / n) \sim N(0,1)$. The decision on acceptance or rejection of the null hypothesis is as follows:
If $|t| < 1.96$, hypothesis is not rejected. If $|t| > 2.58$, hypothesis is rejected as inaccurate because the difference between p and p_0 is highly significant.
In the case of $1.96 < |t| < 2.58$, difference between p and p_0 is substantial, and we can either reject the hypothesis or, better, carry out new testing on a larger sample.

2.4. Testing hypotheses about the equality of the dispersion of two samples of normal sets

When comparing two sets, comparison of their arithmetic means and dispersions is needed. Assuming that for the given sets are with normal distribution, let take two statistically large samples with n_1 and n_2 elements and dispersions of the samples s_1^2 and s_2^2. Let check hypothesis $H_0(\sigma_1^2 = \sigma_2^2)$. Random variable $F = (n_1\ s_1^2\ (n_2 - 1))\ /\ (n_2\ s_2^2\ (n_1 - 1)) \approx s_1^2 / s_2^2$ has distribution with two degrees of freedom $k_1 = n_1 - 1$ and $k_2 = n_2 - 1$.
The decision on acceptance or rejection of the proposed hypotheses is made by comparison of the calculated value for F with the table value $(F^{(k1,k2)})_{0.05}$, , i.e. $(F^{(k1,k2)})_{0.01}$, so that if F is smaller than the table value, hypothesis is not rejected, and opposite if it is higher.

2.5. χ2 test for nonparametric hypothesis verification

Tests that examine the probability distribution of some characteristic in the general population are nonparametric hypotheses tests. The value of χ^2 is used as a measure of deviation between the empirical and theoretical frequencies and is calculated as follows:

$$\chi^2 = \sum((f_i - f_{ti})^2 / f_{ti}) = \sum(f_i^2 / f_{ti} - N)$$

where: fi – frequency of the i-th value of random variable in the given sample or the frequency of the i-th class; f_{ti} – corresponding theoretical frequency; $N = \sum f_i = \sum f_{ti}$ – the total number of elements; α – probability, critical coefficient of the concurrence of empirical and theoretical distribution, the risk of accepting the hypothesis (1 - α is the reliability of hypotheses); k – the number of degrees of freedom (for normal distribution k = number of classes – 3).

The decision on rejecting or accepting of the hypotheses is made by reading the value χ_α^2, according to the chosen value α and a corresponding number of degrees of freedom, from the table of values for which is $P(\chi^2 > \chi_\alpha^2) = \alpha$, and then, if the calculated value of χ^2 is greater than χ_α^2, reject the hypothesis. If the calculated value χ^2 is smaller than χ_α^2, hypothesis is not rejected, but for its acceptance testing on a few more samples is required.

2.6. The Kolmogorov test for verification nonparametric hypothesis

This is a test that requires less calculation compared to the χ^2 test, and often can be used instead. Kolmogorov introduced the size D_n as the maximum difference between the empirical distribution function and the assumed theoretical distribution, and found the probability distribution function of the random variable $D_n \sqrt{n}$

$$\lim_{n\to\infty} P(D_n \sqrt{n} < \lambda) = \lim_{n\to\infty} P(D_n < \lambda / \sqrt{n}) = Q(\lambda) = \sum_{k\in[-\infty,\infty]}((-1)^k e^{-2k^2 \lambda^2})$$

The process of deciding whether to accept or reject the hypothesis of presumed concurrence of the empirical and theoretical distributions goes as follows:

1. Assume that a characteristic X has a distribution function F(x) in general population;
2. Select a large enough sample and form a distribution function Fn(x) and find Dn;
3. Choose the required reliability 1 - α;
4. In the table of function Q(λ) values find the value of λα, for which Q(λα) = 1 - α;
5. Do not reject the hypothesis if Dn $\sqrt{n}$ < λα, otherwise rejected it with the risk of α.

3. RESEARCH RESULTS

3.1. Testing hypothesis for the mean of the total score on the entrance exam

We test the hypothesis that the mean total score on the entrance exam is 86 - $H_0(\mu = 86)$. By using StatSoft Statistica we get the following values: n = 107; σ = 4.05; $\bar{x}$ = 85.36; a = 86; α = 5%; c = 85.36 ± 0.78 and p = 0.10.

Now we calculate $(|\bar{x} - a| \sqrt{n}) / \sigma = 1.64 \leq 1.96$. Since the calculated value of 1.64 is less than 1.96, the null hypothesis is not rejected with a significance level of α = 5%. The same conclusion is obtained by comparing assumed value with critical value c = 86.13. Similar conclusion follows from comparison of the P-value p = 0.10 with the value 0.05. Since p > 0.05, the null hypothesis is not rejected with a significance level of α = 5%.

Variable	Descriptive Statistics (podaci in kolokvijum 4.stw) Valid N	Mean	Confidence -95,000%	Confidence 95,000	Minimum	Maximum	Std.Dev.
ukupno prijemni	107	85,35738	84,58095	86,13381	74,40000	95,16000	4,050979

Figure 1. *Descriptive statistics – the complete sample*

Variable	Test of means against reference constant (value) (podaci in kolokvijum 4.stw Mean	Std.Dv.	N	Std.Err.	Reference Constant	t-value	df	p
ukupno prijemni	85,35738	4,050979	107	0,391623	86,00000	-1,64091	106	0,103781

Figure 2. *Testing hypotheses about the mean value*

3.2. Testing hypothesis of equality of mean values

We test the equality of mean values of the total number of points at the colloquium for students on budget and self-financing. By using StatSoft Statistica we get the following values (index 1 – students on budget, index 2 – self-financing):

$$n_1 = 57;\ n_2 = 50;\ \sigma_1 = 3.39;\ \sigma_2 = 3.61;\ \bar{x}_1 = 14.11 \text{ and } \bar{x}_2 = 12.19.$$

We calculate t = $(\bar{X}_1 - \bar{X}_2 - 0) / \sqrt{(\sigma_1^2 / n_1 + \sigma_2^2 / n_2)} = 2.84 > 1.96$. Since the calculated value of 2.84 is greater than 1.96, the hypothesis is rejected with the probability of error 5%. This means that there is a statistically significant difference in the results achieved by students enrolled in the budget and self-financing students.

T-tests; Grouping: status (podaci in kolokvijum 4.stw)
Group 1: Budžet
Group 2: Samofinansiranje

Variable	Mean Budžet	Mean Samofinansiranje	t-value	df	p	Valid N Budžet	Valid N Samofinansiranje	Std.Dev. Budžet	Std.Dev. Samofinansiranje	F-ratio Variances	p Variances
ukupno kolokvijum	14,11404	12,19000	2,839641	105	0,005424	57	50	3,391188	3,613876	1,135646	0,642451

Figure 3. *Testing the equality of mean values*

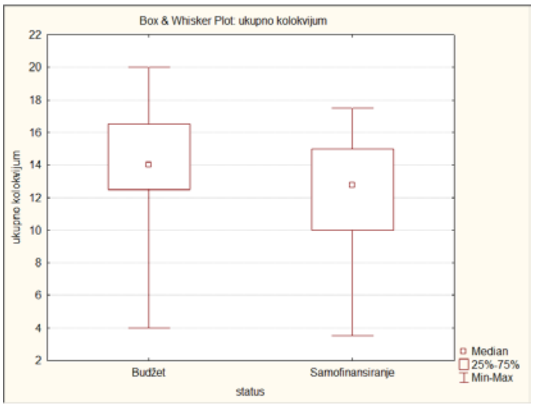

Figure 4. *Box & Whisker Plot*

3.3. Testing hypothesis of the probability of passing the colloquium

We test the hypothesis that the passing level at the colloquium, ie. the number of students with more than 10 points, is 75% - $H_0(p = 0.75)$. By using StatSoft Statistica we get the following values: $n = 107$; $m = 86$; $\bar{p} = m / n = 86 / 107 = 0.80$; $\bar{q} = 1 - \bar{p} = 0.20$ and $p_0 = 0.75$. We calculate $t = (\bar{p} - p_0) / \sqrt{(\bar{p}\bar{q} / n)} = 1.40 < 1.96$. Since the calculated value of 1.40 is less than 1.96 we have no reason to reject the hypothesis.

3.4. Testing hypotheses of the equality of two samples dispersion

We compare number of points at the colloquium for the students on budget and for self-financing students.

status=Budžet
Descriptive Statistics (Spreadsheet in kolokvijum 4.stw)

Variable	Valid N	Mean	Minimum	Maximum	Std.Dev.
ukupno kolokvijum	57	14,11404	4,000000	20,00000	3,391188

Figure 5. *Descriptive statistics - budget*

status=Samofinansiranje
Descriptive Statistics (Spreadsheet in kolokvijum 4.stw)

Variable	Valid N	Mean	Minimum	Maximum	Std.Dev.
ukupno kolokvijum	50	12,19000	3,500000	17,50000	3,613876

Figure 6. *Descriptive statistics - self-financing*

With $n_1 = 57$; $n_2 = 50$; $\sigma_1 = 3.40 = s_1$ and $\sigma_2 = 3.61 = s_2$ we have that

$$F = (n_1\, s_1^2\, (n_2 - 1)) / (n_2\, s_2^2\, (n_1 - 1)) = 0.88.$$

The variable F has a distribution with two degrees of freedom $k_1 = n_1 - 1 = 56$ and $k_2 = n_2 - 1 = 49$. In the table we have no value $(F^{(56,49)})_{0.05}$, but we see that it is in the range from 1.44 to 1.76. We test the hypothesis $H_0(\sigma_1^2 = \sigma_2^2)$, and since calculated F is less than $(F^{(56,49)})_{0.05}$ hypothesis is not rejected with significance level of $\alpha = 5\%$. This means that the dispersion around the mean value is equal for both the budget students and for the self- financing students. In other words, the results of this research are equally reliable for both of those samples and in the future we cannot expect significant changes in the ratio of their achievements, ie. budget students will always achieve better results.

3.5. Testing the hypothesis of independance

Here, we use χ^2 test and make hypothesis that the type of school and its status are independent of each other. By using StatSoft Statistica we get frequencies and values (Figures 7 and 8).

Summary Frequency Table (podaci in kolokvijum 4.stw)
Marked cells have counts > 10

tip škole	status Budžet	status Samofinansiranje	Row Totals
tehnička	13	7	20
ostale	14	9	23
ekonomska	14	15	29
gimnazija	8	8	16
ugostiteljsko-turistička	6	9	15
medicinska	2	0	2
trgovačka	0	2	2
All Grps	57	50	107

Figure 7. *Frequency of data for different types of schools*

	Statistics: tip škole(7) x status(2)		
Statistic	Chi-square	df	p
Pearson Chi-square	7,093856	df=6	p=,31226
M-L Chi-square	8,649167	df=6	p=,19430

Figure 8. χ^2 *test – type of the school and status*

From these Figures 7 and 8 we get the values $\chi^2 = 7.09$ and $p = 0.31$. As for the P-value holds $p > 0.05$, the hypothesis is not rejected with a significance level of $\alpha = 5\%$. This means that there is no significant correlation between types of the school which students attended and enrollment status.

3.6. Testing the hypothesis that the achieved results are in accordance with the normal distribution

The Kolmogorov test is similar to χ^2 test and the hypotheses are similar to the former – if the high school points, points obtained at the entrance exam, total points at the enrollment, the theoretical part and the practical part of the colloquium follow the normal distribution.

Variable	Tests of Normality (poda N	max D	K-S p
bodovi srednja	107	0,087150	p > .20
bodovi prijemni	107	0,073172	p > .20
ukupno prijemni	107	0,092580	p > .20
bodovi teorija	107	0,160116	p < ,01
bodovi praktično	107	0,119716	p < ,10
ukupno kolokvijum	107	0,101548	p > .20

Figure 9. *Test whether the data follow a normal distribution*

By looking at the table of values for the function Q(λ) we find that the limit is $\lambda_\alpha \approx 1.36$. After checking whether the requirement $D_n \sqrt{n} < \lambda_\alpha$ is fulfilled, we conclude that only the points at the theoretical part of the colloquium do not have a normal distribution. The same conclusion would come by observing P-values, because only for the points on the theoretical part of the colloquium we have $p < 0.05$. Further, as an example, the detailed data table is given, which is obtained from testing the same hypothesis for a single value - the total number of points at the colloquium observed by classes of data.

Variable: ukupno kolokvijum, Distribution: Normal (podaci in kolokvijum 4.stw)
Kolmogorov-Smirnov d = 0,06224,
Chi-Square = 18,71057, df = 12, p = 0,09576

Upper Boundary	Observed Frequency	Cumulative Observed	Percent Observed	Cumul. % Observed	Expected Frequency	Cumulative Expected	Percent Expected	Cumul. % Expected	Observed-Expected
<= 2,40000	0	0	0,00000	0,0000	0,14703	0,1470	0,13741	0,1374	-0,14703
3,80000	1	1	0,93458	0,9346	0,34173	0,4888	0,31938	0,4568	0,65827
5,20000	2	3	1,86916	2,8037	0,92725	1,4160	0,86659	1,3234	1,07275
6,60000	5	8	4,67290	7,4766	2,16882	3,5848	2,02693	3,3503	2,83118
8,00000	3	11	2,80374	10,2804	4,37296	7,9578	4,08688	7,4372	-1,37296
9,40000	5	16	4,67290	14,9533	7,60087	15,5587	7,10362	14,5408	-2,60087
10,80000	9	25	8,41121	23,3645	11,38916	26,9478	10,64408	25,1849	-2,38916
12,20000	10	35	9,34579	32,7103	14,71182	41,6596	13,74936	38,9342	-4,71182
13,60000	17	52	15,88785	48,5981	16,38287	58,0425	15,31110	54,2453	0,61713
15,00000	23	75	21,49533	70,0935	15,72767	73,7702	14,69876	68,9441	7,27233
16,40000	10	85	9,34579	79,4393	13,01633	86,7865	12,16480	81,1089	-3,01633
17,80000	14	99	13,08411	92,5234	9,28668	96,0732	8,67914	89,7880	4,71332
19,20000	6	105	5,60748	98,1308	5,71184	101,7850	5,33817	95,1262	0,28816
20,60000	2	107	1,86916	100,0000	3,02851	104,8136	2,83039	97,9566	-1,02851
< Infinity	0	107	0,00000	100,0000	2,18644	107,0000	2,04340	100,0000	-2,18644

Figure 10. *The Kolmogorov test and χ^2 test*

Here it is $D_n \sqrt{n} = 0.64 < 1.36 = \lambda_\alpha$, so the hypothesis is not rejected with a significance level of $\alpha = 5\%$.

4. CONCLUSION

Results of this analysis lead to some new conclusions. It is evident that the entrance exam is well devised, because it does not favor any type of school from which the candidates come. Then, it is encouraging that the average number of points on the entrance exam, 86 of 100, show that the colleges located outside the large university centers can attract good quality students. This further provides opportunity for better quality work with them, and then both budget and self-financing students achieve good consistent results at the colloquium with high success rate. The success of the budget students is slightly better, as it would be expected.

As for the colloquium on the subject of Business Informatics, it can be noted that there are some deviations from the expected achievement in the theoretical part. It is positive that the achievement at practical work, which is particularly important for further study and subsequent integration in the business environment, meets the high expectations.

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The pedagogical benefits and pitfalls of applying tools for teaching and learning laboratory practices in the biological sciences

Snezana Stavreva Veselinovska[1], Snezana Kirova[1]
[1] University "GoceDelcev" – Stip, R. Macedonia
e-mail snezana.veselinovska@ugd.edu.mk

Abstract*: The aim of this study is to research the different methods used by biology teachers and their effects on the success of the students. Three student groups of biology students in University "GoceDelcev", Faculty of Natural and Technical Sciences, Institute of Biology, - Stip, R. Macedonia were offered a topic on general characteristics of Hemoglobin, Methods Based on color development (Sahli's/acid hematin Method) with different sequences of 3 teaching methods. The teaching methods were Laboratory method (student experiment), slide demonstration and lecture method. The first group started the course with experiments in the laboratory, then the lecture method was given to relevant theory of proteins, and then the slides were shown (Group I). The sequence of these three teaching methods used in the first group was changed in both second and third group as follows:*
The lecture methods, slide show and experiment in Group II, and slide show, experiment and lecture method in Group III, respectively. Laboratory method used in the study was focused on the topic of Estimation of hemoglobin - Methods based on color development (Sahli's/acid hematin Method)
This experiment was carried out by students. Slide demonstration method included slides about hemoglobin structure and function. The slides were shown by teachers. Lecture method was performed by teachers as usual. Effectiveness of different sequential teaching methods was measured quantitatively by an achievement test. Achievement test contained 20 questions, testing the knowledge of facts as well as the ability to transfer the knowledge and problem solving ability. This test was used as pre-test before methods' application, post-test after the methods' application and retention test after 30 days from methods' applied.

Keywords: *Slide demonstration, laboratory method, lecture method, teaching methods, biology studying*

1. INTRODUCTION

In respect to traditional teaching dominated by the teacher, verbal methods, mechanical memorization by students, students - future teachers of biology must be prepared and practically trained for something completely different. According to Matijevic, gone are the days when the developmental and educational tasks could have been realized by teachers 'artisans' by just reproducing the models they met with during their education - it is time to educate teachers who are able to create new and original pedagogic situations (Matijevic, 2007).

To make students perceive the complex system of knowledge about nature and understand all the complexity of social relations in which they will find themselves in future, it is necessary, as early as in the first classes of elementary school, to suggest students the ways and means of gaining scientific truth. In teaching biology "such forms of learning must be nurtured and continuously applied which largely contribute to the development of students' thinking skills, engage them most of the time during class" (Cvjetičanin, 2008), stirs curiosity and interest for further study of phenomena, processes and relationships that surround them. Emphasis should be on making students independent, preparing them for using different sources of knowledge, on linking knowledge acquired in various fields, on practical application of knowledge in solving problems in students' daily lives, and on providing conditions for as diverse and creative participation of students in the teaching process as possible. Modern education insists, therefore, on the active role of students in the teaching process, and teachers are expected to be able "theoretically and empirically, to select those most appropriate from a wide repertoire of teaching methods" (Vilotijević, 1999).

One of the most prominent strategic goals of the reform of educational systems in Europe during the last decade, "is the establishment of a comprehensive system of (self) evaluation, monitoring and evaluation of practical training - an experiment which, as an integral part of the educational system, would secure the quality of educational conditions, educational process and its outcomes in accordance with educational standards. According to the same author, the analyses of some of the solutions for practical pedagogical training of students in developed countries and regions indicate that "practical training during higher education is given special attention", while research conducted in our country points to the problem of the lack of quality student practice, i.e. insufficient acquisition, monitoring and evaluation of practical knowledge and skills at universities.

In an attempt to avoid generalized didactics and out of the desire to leave using teaching methods, which can easily be transformed into routine practice and bare practicing, the basic idea of the work was to show how to shape innovative models of educational organization in teaching biology, i.e. the kind of effect they have on the success of students, or what dimensions the teacher has to take into account in order to meet the frames of contemporary teaching of biology.

2. THEORETICAL FOUNDATION OF THE MODERN TEACHING OF BIOLOGY

Modern methodological and didactic theory needs experimental verification of the application of teaching methods in teaching organization for setting clear signposts of teaching practice.

The acceptance of innovation and improvement of competencies must be the foundation of the professional development of teachers, particularly in the areas of effective instruction and management in the classroom, for the development of the desired pupils' competencies for a life in the contemporary environment, as well as in the goal of getting to an effective teaching and contemporary forms of learning in practice. .

Biology teaching must reflect the exciting nature of the subject and its surroundings. Student work in biology lessons should be practical and visual in nature wherever possible. In actual fact, teachers often use only lecture method (without visual aids or demonstrations) in biology lesson in general. There has been a number of researches on the effectiveness of different teaching methods in biology lessons (Galton and Eggleston 1979; Holstein and Lunetta 1982; Johnson 1991; Odubunmi and Balogun, 1991; Killermann, 1998), and especially methods of laboratory and slide demonstration are considered to be very effective in biology teaching. But, these methods must be used in an appropriate sequence. The Methods used in this study will be explained briefly.

Today there are many modern theories of learning, as well as modern theories of teaching. They generally include cognitive styles and strategies, multi-intelligence, critical and creative thinking, role of motivation in learning, cooperative learning, interactive learning, and ambient learning. New circumstances create new learning that is more student-active, self-conscious, creative, and autonomous

We basically start from the systematic - theoretical didactics that applies the methods and procedures of system theory, especially systematic thinking in order to solve problems in a scientific, technical and ideological field. Due to the fact that the purpose of the system theory is to analyze complex systems and prepare technical measures for their effective action, teaching biology here is regarded as a complex system consisting of a series of complex teaching situations. One of the objectives of this research is to discover the elements of teaching situations, then to detect the relations between them, to investigate the criteria under which they act and to lead them to raising the level of students' success. For system - theoretical didactics it does not matter which method will be applied, but the situation for learning is important and it is important which operations a student must perform (observe, learn, to remember).

In the course of the research three methods are used in teaching physiology, teaching unit - Hemoglobin - Methods based on color development - Sahli's/acid hematin Method.

3. RESEARCH HYPOTHESES

The basic hypothesis is: Students have generally positive attitudes when it comes to the application of laboratory methods in teaching physiology but they do not neglect the significance of other methods (oral lectures and slide demonstrations) applied during classes of physiology.

Auxiliary hypotheses we started from in our study are as follows:

- We assume that students' opinions about physiology classes they attended in the previous semester are mostly positive;
- We expect that students positively assess their practical skills for planning the teaching of physiology.

3.1. Research methods and instruments

The research was conducted using a descriptive-analytical method. Interviewing and scaling techniques were used. The survey instrument was a questionnaire, i.e. a five-point Likert-type scale, constructed by the author of this paper according to the defined research tasks. It is designed to enable us to collect empirical data necessary to improve certain areas of practical training of students in the field of biology, i.e. Physiology.

3.2. Research sample

The study included 27 students of the second year of studies at the Faculty of Natural and

Technical Sciences, study program in biology, at "Goce Delchev" University " in Stip. This is the generation that enrolled in 2012/13 academic year, after the curriculum had been reformed in accordance with the Bologna Declaration. The sample was intentional because the collection of relevant data was to be done by testing students who attended classes in the teaching subject Biochemistry.

Starting from the fact that the teaching of Physiology is organized with the aim of better and more efficient professional training of our students, we considered it important that students themselves assess their practical skills and express their opinions about their professional competence. The results obtained should serve as a foundation for modernizing, improving and correcting individual segments of students' practical training for the realization of teaching the subject Physiology at the second year in college.

The first part of the questionnaire includes personal information about the teachers. The second part included questions on teaching methods, the aim of biology teaching, factors affecting the teachers' choice of methods and an open ended question about what method or methods should be used to increase the success level of the students. In the third part, some views related to teaching methods have been put forward, and the teachers were asked whether they agreed with these views and these views were evaluated using the Triple Likert Type measurement tool. The frequency, average and ratio distributions of the data obtained by the questionnaire were calculated by using the SPSS-15 packet programme.

3.3. Lecture method

Lecturing remains one of the more popular methods to transmit information and ideas by teachers, trainers and speakers. As students and audience participants we are quite familiar with the approach. Lectures can be informative, boring and overwhelming depending on the compelling nature of the message and the presenter's style and clarity of message. The lecture method usually is one-way communication and allows for little or none audience participation. The result is audience misunderstanding, loss of information and poor retention.

The traditional didactic lecture method as "an oral presentation given to a class by the teacher" (p. 31), while Ericson (1960) stated that the lecture or didactic is the method of teaching outside of manipulative work. Teachers are comfortable with the traditional method because they remain in control of content and time (Havice, 1999).

Despite the limitations of traditional oral-lectures, introductory courses in biology are forced to offer high-enrolment introductory science courses. Many professors who teach these courses feel that lecturing is their only option, and can only dream of what they could accomplish in smaller classes.

However, there is a small but growing group of science faculty members who have developed ways to engage students in the process of thinking, questioning, and problem solving despite the large class size.

It is important to remember that the single overriding goal of a presentation is to provide meaningful content in an entertaining way so that participants focus their attention, understand material and are receptive to implementing new ideas back home. The whole preparation, presentation and content of a lecture must therefore be directed not to the speaker but to the audience needs and wants. I encourage you to try some of the techniques provided so that your lectures may be perceived as more interactive, understood, and remembered.

3.4. Slide demonstrations

A slide demonstration is an act that a teacher shows and explains something to a class by a prepared PPT teaching tool in Microsoft office software or classically via overhead. This can be used as any educational materials.

Carefully material-selected slide demonstrations are one of the ways of helping students overcome misconceptions, and there are a variety of resources available (Katz, 1991). Slide demonstrations can be very effective for illustrating concepts in the class, but can result in passive learning without careful attention to engaging students. They can provoke students to think by themselves and are especially helpful if the slide demonstration has a surprise, challenges an assumption, or illustrates an otherwise abstract concept or mechanism. Slide demonstrations that use everyday objects are especially effective and require little preparation on the part of faculty. Students' interest is peaked if they are asked to make predictions and vote on the most probable outcome. There are numerous resources available to help faculty design and conduct slide demonstrations.

3.5. Laboratory method (student experiment)

Laboratory work is the hallmark of education in science and technology based fields. Student laboratories are a costly resource yet their educational potential is often not fully realized in practice. It is timely that their design and delivery and the forms of student assessment used be examined critically for their contribution to high quality learning (Winter et al., 2001).

The first area of study is the effectiveness of laboratory activities for promoting learning. Practical work is a central theme of lessons in the natural sciences (Galton and Eggleston, 1979; Holstein and Lunetta, 1982).

Laboratory work is seen as an integral part of most science courses and offers students a learning environment that differs in many ways from the "traditional" classroom setting (Fisher et al., 1998).

It is important to consider whether learning is more effective if the students do the student experiments themselves or they watch the teacher demonstrating the student experiments. Furthermore, are either of these approaches more effective than the teacher simply describing the student experiments to the students and telling them the results? (Killermann, 1998).

It is hard to imagine learning about science, without doing laboratory or fieldwork. Student experimentation underlies all scientific knowledge and understanding. They provide students with opportunities to think about, discuss, and solve real problems. No science can be properly taught without student experiments. The student experiment should be the central part of science teaching. It serves many purposes. Student experiments are performed to find relations among concepts or to verify hypothesis. As in other lessons, in science lessons the effectiveness is related to the use of teaching methods. Some methods may use together for offering a topic. But, which method must take precedence to increase student academic achievement and retention level?

The aim of this study was to determine the effects of the usage sequential lecture method such as didactic lecture, slide demonstration and laboratory student experiment on the academic achievement and retention (remembrance) level in teaching of enzymes.

4. METHODOLOGICAL FRAMES OF THE RESEARCH

4.1. Research problem

How does the usage of sequence of teaching methods in science education effect the academic achievement and retention?

4.2. Sub problems of research

1. Are there any differences in academic achievement among the groups examined? (Group I-Group II, Group I-Group III, Group II-Group III).

2. Are there any differences in retention (remembrance) levels among the groups examined? (Group I-Group II, Group I-Group III, Group II-Group III).

4.3. Methodology, Sample

This study was designed as experimental and carried out with three student groups, each of which included 27 biology students in first year The University "Goce Delčev", Faculty of Natural and Technical Sciences, Institute of Biology.

4.4. Data Gathering Tools

The work was attempted to establish empirically whether the usage of sequential teaching methods was important for academic achievement and retention. The efficiency was determined quantitatively by a written test. This test contained 20 questions (added in Appendix) were selected from University entrance exams by the authors. This test was used as pre-, and post-test before and after methods' applications, and then retention test after 30 days from completing the study.

4.5. Procedure and Data Analysis

At first, a pre-test is administered to three groups that each one had 27 students. According to pre-test's results, differences among groups were analyzed statistically by using one way ANOVA test (Table I), and there was no significant difference ($P>0.05$) among them.

Then, the general concepts and main knowledge of Hemoglobin were taught using three methods in different sequences. The first group started with experiments in the laboratory, then the relevant theory of enzyme was given lecture method, and then the slides were shown by teacher. The sequence of these three teaching methods used in the first group was changed in the second group. In the second group, lesson was started with lecture methods, then used slide show and the latest experiment was done. The sequence of these teaching methods was also changed and the use of the slide show was initiated, then the experiment was done and the latest lecture method was used in third group.

The sequences of teaching methods for the three groups were as follows:

Group I: Student experiment – lecture method – slide demonstration.

Group II: Lecture method – slide demonstration – student experiment.

Group III: Slide demonstration – student experiment – lecture method.

Methods based on color development of hemoglobin

The commonly used methods are Sahli's/ acid hematin method and Cyanmethemoglobin method. The details of these methods are described below.

Sahli's/acid hematin Method

Principle: Blood is mixed with N/10 HCl resulting in the conversion of Hb to acid hematin which is brown in color. The solution is diluted till it’s color matches with the brown colored glass of the comparator box. The concentration of Hb is read directly.

Equipment required

Hemocytometer which consists of

- comparator box which has brown colored glass on either side
- Hb pipette which is marked up to 20mm3(0.02ml blood)
- Tube with markings of Hb on one side
- glass rod
- dropper

Reagents required:N/10 HCl and distilled water

Sample: Venous blood collected in EDTA as described earlier

Figure 1. *Hb comparator box with brown glass on either side and tube with acid hematin solution in centre. The color of the solution is matched with the glass and the concentration of Hb is read directly*

In lecture method, a lecture presented orally on the general knowledge of proteins without using any kind of media.

In slide demonstration, lecture was performed by showing slides that was containing the explanation of characteristics, structure and study principles of proteins. Each teaching approach lasted in two hours.

Then, the same measure tool (pre-test) was applied to each group as post-test. Thirty days after the lesson, it was repeated to each group as retention test. “Delayed retention tests” are research instruments which are administered two or more weeks after instruction and initial testing to measure retained knowledge (Haynie, 1997). Pupils never were aware of any further testing and these tests were not used for grading purpose to avoid the influence of extrinsic variables. Results were evaluated by using one way ANOVA test.

5. RESULTS

Table 1. *Comparisons among groups in point of post test.*

Groups	N	Mean	SD
Group I	27	21.42	1.82
Group II	27	18.90	1.90
Group III	27	21.93	1.76
	Sum of squares	df	Mean square
Between Groups	39.95	4	21.75
Within Groups	193.43	64	3.87
Total	254.87	69	

In Table II, according to one-way ANOVA test results, difference between Group I and Group II was statistically significant ($P<0.05$). This result suggested that, students' academic achievement level in Group I was higher than Group II students. This one-way ANOVA test results established that the difference among the groups' average was significant ($P<0.05$). This meant that, students' academic achievement level in Group III was higher than that of Group II.

Table 2. *Comparisons among groups in point of view retention level*

Groups	N	Mean	SD
Group I	27	22.16	1.79
Group II	27	19.34	1.83
Group III	27	22.34	1.85
	Sum of squares	df	Mean square
Between Groups	31.485	4	13.89
Within Groups	189.32	61	3.86
Total	2230.41	57	

As seen in Table III, the difference between Group I and Group II was significant ($P<0.05$). It meant that students' retention (remembrance) level in Group I was higher than Group II.

6. DISCUSSION AND CONCLUSION

The results of this study showed that academic achievement in lessons began with experiment or slide demonstration was higher than lesson beginning with lecture method. In science teaching, using laboratory student experiment or slide demonstration at the beginning of the lesson attracts attention and motivation of students. But, using oral-only lecture bores students and loses their attention to it.

A laboratory setting is a more conducive learning environment than lecture halls (especially for large classes) as it provides students with real life situations and a chance to exercise their problem-solving skills. At the same time, students have more time and opportunities for hands-on experience, active thinking and knowledge reflection. In addition, a teamwork environment encourages students to practice their interpersonal skills as well as to nurture team spirit and leadership. Finally, oral presentations provide an opportunity for students to sharpen their mental response and presentation skills.

According to this study's results, retention (remembrance) level in lesson beginning with experiment and slide demonstration was higher than that of beginning with lecture. Because, people remembrance 10% of what they read, 20% of what they heard, 30% of what they saw and 90% of what they had a hands-on experience. Laboratory work is a hands-on experience (Beydogan, 2001).

This study has also showed that student comprehension can be enhanced with lesson started with experiment, because these activities increase students' interest in the topics. It is hoped that this study would be a beginning on different teaching methods in biology in Macedonia. Furthermore, the results of the present study could be adapted to any other teaching cases. The same results should not be expected from students who are physically, spiritually, logically and socially different from each other because each student will study and reach conclusions according to his/her condition and capacity. In addition, it is clear that in order to increase the success of the student, the use of laboratories, and the question/answer and demonstration methods are all necessary. But the reason why teachers prefer the narration method instead of the laboratory method is the unavailability of biology laboratories in many high schools, insufficient materials and tools and the excessive number of students in classes. However, in teaching biology, observation and experimentation methods are emphasized as being very important. Conscious learning cannot be achieved without giving importance to experiments. Through experiments, students learn learning by doing, using materials and tools correctly, doing-recording and summarizing, and also by evaluating (Gerçek and Soran, 2005).

Another reason is that biology curricula are heavy and lesson hours are inadequate. It has been found that the education a student receives at university is effective in choosing methods. Gerçek and Soran (2005) support our findings. It has also been established that teachers seldom use the visit and observation method as it means greater responsibility for the teacher of the students on the trip and because of financial problems. In fact, biology is a discipline strongly connected with the environment; therefore, the environment makes for a natural learning place for the students to understand the relationships between nature-humans and living things nonliving things.

As a result, biology teachers should focus on teaching methods that help students to understand essential concepts and develop their reasoning skills together with scientific methods

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Application of ICT in teaching biology (Example of a lesson)

Snezana Stavreva Veselinovska[1] and Snezana Kirova[1]
[1] University "GoceDelcev" – Stip, R. Macedonia
e-mail snezana.veselinovska@ugd.edu.mk

Abstract: *The computer programs as a didactic aid are often described in didactic literature all over the world. It is not enough that they play, for instance, motivational, exercising, synthesizing or supervising function, they are to be made an independent source of reliable, easily comprehensible information, given in a way that activates students. It is also important not to replace various functions and tasks of didactic aids applied in the process of teaching-learning Biology with each other, but only to interfere skillfully. It is underlined that school practice requires methodically grounded application of these aids in the processes of teaching and educating. In this paper in selected ICT tools have been presented in the light of teaching principles and cognitive activities model. Computer science education, information and communication technology (ICT) are at present becoming one of the most important elements defining the basic competences of students. Information technology integrates medial, informative and computer science education, but also all the educational subjects mentioned in the curriculum basis of general education. In science and biology education there increasingly appear concepts of integrated teaching, showing the student the world in a holistic manner. The principle of universal activity of students in cognitive, emotional and motivation, as well as in practical sphere is preferred. More and more often attention is paid to the fact that the contemporary problem is not so much lack of information as its surplus, and the crowd of information as well as its unnecessary excess of details may be an effective tool of disinformation. Hence forming in students such skills as selection, evaluation and organizing of information (forming its structure) seems justified, so that they can serve drawing conclusions.*

Keywords: *information and communication technology (ICT), biology, learning and teaching, knowledge*

1. INTRODUCTION

Information and Communication Technologies (ICT) is a term used to denote all computer and communication technologies.

ICT has become an integral part of the educational system and as a support to teachers in the implementation of the traditional teaching process as well as in the process of learning and teaching.

The new educational paradigm focuses on the student – the student is placed in the center while the environments are learning resources both in terms of time and in terms of place and learning styles. Everything is orientated towards the student and covered with one expression - learning resources (teachers, knowledge, technologies, media, organization....

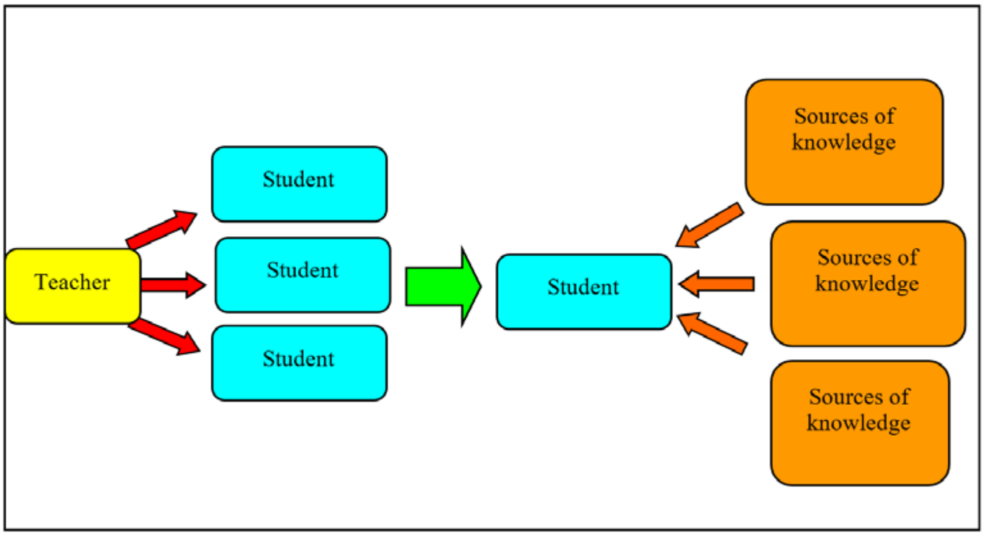


Figure 1. *Transfer of the traditional teaching paradigm into a new advanced one*

With the use of computers and the Internet students can:

- find the desired information;
- explore a variety of topics;
- develop the capacity for finding and gathering information and
- collaborate with other students on projects using the Internet.

Nevertheless, the computers and the Internet should be seen as a supplement, not as a substitute for the traditional way of learning.

It is therefore considered that e-learning can be seen as a completely independent form of education, but also as a component or a complement of classical education. We implement mixed education: a combination of classical teaching in the classroom and teaching using ICT. A popular way of describing e - learning is using the "timeline" of e-learning which shows education as a continuum on whose left side there is classical instruction (F2F - face to face lecturing). Moving towards e - learning starts with the introduction of ICT into F2F teaching. In the middle of the timeline is the mixed learning approach. Online education is located on the right end of this continuum.

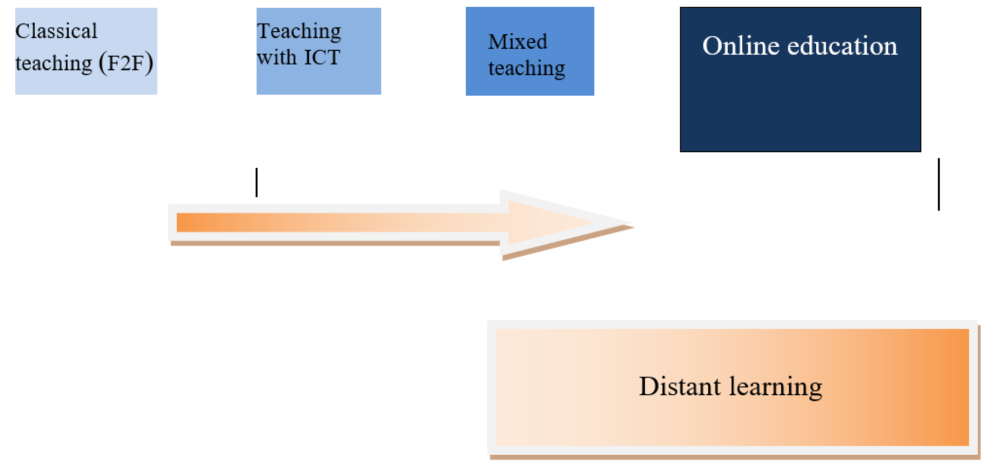


Figure 2. *Classical and online teaching*

The teachers' obligations are:

- To identify strategies for gathering information;
- To determine the relevance of the information they have found;
- To develop problem solving skills, and
- To evaluate the efficiency and effectiveness of the solutions.

1.1. An example of the use of computers and the internet in practice

One of the most successful applications of computers and the Internet so far in practice is the system of education of the American company Cisco known as the Cisco Networking Academy. It is a combination of teaching under the guidance of an instructor who teaches by the curriculum to which he/she approaches by using the internet technology, and the evaluation of knowledge is a combination of practical texts and texts performed on the computer. The test results are obtained immediately so the average grade for the entire group as well as the average score of the same test on a global level are known without delay.

Educational goals and tasks in modern scientific - technological and social changes are not and cannot be marginal pedagogical problems as they were treated by our pedagogical science in the second half of the last century. Pedagogy, which aims to discover and explore the laws of the educational process, should approach the aims and objectives of education as basic and initial pedagogical problems. Pedagogical science should incorporate the goals and objectives of education into its categorial system, because the core understanding of pedagogical problems (raising strategy, content, forms and methods, the position of the subject) derives from it. Without such a relation of pedagogical science to the goals and tasks of upbringing it will not be possible to develop teaching methods for individual subjects as well as new strategies of teaching, learning and self-learning. Teaching methods for information education also faced this problem when it was established.

2. GOAL, TASKS AND CONTENT OF INFORMATION EDUCATION

Educational goals and tasks in modern scientific - technological and social changes are not and cannot be marginal pedagogical problems as they were treated by our pedagogical science in the second half of the last century. Pedagogy, which aims to discover and explore the laws of the educational process, should approach the aims and objectives of education as basic and initial pedagogical problems. Pedagogical science should incorporate the goals and objectives of education into its categorial system, because the core understanding of pedagogical problems (raising strategy, content, forms and methods, the position of the subject) derives from it. Without such a relation of pedagogical science to the goals and tasks of upbringing it will not be possible to develop teaching methods for individual subjects as well as new strategies of teaching, learning and self-learning. Teaching methods for information education also faced this problem when it was established.

2.1. General goal of education

Our understanding of the goal of education as an element of the categorized system of pedagogy shows that it is necessary to redefine the overall objective that needs to be incorporated in the process of education (processuality) and to determine the interrelationships between specific and general objectives of education. At the end of the last century, after the fall of the ideal of the socialist society known as a "universally developed socialist personality", efforts were made to redefine the general goal of education. Thus the goal of education is defined as the acquisition of knowledge of social and civilizational values, maximal development of psycho-physical abilities, critical thinking and creativity. Such a definition of objectives creates four important features:

- acquiring basic knowledge of social and civilizational values;
- Maximal development of innate and acquired psycho-physical abilities;
- Development of critical thinking and
- Encouraging and promoting creativity at different levels of psycho-physical age and in all areas (subjects).

With such definition the overall objective of education is free from ideological and other fleeting definitions. Instead of the term to learn new terms that define the essence of learning, self-learning and creation are introduced. Beside this, the new definition of the objective was incorporated into the very process of education (processuality of the goal). The redefined purpose of education is not incorporated only in the "ideal personality" but in the social ideal also. The overall objective of education based on fundamental laws of personality development becomes a reliable criterion for monitoring in the course of the immediate educational process and for evaluating its outcome. Redefining of the general aim of education imposes the need for reassessment of values and range of specific and individual goals, their classification and mutual relationships.

3. INFORMATION EDUCATION AND INTERACTIVE LEARNING

In the frame of the teaching process reforms during recent years interactive learning is increasingly being confirmed as one of the modern pedagogical innovations in our country too. Regarding the fact that information education is one of the important components of the school system reform, there is an important connection and complementarity between these two modern innovations.

3.1. Notion and essence of interactive learning and teaching

In our country there are also terminological issues about the meaning of the notion of interactive teaching, interactive learning and interactive method. Whether it is about the entire curriculum, the learning process or the application of one method, interaction builds a new way of communicating on the relation teacher, student and curriculum content. Namely, this introduces a new interdependence, interaction and mutual action of students who study together. Accordingly "interactive learning is a process that results in relatively permanent changes in thinking and behavior that are created on the basis of experience, tradition and practice realized in social interaction. (Suzik, 1999, p. 24).

In addition to the advantages of interactive learning compared to the traditional teaching (greater quantity and quality of knowledge) it also encourages the realization of social interaction and social relationships. To establish efficient interaction it is necessary for course work to be organized in small groups, to encourage interdependence between members of the group, to support the inclusion of all students in active work in groups, to encourage and develop interpersonal abilities and emotional environment for group work. So, the essence of interactive learning in teaching is the acquisition of knowledge (cognitive component) and the development of interpersonal and social relationships (affective component). The results of empirical studies have shown that interactive learning has some advantages over classical teaching.

3.2. Interactive learning in information education

In information education as well as in all other types of education and teaching it is reasonable to apply various types of interactive learning. Basic rules of interaction should be observed when applying interactive learning in information education, but only in the form of specific objectives and content of this education. It is therefore important to observe the following elements:

a) The main goal and task of information education;

b) The nature and character of the information content taught in an interactive manner (not all contents of information education is adequate for interactive learning);

c) The level of knowledge of methodical procedures in interactive learning;

d) The teacher's level of training for organizing and introducing various forms of interactive learning and

e) The level of students' training in interactive learning, procedures of interaction and actions of interdependence and mutual action of groups.

Today, owing to universal teaching aids, the most complex organisms can be shown to students, the farthest geographical area with endemic species can be made available, the smallest and most complicated part visible with a microscope (e.g. micro-organisms and microscopic preparations) can be shown.

An obvious example is the electronic encyclopedia, ENCARTA, where the display shows life on the planet and where you can choose the desired area of research.

3.3. Example

In the area of environmental content we can choose any area depending on which educational content is processed (air, water, soil, etc.).

By selecting the teaching content AIR, students are given the opportunity to process this content through: questions, dilemma games, videos related to this teaching content, teaching paper to verify the previous knowledge and skills of students during class and individual activities.

This type of class using ICT in teaching activity allows all students to be active and keep their attention during the entire class. Besides the fact that this multimedia CD can be played on each student's PC individually, it is also possible to present its content with a presentation on an LCD projector, if the school does not have a computer for each student individually.

3.4. Tests

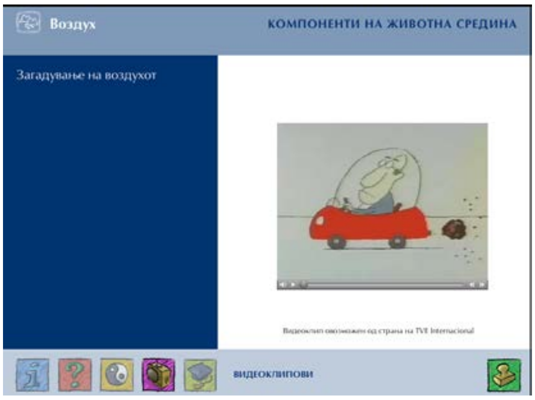
The test consists of alternative answers of which you need to choose one by clicking which is indicated on the table as the right or wrong answer. Finally, the sum of correct points is shown.

3.5. Dilemma - games

Choosing dilemma - games allows students take the role of authority that can solve a problem. First there is a problem and some possible solutions are offered by selecting numbers from 1 to 4.

This procedure encourages students to think independently and it helps their activation in solving problems.

3.6. Video



By choosing this option all students are animated in the course of the class; this clip educates students and they get familiar with harmful air pollutants. With this kind of work the teaching process becomes more flexible. This means that instead of the teacher being in the center, the focus is on the student. Thus the teacher must use new methods and techniques in his/her work.

As an example we will show the realization of one lesson in biology.

4. DAILY PLANNING OF A LESSON IN BIOLOGY, IX GRADE, THEME: BREATHING, EXCHANGE OF GASES (THEME NO. 7)

4.1. Teaching unit

Anticipated outcomes:
Students:
- list the parts and functions of the respiratory tract;
- Sequentially explain the path of air through the airways;
- explain the importance of breathing;
- explain the mechanism of breathing and the role of the diaphragm and intercostal muscles;
- explain gas exchange in the cell and in the alveoli in the lungs;
- should know how to protect themselves against diseases of the airways.
- know the procedures of artificial respiration;
- should be enabled to use the ICT portal school where there are texts, tests and animations with the specified content
- Recognize the importance of hygiene for healthy respiratory organs through an eco-topic - Maintenance of the building and of the healthy school environment.

Materials and equipment needed for realization

- Computers
- Encyclopedias
- Textbook

Forms of work:

- Joint work,
- individual work

Methods of work:

- 1.oral answers to questions asked by the teacher
- 2.oral presentations
- 3.project work

4.2. Activities and guidance from the previous lesson

Teacher

Prepares goals, methods and teaching aids for the realization of the content; guides and encourages activities; has

Activities during class
Introduction

Through questions they revise the content about breathing, and after that, through brainstorming students consult about how to make presentations.

The students are shown an example of a presentation already made by a student, and then they are directed to the following portal:

http://skoool.mk/sites/skoool.mk/files/mk/KS3/Biology/respiratory_system/index.html

They should visit in order to complete their knowledge, to get informed, to test themselves by answering test questions with direct results about correct/incorrect answers, and in the part with animation they should take on the role of doctors and "perform surgery" on a patient and align respiratory organs accurately with which the patient is revived, or the other way round: if they do not know the correct order of respiratory organs, the patient dies.

4.3. Final activities 5 min.

We discuss whose presentation is completely finished and beautiful and which suits best to what they are studying; thus students perform self-assessment of their own work.After that students fill the scoring lists for oral presentations and the total sum of points shows which is the best presentation.

Then the students are informed that during next class the mechanism of breathing will be studied and that they should bring balloons and plastic bottles because we will be making a model of lungs.

List of analytic scoring in the evaluation of oral presentations

POINTS	**ORGANIZATION**
4 POINTS (REMARKABLE)	Well-organized presentation. Thoughts have a logical and spontaneous order. It has a good flow
3 POINTS (GOOD)	Well organized presentation. Most of the thoughts are arranged logically. There are several harmonious transitions between parts
2 POINTS (ACCEPTABLE)	Poorly organized presentation. Thoughts do not follow one after another. The transitions are weak. It is difficult to follow the logic of the presentation.
1 POINT (UNACCEPTABLE)	There is no organization of the presentation at all. Random collection of loosely connected ideas.

POINTS	**CONTENT**
4 POINTS (REMARKABLE)	It shows very good understanding of important ideas.
3 POINTS(GOOD)	The student includes some important ideas that relate to the topic. The student has knowledge of the topic.
2 POINTS(ACCEPTABLE)	The student perhaps includes a significant idea or a few facts, but does not develop the ideas or connections between ideas.
1 POINT (UNACCEPTABLE)	The student shows limited knowledge of the subject.

POINTS	**PRESENTATION**
4 POINTS (REMARKABLE)	Calm with clear articulation, adequate volume of voice, showing self-confidence.
3 POINTS (GOOD)	Relatively clear articulation, fairly steady pace, mainly admirable.
2 POINTS (ACCEPTABLE)	With some murmuring, uneven pace, with little or no expression.
1 POINT (UNACCEPTABLE)	Difficult to understand, with a very slow pace, the speaker seems unmotivated.

4.4. Notes and reflections on the lesson implementation

Through a well-planned strategy by asking a number of questions students were encouraged to think, observe and examine previous knowledge and their acquired knowledge resulted in cooperativeness in providing ideas, mutual assistance and planning presentations; as a result, students had successful presentations and most of them were successfully completed.

Few students showed little uncertainty when they needed to find relevant content that matched the material they studied but I helped these students by selecting some content that they further added to their presentations.

The positive side of such lessons is that they are more interesting for students and include all of them to equally participate in the preparation of the given task without having the feeling of inferiority; in this type of classes students stand out with their cooperativeness, individuality, interest and desire to help each other.

All stages of the lesson were directed to fulfilling the anticipated objectives which enabled students to recognize, list, explore, describe, and analyze, thus creating an interesting lesson.

5. CONCLUSION

Integrating computers in teaching biology allows bringing educational content closer to students, facilitation of learning, revision and acquisition of knowledge, as well as its usage.

It also allows integrating the teaching process into modern technological developments.
What does this kind of teaching enable? Such teaching has a lot of advantages:

1. Students develop their personalities through all aspects, at all levels, because this kind of teaching is also applicable to students with lower levels of knowledge;
2. It helps to complete a number of tasks and to advance the lesson objectives;
3. It helps students to fuse multiple types of knowledge and to expand it;
4. It encourages students to be creative and increases the research method;
5. Students acquire the habit of turning their individual work into collective work because they will be networked into joint work etc.

Why is this manner of work with the application of ICT better than the ordinary type of instruction?
There are a number of reasons.
Disadvantages of the traditional lesson:

1. The lesson will not be interesting if students just sit and listen to the teacher and then reply to questions:
2. Inert atmosphere;
3. Students are not concentrated in the classroom and the teacher it cannot control it;
4. The teacher may not know how much the student has mastered the course material
5. The teacher has no opportunity to ask various questions

Benefits of e – learning

1. All students are involved in the work during the lesson
2. There is interest in finding new content
3. The atmosphere is not inert
4. The teacher has feedback on the level of students’ knowledge
5. All students will be engaged in the teaching content
6. There are questions of different nature
7. All students repeat the teaching unit
8. Through revision of the teaching material the students will further acquire a certain degree of knowledge.

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Students e-portfolio in art classes

Vojislav Ilić[1] and Andrijana Šikl-Erski[2]
[1] Primary school „Milutin i Draginja Todorović“, Kragujevac, Serbia
[2] Primary school „Jovan Ristić“, Borča, Serbia
e-mail vilicdva@gmail.com, andrijana.sikl@gmail.com

***Abstract**: E-portfolio in teaching art is a modern way of monitoring, recording and presentation of students' creativity and competence in general. Art e-portfolio has great potential in promoting students' products and is a good way of presenting students, groups of students and schools.*
This is much more than just a collection of pieces of work - this is a complete record of growth, development and advancement of students. Archived data can be easily accessed, the development path of each student can be easily viewed and it is available to peers, teachers, parents and different audiences.
In addition to traditional portfolios of students this portfolio represents a suitable time in which we live, the way of collecting and archiving of students' art works and as a testimony of individual development and advancement in the art classes.

***Keywords:** portfolio, e-portfolio, teaching art*

1. INTRODUCTION

We live in a world where digital technology involved in all segments of society as well as its operation in general. Digital technologies (today we call a comprehensive Information and communication technology-ICT,) in the last thirty years have changed our relationship to the world, life and its functioning so that today can not imagine any aspect of our lives without these technologies. We live in a world where everything can be digitized will be digitized.

Thinking of today's world Stefan Aufenanger says: "If we look to the future of our society, we really can not imagine different scenarios, but all in all we can identify some key trends. These trends can be expressed through: mobility, miniaturization, integration, globalization and commercialization. " (Aufenanger, 1999)

Mobility is the characteristic of the new media to operate independently from the city, space and time the user; Miniaturization applies to everyday devices to reduce the integration of computers in everyday devices; Integration refers to the connection of current and future media, multimedia in the true sense of the word; Globalization refers to the fact that refers to computer networking, but all areas of private and social life; Communication leads to the media which is increasingly commercialized. As was mentioned above, all of these observations are more or less related to information and communication technologies, which are obviously indispensable factor in today's civilization. These mentioned global trends affect education, so that the education should adapt to modern trends in the world media company.

As ICT have a huge impact on the entire life and functioning of our world, it shows why the tools they provide and offer have such an important role in the educational process. Their use opens up many possibilities and perspectives in education. Today, aware of the inevitability of digital technologies in the functioning of the world, and the benefits that bring, we try to be as meaningful use in education.

2. DIGITAL TECHNOLOGIES IN EDUCATION

Since the digital technology completely penetrated into our lives UNESCO published a document entitled *ICT in Education.* This document speaking of ICT is that: "One can contribute to universal access to education, equality in education, quality teaching and learning, teacher professional development, educational management more efficient, more effective management of the administration." Several key terms related to ICT, the amounts in this document , and they are:

- Teacher education, quality of teachers and their continuing professional education and training are central to the achievement of quality education. Today, the quality of teachers, teaching practices and teacher education is facing serious challenges in systems around the world. UNESCO believes that these challenges could be addressed through a holistic, systemic approach to education and development of teachers and mechanisms that allows increasing role of ICT in this issue. UNESCO supports initiatives related to the integration of ICT in teacher education, practice and capacity building for the development of international standards on ICT competencies for teachers.
- *Mobile Learning*. Today, more than 6 billion people have access to networked mobile devices. Mobile technology is changing the way we live and it changes the way we learn. Mobile learning involves the use of mobile technologies, either alone or in combination with other information and communication technologies to enable learning anytime and anywhere. Learning can take place in different ways: people can use mobile devices to access educational resources, can connect with others, or to create content, both inside and outside the classroom.
- *Open Educational Resources,* are resources on teaching, learning and research materials in the public domain that can be used under license intellectual property that enable students, teachers, states that the use of these resources. The potential of these resources, their availability especially in poor areas, and this is an excellent opportunity to achieve quality education for all.
- *Lifelong Learning* refers to the need of everyday learning and training, given the multiplication of information on a daily basis. Educational systems must accept that this learning takes place at work, community, family, social life or any bastard anywhere. ICT will extend the capabilities of such teachings, people can obtain information, communicate, networking is, on issues of common interest, create and participate in society. The task of UNESCO is to enable all people of the world to exploit the huge potential of ICT for learning and samoosposobljavanje.
- *E-Learning*. One of the basic conditions for education in the 21st century is to prepare people to participate in the knowledge economy, including social and cultural perspective.

E-learning is a cornerstone for building an inclusive society of knowledge and learning. UNESCO contributes and incorporates the ethical, legal and socio-cultural dimensions of the information society and helps to understand the opportunities offered by ICT.

- *Education Management Information System - EMIS*). The information system should assist in the collection and storage of data and information to assist in the design and evaluation of education. (UNESCO, nd)

3. PORTFOLIO AND E-PORTFOLIO IN EDUCATION

The term portfolio has multiple meanings and basic meanings are: wallet, bag, securities, business bag ... Portfolio is a collection of data and papers, all the accomplishments, achievements, plans, ideas and events that they want to remember and present, a complete presentation of the individual, group or company.

The concept of portfolio in education is explained as follows:,, Portfolio, according to certain criteria, carefully organized and developed a collection of all kinds of material that gives a picture of what a teacher, educator or associate knows and can do, reflect his achievements, professional experience , attitudes and thoughts. (Лајовић, 2013)

In education there are different portfolios: portfolio of students. portfolio of teachers, an associate portfolio, portfolio institutions.

E-portfolio can contain a wide range of data: personal data, data on education, knowledge acquired by various education, awards, certificates of training, participation in projects, objectives, self-assessment and progress achieved objectives, competencies and skills, presentations, papers and the like. All items in the portfolio should demonstrate the skills, competence, progress and knowledge of the owner e-portfolio is an important part of the critical review and further plan for development and progress.

Students' portfolio is a collection of data and contains a variety of information, systematically collected, which lists and document the experiences and achievements of students, containing the results achieved by the students through various activities: social, artistic, communicative, sports ... it is a collection of data on each individual student, Collection of documents and observations that were made in preparation during and after the implementation of the educational process. These data can be used student, teacher, professional services, parents of the importance of the promotion, development of competencies and achievements. Portfolio primarily serves the monitoring of student progress and evaluation including self-evaluation.

With the development of computers, there is a possibility that the data stored in digital form, one can save a large number of diverse data along with some new features. E-portfolio is a contemporary way of storing data.

E-portfolio can occur in free form, which is developed by a teacher (a simpler form), there is a special kreiranie licenciranie applications namenjenie educational institutions which include complete forms to record various data and documents.

The advantage of E-portfolio is that it allows a different approach to a variety of artifacts, users can amend the contents of a digital portfolio that using the links connecting parts. Traditional portfolio is static with the possibility of adding a e-portfolio is dynamic with the possibility of a permanent modification, correction, addition and subtraction.

Creating e-portfolio includes five steps:

1. Select: Selection of items that appear in the portfolio based on set objectives and that will best show the specific competence;;

2. Explanation: Clarification of each item in the portfolio with a critical analysis of the selected sentence to demonstrate their knowledge of a particular topic and linking different areas;
3. The creation of the collection: the collection, processing and packing materials on the basis of objective and future use;
4. Planning: Plan of portfolio development and setting future goals;;
5. Links: creating and publishing hyperlinks with the possibility of feedback.

4. TEACHING ART

"Teaching art is different from other subjects in character content, creativity processes, relationships between students and teachers, as well as to the assessment of results. In the world use different terms to describe the subject that deals with visual arts in line with the performance and the goals that countries have set about this." (Илић, 2016:66) It has no dominant intellectual and reproductive character, but experientially emotional and creative, because in the process of artistic culture engages the whole person and the character of the work of teachers is the cultivation of personality, not just education.

The most important characteristic of artistic culture, its creative character, because the fine arts creative. Art classes allows students to express themselves freely and to discover, explore and experiment. The set is expected creativity not only students, but also teachers so that together provide the creative character of the whole process of teaching. The result of the process of creating the art classes are art works and art vuzuelnih. (Winner et al 2013)

5. E-PORTFOLIO IN TEACHING ART

The ultimate goal of creating art and visual art was appearing in public. Students in schools creates works that usually end up in the premises of the school, various art competitions a rare papers end up in different collections. Almost all teachers the right collection of good examples of work and very soon the problem of storage and manipulation.

Portfolio najstandardnijih is one of the ways by which artists are showing their work, abilities and achievements, it is a collection of documents that show the progress, development and achievements of the individual.

On the other hand monitoring of the work, achievements, collect and record various data, the collection of works of visual arts in order to create an overall picture of the progress of a student and his is always a permanent task of every teacher of visual arts.

E-portfolio (*digital portfolio, online portfolio*) is a specific way of organizing, summarizing, sharing artifacts, information and a detailed overview of student achievement. E-portfolio of students in art classes is primarily gallery (database) of art and works of visual arts each student archived or placed on the Internet. It is the digitized data (photographs of works, scanned papers, videos, photos ...). Helen Barrett says that the portfolio is a purposeful collection of student work that shows the student's efforts, progress and achievements in one or more areas. In addition to digital works e-Potfolio Ostle contains information concerning students and their accomplishments. Collection should include student participation in selecting contents, the criteria for selection, assessment criteria and evidence of students' self-reflection. (Barrett according to Brown, 2011)

The problem of storage of art works, he also appeared as a permanent problem of all art teachers, namely the number of papers and the manner of their storage time, dimensions, 3D objects, etc.. has required a lot of space that teachers generally have the specialized classrooms for arts teaching, and in all this is a problem of the influence of weather on works of art works. In fact after only a few months ago the paper changes color, first because of the poor quality of the paper, or the poor quality of the color, or the manipulation of works and inadequate storage student papers fail.

With the help of e-portfolio aforementioned disadvantages can be avoided, although the digitization lose all the advantages of 3D (pastiness colors, textures and materials of paper, especially in collages and assemblages, but the problem with the 3D objects themselves who lose their attractiveness when photographed), but despite all the shortcomings of much benefit we get digitalization of student work.

E-portfolio is a modern way of presenting students products, but this way of presenting the students' works requires additional time and effort from the teachers and students for the organization and presentation. Art e-portfolio has great potential in promoting students' creativity and is a good way of presenting students, groups of students and schools. In addition to traditional portfolios of students this portfolio is the means of recording students' works and as a testimony of individual development and advancement in the art classes.

E-portfolio can be formed in the first grade and amended by the end of schooling, and can contain all artistic works created in class visual culture but may also include works created outside of class. In addition to the work e-portfolio should contain the observations of teachers who may or may not be available to everyone. Comments of teachers on student (social, psychological, pedagogical and artistic development) are not interesting to everyone, in fact many of these comments and conclusions of the internal character. (Lu, 2007; Brown, 2011)

E-portfolio should contain personal information about the student and his individual characteristics that are important for achievement, achievement data checks, data on student engagement and progress, recommendations for further progress, information on pupil behavior and attitude towards school subject and work and other information relevant to the work with the student and his advancement. The information that the teacher has to give the child are confidential, which means that it should be treated with professional discretion. E-portfolio is a collection of works created which provides a picture of what students know and can do, but also comments, observations and suggestions of teachers. Student art e-portfolio is particularly important as a means of feedback in teaching art, because it contributes to the differentiation and individualization of learning.

Assessing the art works of students has always been a difficult task for the art teacher. Evaluation with the help of e-portfolios developed a partnership with a student, encourages self-confidence and motivation of students to learn, a teacher is able to teach students how to set themselves learning goals and develop critical thinking.

The importance of electronic student portfolios, NSEAD organization, seen as a significant contribution to the promotion of student stavralaštva and motivation for further work. Although in many ways similar to a virtual gallery e-portfolio, e-portfolio is a very personal thing. This is much more than just a collection of pieces of work - this is a complete record of growth, development and advancement of students. Archives can be easily accessed and viewed the development path of each student and is available can be peers, teachers, parents and different audiences. Contents of student e-portfolios may be, information on student, teacher observations, works created by traditional art techniques, works created with the use of ICT, photos, photos of three-dimensional works and video works and other video materials. (NSEAD, undated)

E-portfolio can be placed on a computer at school or can be placed on the school Web portal or a particular portal. Often the schools developing systems for e-portfolios in line with their needs and plays what he needs to represent.

Today, there are Web services and special software for creating e-portfolios that offer the ability to create e-portfolio as well as the possibility to choose the way of publication. From commercial Web portal mention just a few: *www.eportfolio.org, www.digication.com etc*. From commercial software to mention: *PebblePad, Angle E-portfolio, Fronter, Webfolio, eXact Portfolio, Argus*, etc., which provide a variety of options for creating e-portfolio, in addition to commercial, there are non-commercial, such as: *Caroflot, Carbonmade, Cargo, Mahara, Elgg Learning Ladscape, OSP - Portfolio*, etc. All you. From the above we can see that a large variety of options and teachers are free to test the software and decide most with the option that suits them best or make the kind they want on their own or with the help of colleagues.

E-portfolio can be formed in the *Cloud* placed on the Internet with the help of Web 2.0 technologies and thus provides interactive content portfolio. Basically there are two possibilities for the formation of e-portfolios of students: At school web portal, which can be set up individual Web pages and students on her art works of students or one of the social networks and the like, where you can set the art works of students within the group or individually.

Benefits of e-portfolios in the Cloud: Availability from anywhere at any time, from any device, the ability to correct and complete the information, link, art-graphic design, printing capabilities, total insight into the achievements and competencies, publication of all or certain parts of the e-portfolio and the ability to send all or parts of the e-mail.

E-portfolio is not necessarily occurring on the Internet, it can be formed at a computer in the school and the data that we want to appear on the Internet can be saved to the web portal of school. Students 'and teachers' portfolios can unite the e-portfolio institutions which are added, the characteristics and history of the institution and it serves as an indicator of labor and the existence of the whole institution.

6. CONCLUSION

Modern technologies in education are increasingly used in teaching but also in support of the educational process. E-portfolio is a good and modern way of collecting, presenting and evaluating students' work.

The core of the e-portfolio in art classes make students 'products generated in the classroom or outside it and provides a complete insight into the students' creativity. In addition to the art works to be found and other information relevant to a complete insight into the progress and competence of students. Portfolio can be formed in the first grade and amended by the end of schooling and then makes an invaluable testimony to the wealth and complete boarding creative work.

Student art e-portfolio is particularly important as a means of feedback in teaching art, because it contributes to the differentiation and individualization of learning.

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Teacher competence as a predictor of acceptance and use of modern media and technology in the classroom

Bojana Anđelković[1]
[1] Agricultural and veterinary schools, Rekovac, Serbia
e-mail bojanaandjelkovic91@gmail.com

Abstract: *Contemporary changes bring many novelties we encounter. Changes do not circumvent the education, i.e. school. Tasks that are placed in modern school are numerous and significant in the context of acceptance and dissemination of changes and innovations that have occurred. Exactly in this context, developing and strengthening teachers' competences present an important predictor, according to technical and vocational training, respectively. A teacher who is willing to learn and improve continuously, to approach own work critically and reflexively in accordance with modern scientific and technological change seems to be a model teacher of the 21st century. This paper presents a review of research on the self-perception of the competence of teachers for the use of modern media and technology in the classroom. The results showed a positive trend in the assessment of competence for the application of modern achievements of science and technology in the classroom, by teachers working in primary and secondary schools. Teachers highly value their competence, which is one of the predictors for the innovation of teaching methods, by using modern technology in teaching.*

Keywords: *competence; teachers; modern media*

1. INTRODUCTION

Scientific and technological changes happening every day brought new needs and requirements in the roles of staff in all areas of work. When it comes to education, it is clear that this is a sector from which much is expected, which is "the leader", initiator and support further changes in other sectors of society (Martin et al., 2011: 1893-1906). Undoubtedly, it is clear that education is a key factor of the change and development of a society, and it is therefore the field which most attention should be paid to (Bass & Eynon, 2009; Guzey & Roehrig, 2009; Turayevo & Parts, 2014). Thus, people that "implement" education in practice and whose achievements in science and technology should be reflected in practice, either a well equipped, large, urban school, or less equipped, small, village school, present "pillars" of the education system . It is about the teachers. Teachers are the ones from whom a lot is expected, who can properly accept certain innovations and act in accordance with them, or on the other hand, do not accept innovations, and continue to work as usual. From teachers much is expected, but if we take into account innovations which we are daily exposed to, and which will reflect much more in the future the requirements are not unexpected and surprising.

Application of media in teaching contributes to achieving a more efficient teaching process (Mishra & Koehler, 2006: 1017-1054). However, if we want the modern media to be applied properly, it is necessary to encourage the development of competencies of teachers for the use of modern technological advances, which would affect at the same time modernizing the teaching process, but also on strengthening the professional role of teachers in the conditions of intense and rapid social and technological change (Carlsons & Gadio, 2002 Global-ready teacher competency framework is the following: standards and indicators, 2004: 51-52). Modern educational technology has become an integral part of the teaching process, with a tendency not only to improve the teaching process, but to change it fundamentally(Martin et al., 2011: 1893-1906). Thus, it takes considerable attention which should be paid to strengthen the competencies of teachers, cope adequately and use modern technologies in the teaching process.

2. METHODOLOGY AND ORGANIZATION OF RESEARCH

The initial aim of the research was to determine how primary and secondary school teachers assess their competence in the use of modern media and technologies, and to what extent they become qualified through their proper and appropriate use.

The research sample consists of primary and secondary schools on the territory of southern and central Serbia (N = 250). The survey was conducted in the period from February to June 2015. The research has included the distribution of a scale for evaluating teachers, whose resolution lasted 30 minutes average. Part of respondents rating scale was filled in according to the established system of paper-pen, while the second part of the respondents rating scale was filled in via the Internet, in the context of electronic scales designed for the collection of answers. Dissemination of electronic scales was done by e-mail, but also using social networks.

Differences in responses were observed and analyzed on the basis of length of service of the respondents, the type of school in which respondents work (primary or secondary), linguistic competence (knowledge of and level of proficiency in a foreign language), IT competence, ie. use of modern technologies, in first line computers and Internet, and participation in seminars and training courses relating to the use of modern media.

The instrument used was revised and adapted evaluation scale, the author Özkan Akman and Cemal Güven, published in the context of scientific research, called TPACK Survey Development Study for Social Sciences Teachers and Teacher Candidates, 2015, in the journal International Journal of Research in Education and Science (Vol. 1, No. 1).

3. RESEARCH RESULTS TO DISCUSS

3.1. The reliability of the scale

In order to achieve greater conciseness and accuracy of the results, the reliability of the revised scales of assessment was measured in relation to the applied pattern.

Obtained Cronbach's alpha coefficient (0.621) indicates the existence of a moderate association and internal approval of the scale for this sample.

3.2. Using computer systems

Table 1. *Determination of the use of computer systems*

Using computer systems	*N*	Completly disagree	Neither agree or disagree	I can not decide	Tend to agree	Completly agree
I can use Office package (Word, Excel, Power Point)	*250*	*7*	*36*	*23*	*109*	*75*
		2.8 %	***14.4 %***	***9.2 %***	***43.6 %***	***30 %***
I can communicate through Internet (E-mail, Skype)	*250*	*19*	*36*	*12*	*118*	*65*
		7.6 %	***14.4 %***	***4.8 %***	***47.2 %***	***26 %***
I can use programs for graphical drawing… (Inspiration, Excel…)	*250*	*24*	*43*	*25*	*94*	*64*
		9.6 %	***17.2 %***	***10 %***	***37.6 %***	***25.6 %***

When the results are analyzed, it is obvious that 73.6% of respondents assessed that they can use Office package (Word, Excel, Power Point). 73.2% of respondents communicate via the Internet (E-mail, Skype). 63.2% of respondents estimated that they can use programs for conceptual diagrams, graphic drawing (Inspiration, Excel...). The results indicate the existence of developed competences of teachers when it comes to modern technologies, which is a condition for the continued application of new technologies in teaching. Teachers greatly value their competence, ie. skills in using modern programs and technologies.

3.3. Using software packages

Table 2. *Use of software packages*

Using software packages	*N*	Completly disagree	Neither agree or disagree	I can not decide	Tend to agree	Completly agree
I am using the media to create and develop daily and annual plan according to teaching units	*250*	*13*	*43*	*18*	*105*	*71*
		5.2 %	***17.2 %***	***7.2 %***	***42 %***	***28.4 %***
I am using the media to make test (multiple choice test, true - false test, open question...) and complementary (checklist, values scale, form of self-efficacy...) criterias in process of evaluation	*250*	*28*	*38*	*13*	*98*	*73*
		11.2 %	***15.2 %***	***5.2 %***	***39.2 %***	***29.2 %***
I am using the media in order to implement different strategies of teaching (presentations, strategies of inventions, strategy of analusis and research)	*250*	*12*	*37*	*35*	*98*	*68*
		4.8 %	***14.8 %***	***14 %***	***39.2 %***	***27.2 %***

When you review the competence of teachers in the use of part of the software packages, it is evident that there is a satisfactory level of use of modern media and technology in the teaching process, by teachers. The teaching process is organized and implemented using modern media, ensuring the realization of educational work at a higher level, in accordance with the requirements of modern times and scientific and tehnological development. All this contributes to the adoption and strengthening of modern, technical and technological competencies of teachers, what is a condition, ie, predictor to overcome the shortcomings of contemporary school and reducing discontinuity between schools on the one hand, and technological development on the other.

Namely, since the changes occurring are intensive and based in process of computerization, it seems that the teacher has not given the option of choice when it comes to the organization of teaching through different means, strategies and media. Computerisation, which has affected the society in its entirety, brings a multitude of IT resources, exemptions, for which is necessary to acquire specific knowledge and skills to get teachers to use them adequately (Houge et al., 2008). It is only the question of time and resources how to provide sufficient technical and technological conditions in schools and education personnel, which will lead to a fundamental information (Greenfield, 2014).

For all these reasons, it is necessary to do systematic and planned approach to strengthen teachers' competences for the application of modern technologies in the processes of education, that teachers can in the right and best use all of the possibilities of modern media, and direct students to properly use information available within certain media and to select and classify them in the right way, and then to use them in the function of acquiring new knowledge, as modern society requires the individual to independently collect information that manages, analyzes and converts them into usable knowledge.

4. CONCLUSION

The research has shown that teachers positively evaluate their competence in the use of modern media and technology in the teaching process. The resulting picture of the situation in schools is optimistic. This is the way to build a new education strategy in the future through setting sustainable goals and tasks at school, in the context of contemporary social changes. The teacher, as a professional must follow the changes, which ones in many cases reflect on education, and to do trainings in order to operate the situation in accordance with these changes. Way to this is to strengthen the competence and professional development of teachers and educators and psychologists in schools, which in the coming period must be a priority to schools and society to keep up with the changes that are experiencing more intense in the right way. In the future it will be a lot harder to set up and assume directions of movement education in a few years, because of intense change and scientific and technological achievements. Thus, it is necessary to show to teachers the opportunities that change and innovation offer, but also the importance and necessity of strengthening their competences in this area, in order to decrease discontinuity between modern scientific and technological developments in society and in school mode, ie, education, while the teaching process is more efficient.

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Applying e-portoflio for improving the monitoring process and evaluation of teachers' work in elementary schools

Snežana Đorđević[1], Sanja Puzović[2] and Vladan Paunović[2]
[1] Primary School „Sveti Sava“ Batočina, Serbia
[2] University of Kragujevac, Faculty of Technical Sciences Čačak, Serbia
e-mail snezana.bat@gmail.com, sanja.puzovic@ftn.kg.ac.rs, vladan.paunovic@ftn.kg.ac.rs

Abstract: *The paper presents the contribution of the e-portofolio application in the process of evaluation of teaching work as the basis of evaluating the working process itself and the effects of improving competences of teachers. For evaluation it is important to set in advance the criteria and indicators on the basis of which the work of teachers will be evaluated. Monitoring of teaching work is the important element in the process of evaluating their work and its aim is to identify the potential problems and include teachers in training programmes. The importance of this process is reflected in obtaining the clear picture of the achievement level of the objectives and tasks planned and in development of teachers. The process of work monitoring and vocational training of teachers can be successfully conducted using the planned managing of documents through teaching record – portfolio. Portfolio has a long tradition in education and teaching work, today it is also available in electronic form. The importance of applying portfolio is analysed using the example of elementary school „Sveti Sava“ in Batocina.*

Key words: *portfolio, vocational training of teachers, evaluation*

1. INTRODUCTION

Modern conditions demand the use of technical and informational innovations in order to achieve the quality of work and development of students' and teachers' competences. Today is unacceptable that a teacher is out of ICT progress and its application, because then he would be "unable" to perform his professional function. Education, as the most powerful driving force in society imposes the need for permanent education and self-improvement of teachers allowing greater independence in planning and realization of the educational process. Techniques and means of informational and communication systems have a greater and more significant applications in education, teachers' work and its evaluation, which requires proper training and motivation of teachers for its use.

Portfolios have strong tradition within teacher education and have been used for a variety of purposes including supporting and documenting profesional learning and development and meeting registration requirements (Wray, 2008; Barton & Collins, 1993; Grant & Huebner, 1998; Ryan & Kuhs, 1993).

2. THE ROLE OF MONITORING AND EVALUATION OF WORK IN VOCATIONAL TRAINING OF TEACHERS

Professional development of people working in education is a comprehensive process which includes creating conditions and developed strategy at the level of community for a planned and continuous process of vocational training and their own professional development. In this way teachers are becoming the part of the process of improving the quality of educational practice (Grandić & Stipić, 2011). Professional development of teachers involves increasing teacher awareness of what works, how it works and how it can improve its work (Bjekić & Zlatić, 2006). In teacher education, e-portfolios raise issues including the best ways to intergrate these into preservice teacher learning, working with the under pinning pedagogies, and how best to support and assess preservice teacher learning using the new technology (Wray, 2007).

The quality of education of students largely depends on system of knowledge, abilities and skills of teachers, ie. on professional competencies. Teachers' professional competencies or the key abilities are classified in four groups (Code on competency standards for the teaching profession and their vocational training *("Official gazzette RS – Education gazzette", no. 5/2011*): educational area competence, subject and teaching methods; teaching and learning competence; competence for supporting development of students' personality and communication and collaboration competence.

Monitoring the work of teachers is an important element in the process of evaluation of their work and its goal is to identify potential problems and to include teachers in training programmes. The importance of this process is reflected in obtaining the clear picture of the achievement level of the objectives and tasks planned and in development of teachers .

The process of work monitoring and vocational training of teachers can be successfully conducted using the planned managing of documents through teaching record - portfolio. The heart of the portfolio are examples of the teachers, but not just on what teachers say about their work, but the facts and examples of what they have actually done (Edgerton et. al, 2002). Portfolio has a long tradition in education and teaching work, today it is also available in electronic form. The advent of information and communications technology (ICT) not only creates new demands for teachers skills in this area, but also provides opportunities for using an electronic version of the portfolio (Strudler & Wentzel, 2005).

3. E-PORTFOLIO SUPPORT IN MONITORING AND EVALUATION OF TEACHERS' WORK

ICT have become an integral part of the educational system as a support for teachers during teaching and for professional improvement. The complete professional development of teachers can be represented through cumulative auto record which would provide functioning of the so-called evaluation circuit (Živković, 2000). E-portfolio is that kind of record (teaching portfolio).

Through e-portfolio teachers present their ideas and achievements as an integral part of their work, as well as the results of the self-evaluating and self-assessing process. E - portfolio as a collection of teachers' data, papers, achievements, awards and trainings, represented in digital format, is necessary to be filed continuously and systematically.

Teachers in elementary school "Sveti Sava" in Batocina in their work use e-portfolio "Fig. 1".

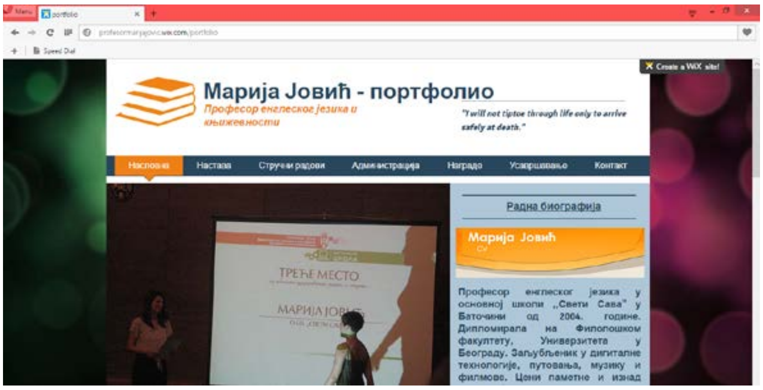

Figure 1. *Front page of the e-portfolio of teachers in elementary school "Sveti Sava" in Batocina*

Portfolio of elementary school "Sveti Sava" in Batocina contains the following information: CV; vocational training; teacher as a seminar leader; personal competence evaluation (according to the indicators in Code on competency standards for the teaching profession and their professional development ("Official gazzette RS – Education gazzette", no. 5/2011); personal competence evaluation (according to the indicators in Code on continuous professional development and acquiring teaching vocation ("Official gazzette RS", no. 85/2013.86/15); external evaluation of teachers' work; professional accomplishments; examples of good practice in working with pupils; examples of good practice in working with parents; additions to the self-assessment of teaching and learning field; significant results of methodical work (plans, preparations, additions on specific working methods, teaching resources...); annual overview of the accomplished vocational training and a personal plan of further vocational training; "My beginnings to remember"; "I want to keep from forgetting"; "My personal corner in the portfolio" "Fig. 2".

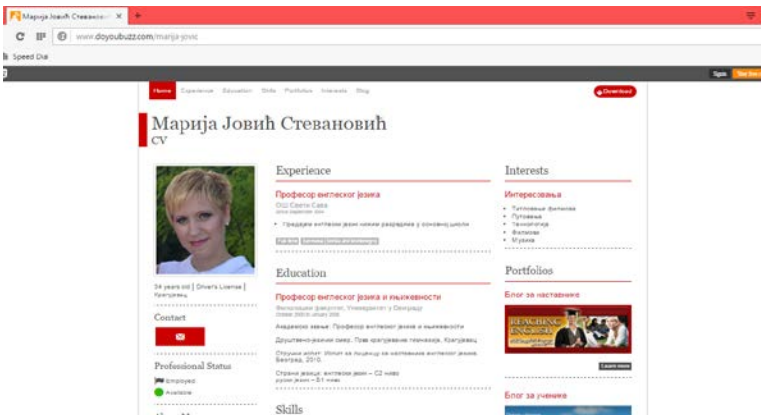

Figure 2. *CV in e-portfolio of teachers in elementary school "Sveti Sava" in Batocina*

Portfolio of elementary school "Sveti Sava" in Batocina provides the teachers an opportunity for saving, selecting and editing data of achievements and making effort in working with students; systematization of indicators of professional status and teachers' vocatioval education; presenting their own work available to the external evaluators and interested professionals; displaying teaching competences necessary for acquiring the vocation of pedagogical advisor. “Fig. 3”.

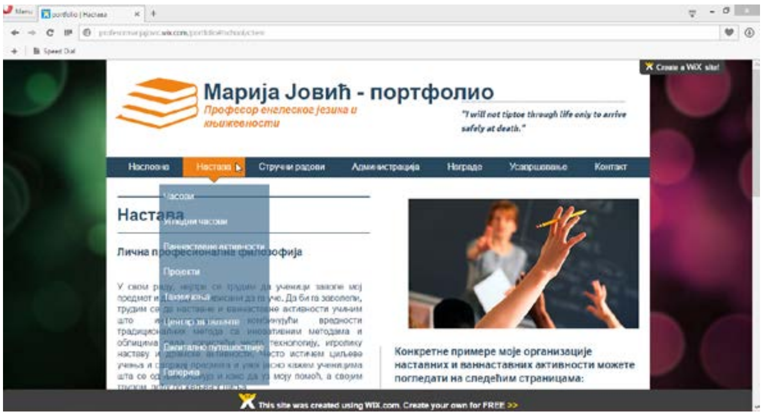

Figure 3. *The opportunities provided by e-portfolio*

E-portfolio provides a particular opportunity for creating blogs. Blog aims to instruct pupils to additional sources of knowledge, to display the work and dedication of students and to educate them in terms of technology. Teachers edit their blog partially on theirown, and partially in interaction with their students, their needs and interests. The displayed e-portfolio of teachers in elementary school “Sveti Sava” in Batocina owns blogs: Online classroom “Fig. 4”, Reaching-English, Webcyclopedia, A Click to knowledge, St. Sava – Badnjevac, Professional orientation...

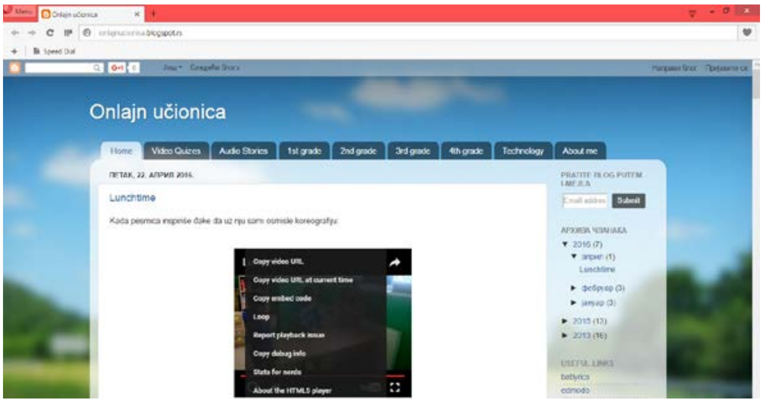

Figure 4. *Online classrooms blog*

3.1 Portfolio support in the process of work self-evaluation

Self-evaluation is a continuous process of implementation, analysis, adjustment and work improvement carried out in teaching practice contributing to the quality of school work. Self-evaluation is based on questions: How have we done something? Whether it could have been better? What can be improved? Which goals have been achieved, and which have not? What else we need to know so that the achievements in the next self-evaluation are better? How do we contribute to improving the quality of school work by improving our own work?

The process of self-evaluation is carried out in accordance with the criteria of the continuous vocational training Code (September, 2013 and amendmends, October 2015), which defines the obligation of creating a portfolio. Criteria are part of the Code that regulates the way of progressing and acquiring the vocation of pedagogical advisor, independent, high and senior advisor.

In e-portfolio of elementary school “Sveti Sava” in Batocina are given the self-evaluation forms made according to the indicators of both documents, so that each user can opt for the first, second or both ways of self-evaluation. “Fig. 5”.

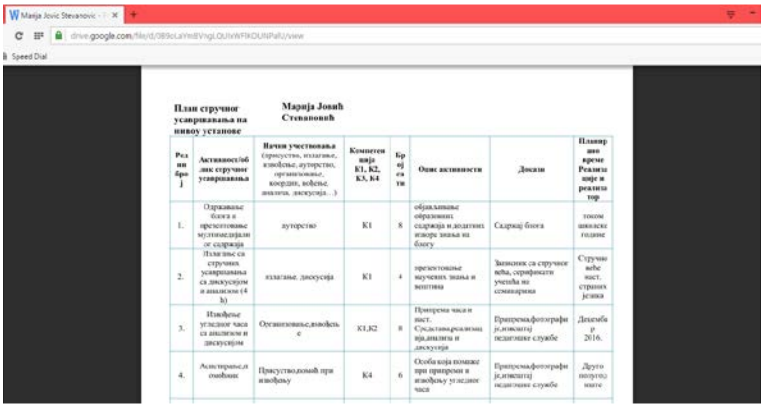

Figure 5. *Self-evaluation pages in e-portfolio*

4. CONCLUSION

The paper highlights the importance of applying e-portfolio in the process of monitoring and evaluating teachers’ work, esspecially in modern conditions characterized by the intense development of ICT and their increasingly frequent use in educational processes and in developing teachers’ competences.

The use of e-portfolio provides the possibility for efficient monitoring of continuous process of teachers’ vocational trainings and evaluation of their work throughout their whole working life.

Expiriences of teachers in elementary school “Sveti Sava” in Batocina confirm the benefits of planned record keeping through teaching record in electronic form – e-portfolio. By using e-portfolio in this educational institution the educational process has been improved, while the process of monitoring and evaluating teachers’ work has become more efficient, with positive effect on their vocational training.

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Opportunities and challenges of professional development school pedagogue in contemporary conditions

Mira Jovanović[1]
[1] Visoka škola strukovnih studija za vaspitače,Šabac ,Srbija
e-mail mira.jovanovic@itecom.rs

Abstract: *In recent years, both in the world and in our country, is increasingly emphasizes the importance of professional development of expert associates in school and their adaptation to the new social conditions. One of the starting points for this work represents recognizes the need for explication of the meaning of the language used when talking about professional development of school pedagogues in the context of modern schools, to allow that it is being discussed that he reviewed, in order to build shared meanings .Professional development of school pedagogue conceive in the context of lifelong learning starting from the conclusion that professional development starts in very early departure of an individual in a formal system of education, and possibly before. This paper analyzes theOrdinance on permanent professional development of teaching positions, teachers and educationists (Official Gazette of RS, No. 13/2012).*

Keywords: *teacher; professional development; opportunities*

1. INTRODUCTION

Initial education school pedagogue involves his formal education at the university, or study group for school pedagogy, which resulted in obtaining a diploma entitling him to get a job as an associate in the school. In this sense, it represents only one of the stages of professional development in which the foundation for the construction of his professional identiteta.Near initial education school educators, an integral and mandatory part of his professional development makes the professional training which includes acquiring new and improvement of existing competences and, as such, , it is a career development expert associates school pedagogues progresses to a certain title.

1.1. Professional training pedagogue

School teacher, in cooperation with teachers, makes a variety of tasks and activities aimed at improving the educational work. Planning innovation, new solutions, particularly the efficiency of new organizational forms of school work is very responsible job of teacher. Its meaning in the present and obvious popularize pedagogical innovation. In preparing and implementing innovation in the educational work of the school, teacher brings their expertise, awareness and monitoring didactic innovation, a teacher of their practical training and direct communication with students during the school work organization and the effects of the planned innovations. Improving educational work, in addition to experimental classes, include the development of a program of prevention and corrective work, health and mental-hygiene education (Trnavac, 1996, 21).

In the Ordinance on continuous professional development and the acquisition of teachers, educators and professional associates (Official Gazette of RS, No. 13/2012), the manner of organizing professional training of expert associates teachers.

Unlike the previous Regulations (Official Gazette of RS, Nos. 14/04 and 56/05), applicable to the fore, which is under the professional training of expert associates involved monitoring, adoption and application of modern achievements in science and practice to achieve the aims and objectives of education and education and improving educational practice (Ibid), the new Rules under the professional training of expert associates involves the acquisition of new and improvement of existing competences important for the advancement of education, educational, educational, professional work and child care (Official Gazette of RS, No. 13/2012).

Each Associate - school teacher and the teacher was required to during the five years he attended at least 100 hours of program (at least 60 hours from the list of mandatory and up to 40 hours with the lists of the program).

Basic settings of the Ordinance on permanent professional development of teaching positions, teachers and educationists (Official Gazette of RS, No. 13/2012) were:

-Lifelong learning

-Professionalising Interest in education - educational system

-Balanced Professional development

The same Ordinance introduces the following newspapers:

• Planning professional training

-Personal Professional development plan

-Prioritetne authorities

Linking with professional training competencies

-enriched List of activities and forms of professional development

-Promoted conditions and procedure for granting professional training programs

-Portfolio Professional development

-professional Training in the context of the annual norm-pedagogical training in an institution

-conditions, Procedures and deadlines for acquiring

-jobs Performing employees with grades

Competence in the aforementioned the Rulebook applied and included in professional development through the approval of a program of professional training, self-worth individuals and institutions, the adoption of a plan of professional training in the institution, a personal professional development plan determining the responsible person in the pedagogical collegium for monitoring training and reporting on it.

2. INFORMATION AND COMMUNICATION SKILLS OF SCHOOL PEDAGOGUE

The skills needed for the development of information and communication literacy as a working-action competences are: the use of appropriate user stripes, use of the Internet, a work base nonviolent and cultural as well as business communication, knowledge of english, knowledge of a second or other language. Under the computerization of education and pedagogical work involves "the process of securing the field of education WHO methodology and practice of optimum use of new modern information technologies aimed at achieving psychological and pedagogical goals (Đorđević, 2003: 47).

Information literacy is to admit its need for information, possessing knowledge about how to find, evaluate and utilize the best in order to solve a particular problem or made any decision. In today's age of computer literacy is an essential condition for information literacy, particularly the need for finding information. The effectiveness of educational communication depends on who the sender is and how it is able to send the contents of which are objects of communication, as well as how the recipient is competent for the receipt of the message or the content of educational communication (Jevtic, 2011).

3. FEATURES OF PROFESSIONAL DEVELOPMENT SCHOOL PEDAGOGUE

Professional development of school pedagogue, as a process that is based on the active participation knower - educators, its foundation is the key assumptions - knowledge, skills, competencies necessary for the realization of high-quality educational work of the school, develop through participation, interaction and interplay of pedagogues , teachers, parents, other colleagues and associates in school. In the system of professional development of teachers and school pedagogues were introduced and licenses that involved meeting certain criteria, namely the number of hours of professional development. Constructivist meta-theory developed new perspectives on the nature of knowledge, but stresses that knowledge is hypothetical, anticipatory construction of reality (Stojnov, 1998). The nature of knowledge is relative and socially conditioned, perspective knower is inseparable from knowledge of the subject - it is involved, participates in finding the object, the validity of the principle of replacing the principle of sustainability, structures, phenomena that are studied are inseparable from the social and cultural context of their events (Andevski, Knežević-Florić 2002). An important factor in the development of competence and professional development of school educator educator is the need for professional training. Attitudes toward school educator professional development and training of the personal construct that is fueled by his need and desire for further improvement and development. An important role in this development has an environment in which a school teacher working conditions in which takes place the educational process, the specifics of the environment in which the school is located, the characteristics of the collective school, school pedagogue needs and the needs of teachers, students, parents ... This confirms and constructive attitude in which he emphasizes that it is a phenomenon that is inseparable from knowledge of subject knowledge.

4. CHALLENGES OF PROFESSIONAL DEVELOPMENT PEDAGOGUE TODAY

The challenges that a teacher should respond to work together with the other participants can be achieved with the following tasks:

1.School like to enrich the different organizational capabilities, structure, teaching process, teaching new technology and modern equipment. The curriculum in teaching means teaching in the school, outside the school building, and certainly in places important for the life of pupils. The use of IT equipment in parts of the teaching process contributes to the dynamic delivery of instruction and creates a motivational basis for the successful work of students and teachers.

2.Position all participants in the educational process becomes recognizable. We talk about the affirmation of personal responsibility for realization of all participants. Teacher remains leader and one of the main pillars of the teaching process. He is, in his work with students, occasionally joined by associates or any other subject teacher with a view to carrying out teamwork. In this way a school whose work is based on different approaches, using various forms and methods as well as creating opportunities for promotion of every individual, and thus the school as a whole. Team teaching approach is the basis for quality realization of the curriculum of the school.

3.Stvarati conception of school that will encourage and facilitate the plurality and articulation of different possibilities and creativity in the educational process. It is necessary to change the holders of activities in the field of education, learning and motivation to work. In addition to teachers, holders of certain parts of the teaching process become disciples, associates, external collaborators, and sometimes parents of students. By including a larger number of participants of the teaching process is achieved by the dynamism of educational work, and also develops the ability to participation in the creation of conditions for the achievement of common goals (Vukovic, 2011: 554).

5. CONCLUSION

Starting from social constructivism, which emphasizes that knowledge is positioned between people, through their active participation and interaction of the learning process, as well as modern approaches to improve the quality of school work to point out that vocational training school pedagogue must be primarily be directed towards development communication competencies, cooperative, partnership and equal in all relations of the school, the questions are: "How much are teachers in our schools are ready to engage in a process of professional development? What skills and competencies they lack the most? "Are teachers in our schools are in need through continuous personal and professional development of foster partnership, equitable, efficient communication with direktorm school, the other co-workers, students, and other colleagues outside the collective and thus contribute to creating a positive socio -economic climate, according to which the identity of the school to be recognized not only in an environment where the school is located, but beyond?"

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Teaching and learning through the use of screencasting tools in teaching informatics and computing

Ajsela Hadžiahmetović[1] and Rifat Redžović[2]
[1] ES“Selakovac“, Novi Pazar, Srbija
[2] City Administration, Novi Pazar, Srbija
e-mail ajsela.hadziahmetovic@gmail.com, rifatredzovic@yahoo.com

Abstract: *In this paper was conducted a research of success of the implementation the screencasting tools in teaching of computer science in the elementary school and the impact on improving the areas of evaluation teaching and learning, based on the quality standards of work the school. Through the testing of students in order to determine the impact on the level of student achievement; evaluating the quality of lessons by teachers and interviewing teachers and students in which they expressed their views to relevant questions for their target groups, it comes to results which show that teaching aided by using screencasting tools excels compared to traditional classes. Survey results of both target groups indicate that the use of screencasting tool in teaching computer science is zarecognized as the quality of the work and influence on the improvement of the teaching process. Identified the potential for application in other cases. It comes to the conclusion that combining e-learning with traditional teaching and the use of electronic tutorials teaching contributes to ensuring the quality of work the school.*

Keywords: *screencasting tools; improvement of teaching and learning; e-learning;*

1. INTRODUCTION

The trend of development of information and communication technology is the strongest stimulating factor for new potentials that contribute to improving the quality of teaching. In the modern concept of learning based on learning and the student it is not just desirable, but also requires that teachers in the classroom apply the tools and technologies that ensure the success of the learning process.

Continuous recording running software applications on the screen with the possibility of adding audio comments represent screencasting and thus forms a material that can be used for creating multimedia instructions (Richardson, 2006) [1]. The concept of screencasting is relatively new and was first mentioned in 2004 when a columnist Jon Udell used him, which introduces a new approach to creating documentation and user education. The desirability of using the multimedia instructions definitely is in the fact that an increasing number user-oriented tools for their making provide opportunities of application both in combination with traditional teaching, as well as a solution for e-learning.

Screencasting tools are increasingly used in education as a source of learning materials. There more numerous studies about using of this form of teaching materials, and one of the study (Winterbottom, 2007) [2] shows that students have a high positive thinking of application screencasting media where the highest priority emphasizes great flexibility, but also the possibility of re-watching lessons.

2. APPLICATION OF SCREEN CASTING TOOLS IN TEACHING

There is a wide range of applications screencasting tools for teaching. Particularly these Interactive contents are interesting because of the possibility of personalization and customization specifics of the students' in terms of selection of dynamics and the time required for the appropriate the knowledge that being placed this way.

These videos provide a simple tool to expand the facilities of the subject that is studing, suitable for students in remote locations, students with special needs, as well as all others who can benefit from the presented content, and are not able to attend classes. Tutorials adds an active visual element to teaching, which remains available for students after the end of the class. In addition to virtual classroom with the tendency of distribution of ICT in teaching also screencasting tools get more space in a traditional classroom.

The popularity of interactive teaching materials in the form of tutorials is largely represented on the use of the readymade materials available on the internet, but thanks to the fact that these tools are very easy to use, more teachers create their own interactive content in accordance with the outcomes of the teaching unit. An additional relief in the creation of these contents are online screencasting tools that do not require the installation of software on your computer, but also provide the ability to create online materials on the site which can be placed directly on the internet. Simplified user-oriented software provides the ability to use screencasting tools and by the students. Although there is no direct interaction between teachers and students this way created teaching materials promote the aspect of individualized teaching, where students gain an impression of work one-on-one.

3.THE AREA OF EVALUATION TEACHING AND LEARNING AS A FRAMEWORK FOR EVALUATION OF THE TEACHING CLASS

The formal framework and instrument for evaluating and monitoring the flow of teachers class in schools in our education system is the area of evaluating teaching and learning. This is a key area of evaluation within the Quality Standard of school work (Rules on the work quality standards of school "Off. messenger RS", no. 7/2011).

Teaching and learning is based on defined standards and individual indicators (standardized statements) achievement of individual segments of the teaching process as a prerequisite for the successful realization teaching. This standardized instrument for periodically evaluating used in self-evaluation and external evaluation of the quality of school. They are also daily used in the both for self-evaluation of teachers class, as well as monitoring and evaluation by other teachers. The area of evaluating the quality of teaching and learning is defined through 7 standards, each of them with a several quality indicators. The importance of standards in this area of evaluation is reflected in the fact that they can serve for monitoring the actions and behaviors of both, teachers and students. On this way the we get the information about what happened at the class, about quality of the processes and results of learning. In evaluating the quality of the field teaching and learning particularly focuses on

the following aspects of teaching: the different techniques of learning, construction of knowledge at the the class, adaptation of teaching to the different educational needs of the students, managing the process of learning, evaluating in the function of learning.
The area of teaching and learning consists 38 of quality indicators which are grouped in 7 standards. Evaluation of the quality field of teaching and learning is achieved through the monitoring and evaluation of the teaching class, during which it is assessed achievement of quality indicators in this area. As a formal instrument for monitoring and evaluation of the teaching class is used the form for monitoring of the class that was developed for this purpose. By summing the assessment of achievement of quality indicators within individual standards leads to the the final evaluation in the field of teaching and learning, and assessment of the quality of the teaching class.
Considering that teaching and learning is the key area all of 7 in the quality standards of school, the effects of successful achievement of other areas are indirectly reflected on the teaching process. Ensuring the quality standards also represents the ensuring of educational achievement outcomes and the student achievement standards aligned with the educational policy of the Education System.

4. THE RESEARCH METHODOLOGY

This part of the paper refers to the concrete results of research of teachers and students, as well as the level of student achievement results and evaluating of teaching informatics and computer science. The research was conducted in the primary school "Selakovac" from Novi Pazar, by the author of this work and colleagues who teach technical and information education and mathematics. The research included 56 students (8th grade students of two classes of these schools) and 17 teachers and school expert associate (1 associate, 9 teachers from groups of subjects of natural sciences, 4 teachers from a group of community-linguistic sciences and 4 teachers from classroom teaching).
At the beginning the survey conducted for teachers and students, and then was held a training for teachers (Screencasting tools and application possibilities in the classroom), which were implemented in classes with the experimental test group of students.
The first survey that was conducted among teachers was aimed at examining the attitudes of teachers in terms of readiness for aplication ICT in teaching, knowledge terms such as e-learning, ICT, screencasting tools, tutorials, innovative teaching methods, etc. This survey was done total of 18 subjects (17 teachers and associate). The second survey was conducted among students to examine the attitudes of students in terms of how successful they find the current way of teaching informatics and computing, providing proposals for improvement connectivity options of the acquired knowledge in informatics and computer science with other subjects, how them helps acquired knowledge from informatics and computing in learning of other subjects, how much lessons learned in informatics and computing helps in everyday life, etc. This survey was done 54 of students, or 96.43% of the total number of students who are taking part in the research.
After sorting the results of surveys for teachers, they have shown that teachers expressed positive attitudes on mostly all issues, after that was a training for these teachers. A training was held at the school for a period of 4 school classes, where teachers were inroduced with the basics of pedagogical e-learning, possibilities of applying ICT in teaching, the concept of screencasting tools and application possibilities in the classroom.
video tutorials were made for the teaching unit HTML and they placed on the Internet. Students of the the experimental group (29 of them) had the opportunity for a week before

the experimental class to access the tutorials, and in this way they have prepared for the class which would be based on the concept of "flipped classroom". For those students who did not have the ability to access to the Internet from home or from their smartphone every day was allowed the access at the school in the digital classroom.

In both classes (experimental and control group) was held by one class of informatics and computing, in the first group was held a traditional class of processing the new material, while the experimental group was held class of processing of the same teaching unit, but on the principle of "flipped classroom " and applying screencasting tools in the classroom. In both groups the classes were attended by teachers and expert associate who have followed the course of classes and evaluate them through the evaluation list (form for monitoring of teaching class). After finalizing of the classes conducted a discussion and analysis by teachers and expert associates who have made a general observation that in the experimental group in addition to being fully realized education outcomes was clearly expressed self-regulation of students in the work, it was more encouraged peer learning and teaching, more successful were the activities that encourage the development of critical thinking and discussion among students, as well as that was clearly expressed by stimulating atmosphere for work on the class.

Arranging results of these evaluation list from classes in both groups, it was found that the class held by the experimental group teachers estimated for 23% more effective as compared to the traditional class. Class, which was held in the control group was graded 3.19 (maximum of 4 ratings), while the class held in the experimental group estimated an average score of 3.92.

At the following class both groups (classes) had a control exercise that came to check the level of student achievement. Results of the knowledge test in the experimental group showed a better average level of student achievement for 27.48%, whose average score was 4.35, compared to the average achievement of the control group in which the average score on the knowledge test was 3.42 (Figure 1).

A second survey was conducted for teachers and students after the control exercise. In the second survey the teachers (attended by all 17 teachers and 1 expert associate) tested following attitudes:

To the question what extent the application of screencasting tools contributes to improvement of the field teaching and learning the teachers gave ratings: on a scale from 1-4 was rated 4 72.22% or 13 respondents, with grade 3 or two of them 11,11%, while the grade 2 also gave two of them that is 11.11%, and only one respondent rated 1, which is 5.56% of the total number of respondents. To the question whether they consider that the application of screencasting tools in the classroom contributes to the development concept based on learning 94.44% answered with yes. It is interesting that 100% of them considered that this innovation in teaching contributes to self-regulated learning and creating a stimulating atmosphere. 77.78% of teachers believe that in this way, in addition to developing digital competences comes to developing competences for lifelong learning. 66.67% of teachers believe that there is a possibility for application of these tools in the teaching of other subjects. 100% of them think that in addition to of informatics and computing application of these tools contributed most to the teaching of mathematics. 55.56% of the teachers thinks that in their subject there is at least one teaching a theme that would be suitable for use screencasting tools.

94.44% of the teachers expressed a wish for professional training in the application of screencasting tools and other e-tools in the classroom. In the second survey conducted among students of the experimental group 96.55% taking part, or 28 of 29 students. At the repeated question from the first survey which related to the success of the teaching of informatics and computer science occurred was a positive difference for 21,42% from 75% to 96.42% on repeated testing. 92.85% of students think that it should provide support for each teaching unit in the form of tutorials. 85.71% of the students expressed a wish that through leisure activities - computer section learns to work with screencasting tools, the same number would be like to does the homework in informatics and computing in this way. 92.85% of students believe that their achievements ware accelerated when if in other subjects apply these tools. To the question in which subject in addition to the information technology and computing they like to have support in the form of tutorials 100% answered in mathematics.

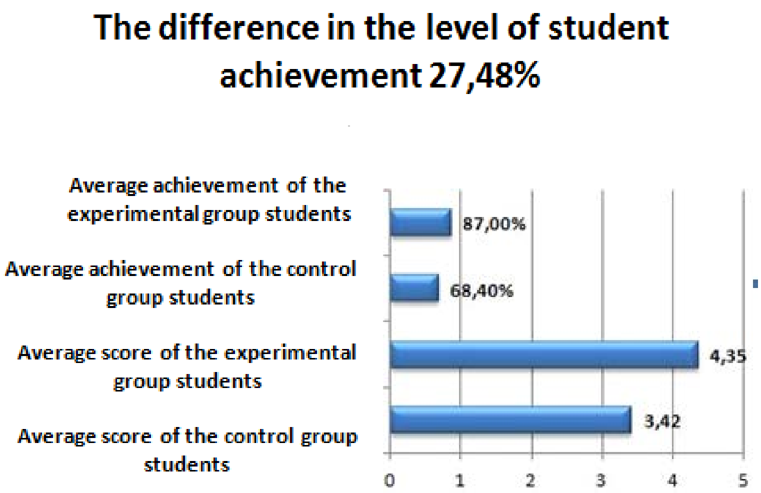

Figure 1. *The difference in the performance of the class with the implementation of screencasting tools compared to traditional class*

5.CONCLUSION

Through the research it was noted that there many possibilities for applying screencasting tools in teaching. It comes to the knowledge that the special good effects provides a combination of this way created interactive teaching materials with traditional teaching, whereby in particular comes to encouraging self-regulated learning in of students.

The research has clearly demonstrated in addition to the application of screencasting tools in teaching informatics and computing provides the realization of educational outcomes of sabject, contributions and raising the quality of teaching, and therefore the introduction of these innovations into the teaching comes to improving the quality work of the school. Also there was performed , the influence in reliance with regard to the development of cross-curricular competencies in teaching informatics and computer science, which is in the course of their training necessary to develop in students the knowledge acquired to be functional and used in the context of lifelong learning.

Possibilities for application of screencasting tools in teaching informatics and computing are enormous, both in the context of regular classes, as well as extra-curricular and leisure activities so that there is space to support the students in this way in terms of personalization and individualization of instruction. In the majority of subjects there is also the possibility of applying these tools, which would significantly impact on improving the quality of teaching and improve student achievement levels. An interesting fact is that besides mathematics and objects belonging to the group of natural sciences, also ideas for implementation next coming of classroom teaching and socially-language sciences with the subjects. A positivee climate in the field of educational policy encourages the use of ICT in education and professional training and development of teacher competencies in that direction. The conclusion that the potential lies not only in the application by teachers in the classroom, also the enabling students to create material using screencasting tools also accelerate the achievement of educational outcomes of teaching informatics and computer science and other subjects and so lead to the improvement of students achievement levels. The systemic recognition of needs of teaching and schools for improving quality through the use of ICT in teaching contributes to the development of a positive climate in our schools. Terms such as e-learning, ICT, Web tools becomes everyday life and increasingly lead to combining elements of e-learning with the tradicional teaching in our classrooms.

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Bridging the gap between the classroom and reality (ESP) – Task based/Topic centred learning

Vesna Kovačević[1]
[1] Faculty of Technical Sciences in Čačak, Čačak, Serbia
e-mail vesna.kovacevic@ftn.kg.ac.rs

Abstract: *One of the main goals of teaching a foreign language is its application and usage in real, everyday life. Task based learning is an approach in teaching English which gives students the opportunity to learn by doing while a teacher has a complex task to help them master variety of language and professional skills.*
As students experience different roles in accomplishing their task, the opinion is that task based learning gives the opportunity to bridge the gap between the classroom and reality because it is authentic and true to life, and the results of students' work can be used in real life.

Keywords: *task based; topic centred learning; ESP*

'To learn something effectively, learners need to know what to do. They need to know how to do it. They need to know why it is important. They need to know how it relates to who they are – their role…. '

Robert Dilts

1. INTRODUCTION

I have been teaching as an ESP lecturer at Faculty of Technical Sciences in Cacak, Serbia for 19 years now. The question which has always bothered my mind was how to help my students bridge the gap between the classroom and reality, how to help them be ready for everyday life usage and application of the foreign language knowledge and skills as future managers, engineers, teachers.

In order to learn and acquire different skills and knowledge you have to learn about yourself and the world around you.

2. EFFECTIVE LEARNING IS A MULTI-LEVEL PROCESS

Effective learning is a multi-level process. As a teacher, you need to ensure that all the levels are working to support the learning of your students. Make sure:

1. ENVIRONMENT – Where? (When)

That the environment is as conductive as possible to learning and that adequate time is allocated for key activities.

Most of us live our lives in many different environments: at home, in the classroom or training- room, in the staffroom, at the gym, at social events. …

2. BEHAVIOUR – What?

That classroom behaviour and activities are relevant, interesting and useful

In different environment, we do different things;

3. ABILITY – How?

That learners develop abilities and skills, and that they learn how to learn

How do we do things we do? What skills do we have to enable us to do the many and varied activities that we do in our life?

4. BELIEF – Why?

That learners believe that they can learn, and that they develop confidence

Why are we able to do the things we do? What beliefs do we have that enable us to have those particular things and that support us in what we do?

5. IDENTITY – Who am I?

That learners have a sense of themselves as proficient learners and users of language at the level of identity;

What is my sense of myself? Who is the core self at the root of all the many selves or roles that I play in my life? What is my essence?

6. SPIRIT – What else?

That learners have a sense of spirit, of their learning being worthwhile in a much wider sense;

What is my life about? What does it mean? Why am I here? Where am I going? What do I want ultimately?

Fulfilment comes from having all the levels in alignment. [8]

So, if I am in a place I like, doing things I enjoy, using skills I am good at, sustained by positive and empowering beliefs, having a strong sense of all this being a part of who I am and connected to a higher sense of purpose – then that is wonderful.

I am centred, connected, congruent and content.

"Help students take responsibility for their own learning. Incorporate -learning to learn-strategies and self-evaluation into your lessons. Encourage your students to take initiatives.'[5]

Teachers should direct students' attention and hope they will learn from exploring and noticing.

In order to achieve all this my choice is – TASK BASED LEARNING

3. WHY TASK BASED LEARNING?

Task based learning and teaching in ESP is an approach which gives students the opportunity to learn by doing, and us to teach in an engaging, dynamic and interactive way. [9]

It has also enabled me to divide groups of students into smaller, manageable size, and the number of lessons which is insufficient is extended in the way that students meet not only in the language classrooms, but in the Library, computer rooms, discuss the assignment with ‘content teachers’ in order to accomplish it.

As students experience different roles in completing their tasks – the teacher has the opportunity to bridge the gap between the classroom and reality because task based learning is authentic in a sense that it allows time for variety of activities and it also gives students opportunity to show how skilful they are in searching, compiling and presenting data dealing with a certain task/project they have been given.

Task based learning has also helped me to assess their reading, writing, speaking, listening – all four language skills in a new, more realistic – true to life way and thus more objective way.

This model is especially appropriate for combining professional knowledge with knowledge of a foreign language. A small, self-directed group of students is faced with a real –life assignment to be accomplished in the professional context. Students explore the possibilities; identify what they already know and what they need to learn, do self-study and search for knowledge in a systematic way using modern technology.

In the last step, they integrate their ideas and present their achievements. The model combines social and individual learning processes, putting emphasis on active participation of individual members – just like in real life situations. [3]

That is why students need more content-based teaching, more topic-centred lessons which are components of a task based learning.

In order to tackle and deal with all these demands I try to help my students learn out of the classroom as well, I try to find and use activities which are focused and task based so they include content/subject teachers as well as media sources as much as possible. In that way students use the foreign language in discussions and preparations of material with content teachers and needless to say, when they search the Internet or watch satellite/cable TV channels looking for specific pieces of information. (All these activities are IN and OUT of the classroom.)

TBL is organized in series of group project meetings during which the following seven steps need to be taken:

STEP 1 – Making the case clear

The group is given the task. The teacher clarifies anything the students do not understand. Each group chooses a chairperson and a secretary, to co-ordinate the work and to take the notes. Students take these roles in turns. In that way teacher is in a better position to monitor the group work and give guidelines or whatever the group needs.

STEP 2 – Formulating questions and queries

The teacher asks each group to discuss the task in more depth. Students start a brainstorming session about the topic. The students write down the questions addressing the task.

STEP 3 – Identifying the current knowledge

Each group has to find out how much its individual members already know about the questions from STEP 2. At this step students are allowed to use their mother tongue in order to show their existing professional knowledge. If this occurred in English, some knowledgeable students would tend to remain silent because they would not know the right words in English.

STEP 4 – Structuring the ideas. Identifying learning needs

Students decide which ideas belong together and group ideas around the questions from STEP 2. Students also identify what has to be learnt or would require further research.

STEP 5 – Formulating learning aims

Distribute assignments among group members

Each student is assigned to the task he/she is most knowledgeable about. The secretary writes the names of students and their tasks.

STEP 6 – Individual activity/research

Students use various sources for their research. This can either be the library, Internet, the lecture notes or textbooks on professional subjects or content teachers. At this point there is a lot of exchange of information among the students and content teachers.

STEP 7 – Discussion and evaluation of information. Presentation.

In this step the students have to use the target language only. After they have discussed and evaluated gathered pieces of information and completed assignments by all members of the group, they start preparing the presentation. The final step of this project is delivering a presentation when evaluation of the whole task is carried out by teachers and students as well. [7]

The selection criteria used is:

- The activity is interesting
- There is a task
- The task is authentic
- There is an element of risk
- They have to meet deadlines
- There is emotional involvement
- There is a multi-media input/output
- The outcome is true to life
- The students practice all four language skills – reading, writing, listening and speaking [1]

As I teach students of Management, Computing, Electrical Engineering, and Mechanical Engineering, the content teachers could/should be included – teacher of Psychology, Marketing, major subject teacher, teacher of Computing and language teacher.

4. ROLES OF SUBJECT TEACHERS

As adviser and tutor, the subject teacher should make sure that students can contact him/her when needed (by e-mail, or during consultation hours). As mentor, he/she should direct students in their information search and guide them through their research. The roles of the subject teacher could be summarized as the following: facilitator, adviser, case designer, provider of literature and assessor.

The language teacher and the subject specialists can act as assessors; the language teacher will assess the linguistic aspect of the written report and/or oral presentation while the subject specialists will assess the contents of the written report and/or oral presentation.

Language teacher has the most important role here as he or better to say she has to tangle everything smoothly, wrap it up in a foreign language and help students while giving presentations to really give a present – a gift and gifts are selected with care and they are appropriate to the receiver. Language teachers have to give an enormous language input, both in oral and written language. They have to teach students how to use professional literature written in English, which phrases to use when they are having a meeting, negotiating, that some words are powerful, some others are not, what the language of ads is, the language used on the Internet, the language of presentations. Language teachers have to teach the students to use appropriate language for each of these situations. Language teachers also have to help their students master the skills of professional writing – writing summaries, abstracts, presentations, visual aids, minutes of meetings, etc.

TRANSFERABLE SKILLS – It may appear that research is not the domain of language teaching but if we want our learners to become autonomous, we need to become a 'guide on the side', giving them support also in development of the so-called transferable skills which include internet research skills, etc.

As it can be seen, many different kinds of requirements have to be met. Obviously, this cannot be achieved without a team work of both teachers and students, (there is no Mr. Know All) which is another good example for the real world our students will enter tomorrow.

The final step is evaluation where all the teachers are present and take part in estimating students' work, as well as other students who also take part in giving their opinion thus creating a good atmosphere to be more objective and help them see their strong and weak points compared with other students' work. [10]

5. CONCLUSION

One of the main goals of teaching a foreign language is its application and usage in everyday life situations (bridging the gap between the classroom and reality). Task based learning is an approach in teaching English which gives students the opportunity to learn by doing while teachers have a complex task to help them master variety of both language and professional skills in order to be ready to meet the demands of the real world.

So, keep it real as much as you can and whenever you can!

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Learning styles of students of different professions

Biljana Kuzmanović[1], Marija Blagojević[1] and Momčilo Vujičić[1]
[1] Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia
e-mail biljana.kuzmanovic@ftn.kg.ac.rs , marija.blagojevic@ftn.kg.ac.rs, momcilo.vujicic@ftn.kg.ac.rs

Abstract: *The teaching process in higher education, in addition to teaching requires careful planning because of the specificity of different study programs, also requires consideration of personal characteristics of students, such as learning styles. The aim of this paper is to investigate the differences in preferred learning styles between students of integrated academic studies of Techniques and Informatics (TI) and the undergraduate academic studies of Information technology (IT) where Kolb's model of learning styles has been used. The sample consisted of 51 students. The research results showed that there are differences in the preferred learning styles between these two directions, and also that the majority of students prefer a convergent learning style.*

Keywords: *Kolb's model of learning styles, organization of teaching, learning styles of students*

1. INTRODUCTION

When talking about the teaching and learning process in higher education, numerous questions are set concerning the planning and organization of teaching, especially because of the specificity and diversity of educational profiles. Also, abilities of students, previously completed school, pre-existing knowledge and skills, affinities, technical possibilities of teaching and learning styles can be taken into account as well as personal characteristics of students.

Learning styles which are defined as individual preferences of the ways in which an individual collects, processes, interprets, organizes and analyzes information (Kharb, Samanta, Jindal & Singh, 2013) or the ways in which an individual concentrates on some content, efficiently and effectively perceives information (Slater, Lujan & DiCarlo, 2007), and processes, internalizes and remembers new academic skills and knowledge (Csapo & Hayen, 2006), may have a significant impact on the process of teaching practice but also student activities and learning outside it.

2. LEARNING STYLES

Different authors emphasize different aspects of learning styles in which definitions with a focus on preferred sensory modalities are allocated (visual, auditory, kinesthetic... etc.), then the definitions of styles as personal characteristics that affect the behavioral patterns in situations of learning, as well as the definitions which primary focus on cognitive processing (Smith & Renzulli, 1982). Some authors observe learning styles in a broader context, taking into account the cognitive (the way of perceiving and processing information), affective (attention, emotion and evaluation) and physiological aspect (fatigue, habits, daily rhythm of activity ...) (Keefe, 1987, according to Leite, Svinicki & Shi, 2010), which are important indicators of how an individual will perceive and react to the learning environment (Keefe, 1991, according to Wang, Wang, Wang & Huang, 2006).

In the literature, the following models of learning styles are commonly distinguished: MB model (Chaterine Briggs & Isabele Myers, according to Bjekić and Dunjić-Mandić, 2007) which determines learning styles on dimensions of extraversion-introversion, sensitivity-intuitiveness, thinking-emotions, trial-observation; Fielder-Silermanov model (Felder & Silverman, 1988), which classifies styles on dimensions of learning sensitive-intuitive, visual-verbal, inductive-deductive, active-reflective, sequential-global learning and Kolb's model (Bjekić and Dunjić-Mandić, 2007).

Kolb's definition of learning describes learning as a process where knowledge is built up through the transformations of experience through the personal and social knowlege (Kolb & Kolb, 2005a; Coffield, Moseley, Hall & Ecclestone, 2004). Kolb suggests four-phase hypothetical circle of learning, where learning is seen as a continuous, interactive process because an individual durnig learning goes through all four phases (Cassidy, 2004). Four stages of the experiential learning model is described as a concrete experience (CE – experiencing), abstract conceptualization (AC – thinking) if an individual prefers conceptual and analytical thinking in order to understand, active experimentation (AE – doing) which includes learning using attempts and error and reflective observation (RO – reflecting) which includes paying attention to the task and consideration of potential solution before the attempt of solving (Figure 1). The concept of learning styles Kolb describes as individual differences in learning that are based on the preferences of an individual to the different stages of learning.

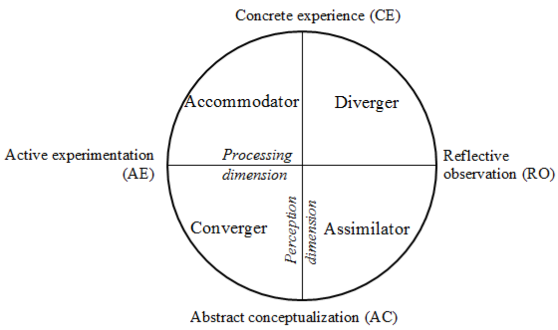

Figure 1. *Display of four-phase circle of learning (Bjekić and Dunjić-Mandić, 2007)*

All four learning styles are described by Kolb in two dimensions (Bjekić and Dunjić-Mandić, 2007; Rayner, 2015): processing dimension (horizontal dimension) that includes a reflective observation and active experimentation (RO-AE) and dimension of perception (vertical dimension), which defines the source of information or dimension of concrete experience - abstract conceptualization (CE-AC). According to this model there are four learning styles that are defined by preferred stages of learning (Kolb & Kolb, 2005a; Wang et al., 2006; Coffield, Moseley, Hall & Ecclestone, 2004; Cassidy, 2004; Hawk & Shas, 2007): divergent style, convergent style, assimilation and accommodation.

Individuals with divergent style (reflective thinker) prefer CE pole of dimension AC-RO, and RO pole of dimension AE-RO. This style is characteristic of individuals who are the best in observing the concrete situation from different points of view; who have the ability to generate a large number of ideas, have a tendency for imagination and emotionality, prefer to work in groups, they are openminded for different points of view and receiving of feedback; they require consideration of learning objectives at the beginning; they work harder under time pressure; they are considered to be very creative because they have the ability to solve problems in different ways.

Individuals with assimilatory style of learning (theorist) prefer AC pole of dimension AC-RE, and RO pole of dimension AE-RO. Individuals with this learning style are the best in the understanding of wide rank of information and their organization into logical form; they are less focused on people and more interested in ideas and abstract concepts; they are prone to analysis, separation of elements and determination of relationships; prefer theories, models and systems; faster devise content on the logical speculative level than in practical application; they are more inclined to scientific disciplines and mathematics.

Individuals with convergent learning style (ractitioner/pragmatist) prefer AC pole of dimension AC-CE, and AE pole of dimension AE-RO. This learning style is characterized by the application of certain theories and ideas in practice. For the practitioners, the best are tasks that require problem solving; they have a tendency to hypothetical-deductive reasoning and experimentation; they prefer solving of technical problems rather than social and interpersonal.

Individuals with accommodative learning styles (activist) prefer CE pole of dimension AC-CE, and AE pole of dimension AE-RO. Individuals with this learning style prefer learn from concrete experience; they are prone to accommodating, ie. adapting their behavior to a new experience, practical activities and slower devise the content on the logical plan; they learn using attempts and error; they prefer to use ready-made information than to analyze.

In his research, Kolb has proved that professions and choice of study largely determines the preferred learning style (Kolb, 1981; Kolb & Kolb, 2005). The research results, using the LSI scale (Learning Style Inventory) showed the following:

- Accommodative learning style prefer individuals educating for business, education;
- Individuals with convergent learning style study medicine and engineering, technology;
- Individuals with divergent style are represented in the following areas: history, psychology, English, political science, art;
- Assimilative learning style have students who are educated in the fields of economics, foreign languages, mathematics, sociology, chemistry, physics.

Kolb's research has shown that female gender prefers specific activities in contrast to men, who are more inclined to abstraction (Kolb 1976b, 1985b, according to Kolb & Kolb, 2005), and also that individualss with ages increase the level of abstract learning.

2.1. Possibilities of Adaptation of Teaching to Student Learning Styles

As already stated, the appreciation of students' learning styles requires a serious approach to the planning of activities within each subject taking into account the characteristics of the study program and the profession for which the students are trained. Accordingly, Kolb et al (according to Hawk & Shah, 2007) connect learning styles with learning activities in which they propose the following activities for all four poles of two dimensions:

- concrete experience: dealing with the problems reading, simulations, laboratories, observation, practical work...
- reflexive observation: puzzles, brainstorming, discussions, personal magazines...
- abstract conceptualization: lectures, papers, analogies, texts reading, projects, models of creation, model of criticism...
- active experimentation: labs, case studies, homework, projects, practical work...

Other authors (Bjekić, 2007a) who were engaged in organization of teaching practice, taking into account learning styles propose similar activities emphasizing desirable forms of learning and ways of checking the achievement for all styles separately:

- converger should learn all forms of practical learning, while checking the outcomes must be realized on practical examples, implementation and analysis of application;
- diverger should learn through discovering, while checking should be based on issues / tasks about cause-and-effect relations, generating new ideas;
- asimilator should learn through meaningful verbal receptive learning, reading, while checking should be organized as an interpretation of the theory and generalization;
- accomodator should learn by solving problems, while it should apply the same method of checking the achievement.

3. ORGANIZATION OF RESEARCH

Research question: whether there are differences in preferred learning styles according to Kolb's model, depending on the orientation of the students?

Subject of research is the difference in the preferred learning styles of the students of different orientations.

Aim of Research: To determine differences in the preferred learning styles between the students of integrated studies of Techniques and Informatics (future teachers), and basic studies of Information technology (future engineers).

Research variables: dependent - learning styles according to Kolb's model - converger, diverger, assimilator and accomodator and independent - study program: Techniques and Information (TI) and Information Technology (IT).

Hypothesis: There are differences in the preferred learning styles between students of Techniques and Informatics and Information Technology.

For research purposes, a non-experimental method was applied, and the data were collected using the Kolb learning style inventory (Kolb's Learning Style Inventory - LSI3) in electronic form. Inventory includes 12 particles for 4 dimensions (concrete experience, reflective observation, abstract conceptualization and active experimentation) that determine learning styles.

For data processing SPSS statistical software was used. Descriptive statistics was used for determining the degree of severity of certain variables, while comparing statistics was used for determining the differences in learning styles between groups, that is. ANOVA.

The sample consisted of 51 students of the Faculty of Technical Sciences in Čačak, of which 20 students are attending a study program of Information Technology, and the remaining 31 are students of integrated academic studies of Techniques and Informatics. The research was conducted in March and April 2016.

3.1. Research findings and discussion

The research results did not confirm the hypothesis that there are differences in the preferred learning styles among students, future professors of Techniques and Informatics and future engineers of Information technologies.

When taken into account both study programs together (Figure 2), it was obtained the highest percentage of the students who prefer convergent learning style (56,9%). The number of simulator is expressed in a significantly lower percentage (23.5%), while the divergent learning style is the least represented.

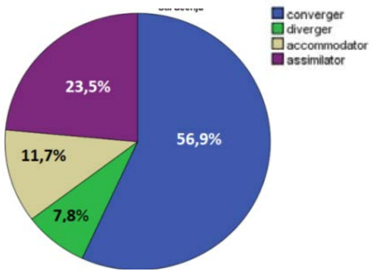

***Figure 2**. Percentage of representation of learning styles*

The following table shows the representation of individual learning styles in both directions (Table 1).

***Table** 1. Frequency of learning styles in the study programs TI and IT*

SP	Frequency	N	Converger	N	Diverger	N	Accomodator	N	Assimilator	N
TI	60,8%	31	58%	18	6,5%	2	12,67%	4	22,6%	7
IT	39,2%	20	55%	11	10%	2	10%	2	23,5%	5

Statistically significant differences were not found by comparing students according to preferred learning styles depending on the study programs which they attend.

The results of this study are not in accordance with other research conducted with future professors of Techniques and Informatics. The studies that have dealt with similar issues (Marentič-Požarnik, 1995, Bjekić, 2006, according to Bjekić and Dunjić-Mandić, 2007) showed differences between members of different professions, but also between persons the same professional orientation prior to the completion of studies and during professional engagement. Students of pedagogy prefer divergent style, while graduated pedagogues have accommodative learning style; and students of Techniques and Informatics prefer divergent learning style, but mixed style is the most common (which can be attributed to the multidisciplinary nature of the study program); students of mathematics are prone to the convergent learning style, while professors of mathematics prefer assimilative learning style. The same survey conducted among high school students showed significant differences in the dominant styles between students of socio-linguistic direction and natural-mathematical direction (Bjekić and Dunjić-Mandić, 2007). Research (Bjekić, 2007b) which did not dealt only with the preferred learning styles of students of Techniques and Informatics, but also with connection of represented styles with their achievement in the subjects of Psychology and Pedagogy, and also with overall average mark (which did not include two subjects dealt with), also showed that students prefer this direction divergent learning style, and that these students have achieved better end results in the

Pedagogy. The results of the same research showed that students of mixed learning style have higher achievements compared to students who prefer individual styles.

Other research has shown (Dille & Mezack, 1991, according to Diaz & Cartnal, 1999) that less successful students prefered more concrete experience, and that the majority of students possessed accommodative learning style (Wang et al., 2006).

The similarity in preferred learning styles between students of Techniques and Informatics and Information Technology can be explained, regardless they are students of TI teaching education, by the similarities of the two study programmes, because both are focused on information content during the study.

Of course, these two preferred learning style has its advantages when it comes to the teaching of information technology: the possibility of logical thinking at assimilates, ie. possibility of abstract thinking and problem solving in teaching of programming work on practical tasks in groups allowing the realization of projects, for example software design, implementation of practical solutions, tendency towards experimentation and solving technical problems which are actually common in the field of informatics and computing.

However, we should not neglect the students who have the assimilative learning style, which is represented in slightly less than a quarter of students in both study programs, which is not a small percentage.

4. CONCLUSION

It can be concluded that there are visible changes in learning styles between students of the same direction but different generations. It is necessary for a teacher to continuously monitors and gets to know his students in order to successfully organize education. Learning styles, to a large extent can contribute to the efficiency and effectiveness of teaching.

The research results showed a discrepancy in comparison to other similar studies conducted. Differences between students - future professors of Techniques and Informatics and future information technology engineers are not shown even though the previously conducted studies have shown differences in preferred styles from different professions.

So, students at both study programs prefer convergent learning style which is not optimistic result to be taken into consideration when it comes to the teaching process because of the limitations of teaching activities which help students to learn the easiest way. The representation of this learning style is about the lack of creativitybut also the independence of students in finding original solutions. This is particularly devastating for students of teaching orientation by the fact that the work in teaching requires a high degree of flexibility, imagination and creative way of thinking. However, a number of students with assimilative learning style is not small, reflecting the presence of two completely different approaches to learning, ie. the most distinguished are learning through practical activities (converger) on the one hand and learning through adoption and analysis of theoretical and logical based content (asimilators) on the other side.

Both mentioned study programs, given the multi and interdisciplinary, which are characterized by (especially TI) allow the implementation of different activities in the teaching process. For IT students but also for TI students laboratory exercises, problem solving, tasks (eg. in teaching for TI students), lectures, studies of cases, projects and so on as applicable, which would be in accordance with the represented learning styles also with an incentive for development of other styles.

However, as applications for further research it can be used checking of learning styles of the same current students after graduation and after a few years of work experience in the profession considering the fact that the learning styles are changeable category due to the acquisition of different experience.

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TECHNICS AND INFORMATICS IN EDUCATION
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UDK: 371.14+378.126]:62 Review paper

School-based mentoring of students–teachers in the practice and beginning teachers[1]

Dragana Bjekić[2], Milica Stojković[2] and Biljana Kuzmanović[2]
[2] Faculty of Technical Sciences, University of Kragujevac, Serbia
e-mail dragana.bjekic@ftn.kg.ac.rs, milica.stojkovic@ftn.kg.ac.rs,
biljana.kuzmanovic@ftn.kg.ac.rs

Abstract: *Teacher education is a very important field of university work because the quality of educational system mostly depends on teacher qualification. Responsibility of higher education institutions for teacher education is great, especially in the first phase of teacher education – initial education. Attention on the school practice of student-future teacher and on mentoring is increasing. The school-based mentoring of students-teachers in school practice and of beginning teachers in induction period is considered in the paper. Some conditions of effective mentoring are selected; these conditions are the criteria for teacher-mentor selection, too. Education of teachers in the field of technics and informatics directed selection of comparison between mentoring of students-future teachers and mentoring of beginning teachers. It is necessary to mentoring school and teaching practice (both for the student-teacher and beginning teacher), not only to supervising. Then, the role of teacher-mentor is very complex and requires adequate preparation and professional development of mentors.*

Keywords: *mentoring, school-based practice, student-teacher, novice (beginning) teacher, initial education, induction period*

1. TEACHER PROFESSIONAL DEVELOPMENT AND EDUCATION

Teacher education is a continual process and a constituent part of teacher lifelong learning. All phases (stages) of teacher education in Serbia (initial education realized at the university, induction period and in-service teacher education along the whole teachers' work life) are affected by the actual social and educational needs in the country, systematic researches and teachers' professional development monitoring, accepted European tendencies in high school education, and the goals of the Serbian school system development (Bjekić & Dragićević, 2008). These are the framework for education of teachers of technics and informatics courses, too. In initial teacher education, the student-teacher's school-based practice and teacher-mentor work with mentees are becoming in the focus. Nowdays, mentoring as special way of teacher's work with students-teachers or

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beginning teachers, is considered from both the practical and theoretical aspects (Ambrosetti, 2014; Buhberger, 2015; Franke & Dahlgren, 1996; Hudson, 2013; Stanojević, 2014; Wilkins, & Okrasinski, 2015).

1.1. Teacher Education

Current european educational systems are established the clear framework for teacher education. School system in Finland, as one of the most efficient school systems, defined master level as obligatory level of teacher education for teaching in primary and secondary schools (Nieme, 2008; Bjekić & Dragićević, 2008: 36). Today, in the most european countries, teacher five years initial education, induction period from 1 to 3 years in different countries (1 years in Serbia, Estonia, Eisenschmidt; 3 years in Finland, Nieme, 2008, according to Bjekić & Dragićević, 2008) and continual in-service education and longlife learning are mandatory.

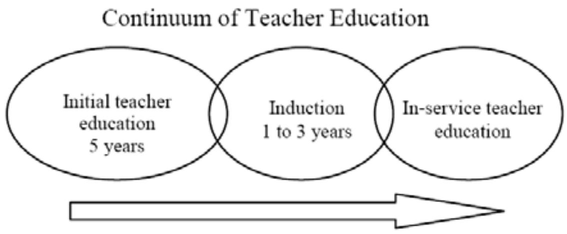

Figure 1. *Continuum of teacher education (Bjekić & Dragićević, 2008: 36)*

Although academicians research all levels of teacher education (Karras & Wolhuter, 2010),, there aren't enough researches of education of subject teachers in different teaching fields.

1.2. Education of teacher of technics and informatics courses

Additionally to the common framework for education of teachers in Serbia, the framework of Serbian technical-technological teachers' education is determinated by the following: teachers' education systems in Europe, development of technology, technical sciences and practice, and characteristics and needs of Serbian school system. All these are also the elements of the professionalization of teachers' work (Bjekić & Dragićević, 2008).

Today, future teachers of the course Technical and informatic's education in the second cycle of primary comprehensive education are prepared at 3 universities in Serbia: the Faculty of technical sciences in Cacak – University of Kragujevac and Educational faculty in Vranje – University of Nis realize integrated academic curricula (5 years, 300 ESPB), the Technical faculty „Mihajlo Pupin“ in Zrenjanin – University of Novi Sad realizes sequentional curriculum (4+1 years, 240+60 ESPB).

2. THE ROLE OF TEACHER–MENTOR IN TEACHER EDUCATION AND PROFESSIONAL DEVELOPMENT

The quality of teacher education is one of the basis of education quality. Very important element of teacher education is teaching practice (practical teaching) or student–teacher's and beginning teacher's practice in regular school environment and teaching. Most of researchers of teaching practice argue that „it is a culminating experience in teacher preparation, as it provides opportunity to beginning teachers to become socialized into the teaching profession“ (Furlong et al., 1988, according to Maphalala, 2013).

Now, teaching school practice becomes a most important part of initial teacher education and of induction period (or stage) around the world, and in Serbia, too.

Initial teacher education is the period (or stage) of formal education at the university. The functions of school practice in teacher initial education are: to enable students to develop a comprehensive insight into the teacher work, to test their skills in the realistic and security educational settings in cooperation with teacher–mentor, to get a formative feedback from mentors.

Induction stage is the form of novice (beginning) teacher education in their first years of teaching; induction stage is bridging the gap between initial teacher education and the continuous professional development phase. The main functions of induction stage of teachers' professional development are providing support and sistematicaly guiding of novice teachers. Three key levels of support are: personal development support, social development support and professional development support (Eisenschmidt, 2006, according to Zlatić, Marinković & Vučetić, 2014).

Programmes of beginning teachers induction to work support the novice teacher to develop own experience and to adapt in realistic school context. There are two kinds of support: formal support – novice teachers have to complet special induction programme as mandatory (obligatory) precondition for the licence; nonformal support – novice teachers have a chance to participate in the induction programme, but it is optional (Zlatic et al., 2014).

School–based mentoring is recognized as on of the basic support system. Mentor is crucial person in the process of socialization of novice teachers in school context and their professional development (Feiman-Nemser, 2001). Some researchers confirmed that the mentoring can to accelerate professional development and provide emotional support for new members of school comunity (Wang & Odell, 2002).

2.1. Mentoring in teacher education

Student–teacher's and beginning teacher's practice are supported by the mentoring and mentor collaboration. The terms „mentors" (collaborating practicing teachers who support beginning teachers or students–teachers to teaching) and „mentees" (beginning teachers or students–teachers who are supported in the real teaching by mentors) have the clearful meaning on English, but on Serbian there isn't specific term for the persons who are supported by mentors. Than, we describe the group of mentees in Serbian on the following way: students–teachers and beginners–teachers who are mentored by the mentors.

Evidence (results of scientific researhes, action researches, reports and everydays evidence) suggests that mentoring improves the quality of teaching. One report of investigation emphasized that „70% teachers who receive mentoring at least once a week beleive that their instructional skills have improved…" (NFIE, 1999). Mentoring is a way to change the teachers-mentors, too. Some of the mentors in this study thought that all of them who were mentors changed radically; classroom management ckills changed; the relationship with the other teachers in the same area was changed; the skills for working with students in the classom were changed (NFIE, 1999).

Some authors considered the mentoring as a process of developing „relationship between the mentor and mentee, which in turn provides the underpinning for the growth of the mentee's skills; thus in mentoring, the relationship becomes central to the interactions that occur" (Ambroseti, 2010: 30). But, it is very important to recognize mentoring as a holistic process which includes three components: relationship, developmental needs and contextual elements (Ambrosetti, 2010).

Hudson (2007) emphasized that mentoring can develop teaching practices as it provides opportunities for mentors and mentees to engage in pedagogical discourse and reflective thinking.

Wilkins and Okrasinski (2015) explored the student teachers perspectives „about induction and mentoring programmes, and how teacher education programmes could contribute to a broader continuum of supports that span from preservice to inservice teaching“ (Wuilkins & Okrasinski, 2015: 299). Results suggested that student teachers have limited comfort with and awareness of induction programmes, including novice teacher supports. Levels of understanding utilizing a new induction continuum theory are described: limited, basic, emerging, and knowledgeable.

Consideration that „the use of mentoring has nowadays become a predominant practice for the professional placement component of pre-service teacher education programs“ Ambroseti (2010: 30), is the basis for nowdays approaches toward the mentoring as very important component of teachers' induction stage.

2.2. Teachers-mentors

Mentors should be required to be „not only supportive but pro-active trainers demonstrating their qualities as reflective practitioners as well as encouraging reflection in their beginning teacher charges“ (Turner, 1993: 41). The role of mentors–teachers is crucial in the students–teachers growth and development, too (Maphalala, 2013).

Who is a mentor or mentor–teacher ? „Mentors–teachers as practicing professionals, are aware of current issues in education, and they are uniquely positioned to help beginning teachers or student teachers to navigate the demands of the practice, particularly in matters of curriculum and classroom management. Mentees will look up to their mentors for support through a period that is frequently stressful both emotionally and physically“ (Handbook for PDPP 2010-2011, according to Maphalala). The school-based mentors (teacher-mentor) of pre-service teachers „needs to nurture, advise, guide, encourage and facilitate authentic learning experiences for developmental growth“ (Le Cornu, 2005, according to Hudson, 2013: 30).

Hudson (2007) developed five-factors model for mentoring in teaching:

- personal attributes: mentors need to display personal attributes that facilitate a supportive learning environment and support development of positive attitudes and confidence in the mentees);
- system requirements: framework for regulating the quality of teaching practices (curriculum documents, systemic aims, school policies, school directives);
- pedagogical knowledge: mentors need to have adequate pedagogical knowledge and to articulate pedagogical knowledge for the range of teaching experiences that promote effective learning;
- modelling: mentor's modelling of teaching practice;
- feedback: mentors give a feedback to mentees in relation to the outcomes for producing effective teaching, and encourage mentees to think critically about their practices.

Rowley (1999) has identified six qualities of the good mentor: commitment to the role of mentoring; acceptance of the beginning teacher or student-teacher; development of the skills to providing instructional support; effectiveness in different interpersonal context; a model of a continous learner; communicates hope and optimism.

What are the (minimum) requirements for teachers–mentors?

In the New York City public schools the minimum preferred requirements are: five years of teaching in public school, mentor's demonstration of mastery of pedagogical and subject matter skills, evidence of excellent interpersonal skills, commitment to participate in professional development (NYS).

Minimum requirements for teacher to mentoring beginning teachers and students–teachers on school–based practice in Serbia are not explicitly defined. There are significant differences between selection of the mentors for beginning teachers (it is often determinated by the school human resources), and mentors for students on the school-based practice. The most commonly used criteria for the selection of mentors for students are the following: adequate education (defined in the school legislative, rule guide on the types of teacher education for some subjects), licence for teaching, minimum of five years teaching experience in the courses, continual in-service education, development of the programmes and activities of the in-service education, teaching results, training for mentoring, reputation in school collective, progression and promotion at work.

2.3. Specificities of mentoring students on school-based pactice and beginning teachers

Mentoring of preservice teachers (students–teachers) and mentoring of beggining teachers (novice teachers) is based on the same goals: to empowering mentees to be effective teachers. But, preservice teachers as mentees realize school-based practice on distance to their autonomous and real teaching, and beggining teachers have real context of their professional activities and they don't have distance to real teaching.

Mentoring of preservice teacher is collaborative process involving the student, university members (teacher educators) and the cooperating teachers–mentors (Campbell, & Brummet, 2007).

Mentoring of novice teachers is focused on their activities in the school. Although support in school was the basic, sometimes only one model of the support to novice teachers, nowdays the most of european countries develop organized connection between the school and university to support mentoring of novice teachers and support novice teachers (Eisenschmidt, Oder, & Reiska, 2013).

In Serbia focus is moving to the cooperation of schools and centres for teachers professional development, and cooperation with the other educational institutions. But, there aren't yet organized university support to mentoring of novice teachers.

3. INSTEAD CONCLUSION: COMPARISON OF MENTORING

The elements of Technics and informatics techers' mentoring of students–teachers and novice teachers are compared (Table 1).

Table 1. *Mentoring activities in school-based practice for students-teachers and novice teachers*

Mentoring of students-teachers (part of initial teacher education)	Type of activities	Mentoring of novice teachers (induction period)
Mentoring in the mentor's working place, student is a guest in the school	The place of mentoring	Mentoring in the novice-teacher's and mentor's school, at their common working place
Preparation programme or operative plan of school-based practice (activities, timing, tasks etc.)	Planning	Planning of instruction preparation, class preparation
Student participate and observe all mentor's activities: classes and courses; special types of classes; non-teaching activities in school and local comunity; mentor's activities in the school competition and manifestation.	Mentee activities	Novice teacher activities in regular classes as autonomous teacher Novice teacher observation of selected mentor's classes Participation in all activities in the school as school-workers
In real classroom sometimes, with mentor presence on each class	Classsroom management	In real classroom everyday, sometimes with mentor presence (mentor and mentee in the classroom)
Mentor cooperate with student and university staff responsible for practice	Mentor – colla-borative partner	Mentor cooperate with mentee and school management and administration
Direct communication between mentor and student-teacher, between mentor and university coordinator of practice	Communication	Direct and everyday communication between novice teacher and mentor, school staff
Student-teacher prepare special evidence in Practice diary, special template for tasks Mentor's reports of student-teacher practicing	Evidence	Novice teacher prepare regular evidence and school documentation Mentor's report
Additional support from university teachers to prepare practice	Engagement of university staff	No
E-course SCHOOL PRACTICE in FTN Moolde system for student/teachers e-communication between mentees, mentors, university teaching staff	e-support	e-communication and correspondence between mentors and mentees
After every student-teacher activities in school Mentor's and student-teacher's conversation before and after every student activities	Feedback and reflection	Everyday conversation, consultation between mentor and novice teacher Continual feedback from mentors

Feedback from university teachers		
Student-teacher report to the university teachers and mentor	Report	Novice teacher's report to the school management and mentor
Mentor's report to the university teachers		Mentor's report to the school management, state licence commission

As an example of mentoring of students, mentoring of school-based practice of students–future subject teachers of Technics and Informatics is presented. Integrated curriculum of Technics and informatics at the Faculty of Technical Sciences in Čačak is five years curriculum with 300 ESBP. The students can realize proffesional school practice in 6th and 10th semesters, and they can get 11 ESPB for practice; they have some practical teching activities and practical tasks in the other courses, too.

Teachers–mentors of students in initial teacher education programmes Integrated curriculum of Technics and informatics (at the Faculty of Technical Sciences in Čačak) are the subject teachers in the primary compulsory educaton and secondary education. In the primary comprehensive schools, in second cycle, teachers–mentors have a licence for obligatory course Technics and Informatics education; they fulfill the other conditions, too (see 2.2). In the secondary school, mentors are the teachers for the course Computing and Informatics, the conditions for mentoring are similar. Faculty of technical sciences cooperate with 35-40 teachers-mentors in one year.

Mentoring of students–future teachers of technics and informatics is complicated additionally because the teaching field is complex and interdisciplinary (but, it isn't the subject of this paper). The comparison of the activities of teachers–mentors and students–mentees, and teachers–mentors and novice teachers as mentees is based on the analyses of the specificities of teacher professional and formative competencies.

The school-based practice in initial teacher education, and activities in induction period for beginning teachers, become an important topic for planning and evaluating teacher education in Serbia. Mentoring of students–teachers and beginning teachers is the basis of the practice quality; therefore, it is necessary to select and educate mentors carefully.

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SECTION IV:

ENGINEERING EDUCATION

TECHNICS AND INFORMATICS IN EDUCATION
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Professional paper

Comparative analysis of engineering study programs at two universities in Italy and Serbia

Milica Stojković[1] and Elisabetta Ghirardelli[2]
[1] Faculty of Technical Sciences, University of Kragujevac, Serbia
[2] Student of University of Brescia, Brescia, Italy
e-mail milica.stojkovic@ftn.kg.ac.rs, e.ghirardelli@studenti.unibs.it

Abstract: *Engineering is the discipline and profession that has as its objective the application of knowledge and results of the mathematical, physical and natural sciences to the resolution of problems regarding the satisfaction of human needs. In the context of internationalization of higher education, the main goal of this paper is to compare opportunities for engineering education in educational systems of two European countries, Italy and Serbia. For that purpose the structure of university study programs in the field of engineering education at University of Brescia and University of Kragujevac was analyzed.*

Keywords: *engineering education, university study programs, comparative analysis…*

1. INTRODUCTION

Engineering arises as the technical field related to the use of scientific knowledge for the development of systems and solutions that meet the needs of society. In this sense, applying the technical standards, it provides methodologies, projects and specifications for the design, implementation and management of a physical asset, of a product or of a more or less complex, and more in general service for the development and control of an industrial process through appropriate system. [1]

Nowadays engineering covers a lot of different disciplines ranging from industrial, mechanical, chemical, energetic, textile, civil and environmental, information engineering, electrical and informatical, clinical to marine, nuclear and aerospace engineering. From these disciplines are derived a lot of different specializations, so that there are around 50 different fields belonging to engineering education.

Higher education is becoming more and more international for several reasons related to commercial advantage, knowledge and language acquisition, enhancing the curriculum with international content, and many others.

2. HIGHER EDUCATION IN ITALY AND SERBIA

Italy has played an important role in European higher education: it is one of the four countries that first engaged to create the so-called "European Area of Higher Education" (Sorbonne Declaration, May 1998), thus starting that type of higher education reform which, known as "Bologna Process" (Bologna Declaration, June 1999) is being implemented all over Europe.

According to the report from 2012 made by MIUR (Ministry of Education, University and Research), in collaboration with CIMEA Foundation Rui and CINECA [2], Italian higher education is structured in a binary system, consisting of two main articulations: the university sector and the non-university sector. At present, the university sector is made up of 89 university institutions which are classified in 58 State universities, 17 non-State universities but legally recognized by the State, 2 universities for foreigners and 6 higher schools specialized in postgraduate university studies and 6 online learning universities. The non-university sector includes 4 education typologies with their institutions: higher schools of design (polytechnics for the arts, academies of fine arts, higher institutes for applied arts, music conservatories and recognized music institutes, higher institutes for musical and choreographic studies, national academies), higher education in language mediation (higher schools for language mediators), higher integrated education (programs of higher technical education & training) and a few specific fields (e.g. archiving, diplomatic, restoration, military studies, etc.) which, along with their respective institutions, fall under the supervision of ministries other than that of Education. According to a statistical survey made by the Office of Statistics of MIUR updated to November 2015 [3], in the Italian universities there are around 1 600 000 students.

According to report from 2012 made by EACEA (European Commission Education, Audiovisual and Culture Executive Agency) and National Tempus Office in Serbia [4]. the three-cycle structure of higher education based on the Bologna principles was formally implemented in the academic year 2006/2007. The Law on Higher Education (LHE, 2005 and amendments in 2008, 2010 and 2012) provides a legal basis for full implementation of the Bologna Declaration and the Lisbon Convention.

There are three types of higher education institutions in Serbia: universities (*univerzitet*), colleges of applied sciences (*visoka škola strukovnih studija*) and colleges of academic studies (*visoka škola akademskih studija*). Serbia has altogether 8 public and 9 private universities, 47 state-funded colleges of applied studies and 17 private colleges of applied studies. The number of colleges of academic studies is 8 in total: 3 are state funded and 5 are private. According to the data for academic year 2011/2012, there were approximately 200 000 students in higher education.

A comparative overview of important features of higher education system in Italy and Serbia is presented in Table 1.

Table 1: An overview of important features of higher education system in Italy and Serbia

	Italy	Serbia
Types of tertiary education programs	The three-cycle structure (Bachelor, Master and PhD)	The three-cycle structure (Bachelor, Master and PhD)
Types of tertiary education institutions	- Universities (58 public, 17 private, 2 for foreigners, 6 postgraduate university and 6 online learning university) - Higher schools of design - Higher education in language mediation - Higher integrated education - Other specific fields	- Universities (8 public and 9 private) - Colleges of applied sciences (47 public and 17 private) - Colleges of academic studies (3 public and 5 private)

In Serbia Faculties usually have the status of a legal body, but they cannot exist independently as they need to be a constituent part of a university. Universities are the only teaching and research higher education institutions in the country that provide all three cycles of higher education as well as some forms of lifelong learning. In Italy the universities are organized in departments. A department is an organizational structure within the Italian university, which promotes and coordinates research activities and related teaching of one or more areas of research that are of uniform purpose and method. The Gelmini's reform in 2010 (Law 30 December 2010, n. 240) abolished the university faculties and the related organs, replaced and merged the competence of the university department [5]. The departments enjoy administrative and financial autonomy within the limits prescribed by the regulations of the universities.

3. ENGINEERING EDUCATION AT UNIVERSITY OF BRESCIA, ITALY, AND UNIVERSITY OF KRAGUJEVAC, SERBIA

In this paper comparative analysis was conducted at level of two medium size public Universities in both Italy and Serbia. University of Brescia and University of Kragujevac are very similar regarding the size of these universities, referring to the number of students, employees and departments/faculties (comparative data of main features of both Universities are presented in Table 2). As it was argued in the previous section, faculty level in higher education in Serbia equals department level in Italy.

Table 2. *Comparison of main features of University of Brescia [6] and University of Kragujevac [7][8].*

	University of Brescia	University of Kragujevac
Number of employees	1 078	1 133
Number of students	approx. 14 600	approx. 19 000
Number of faculties / departments	8 departments:	12 faculties:
	Economics and Management	Economics
	Law	Law
	Molecular and Translational Medicine	Medical Sciences
	Surgery, Radiology, and Public Health	
	Mechanical and Industrial Engineering	Mechanical and Civil Engineering
	Information Engineering	Engineering
	Architectural Engineering and Mathematics	Science
	Civil Engineering	Technical Sciences
	Clinical and Experimental Sciences	Agronomy
		Education
		Teachers Training Faculty
		Philology and Art
		Hotel Management and Tourism

University of Brescia consists of 8 departments related to 4 big teaching areas: economy, law, engineering and medicine. All the departments are located in the city of Brescia [9]. University of Kragujevac consists of 12 accredited faculties which are located in 6 cities of central Serbia: Kragujevac, Čačak, Jagodina, Kraljevo, Užice and Vrnjačka Banja [10].

According to the data for academic year 2014/2015, at a national level, University of Brescia covers the 22nd position among the 58 Italian public universities, considering a lot of factors like attractiveness, sustainability, international mobility, satisfaction, teaching and research. According to Webometrics Ranking of World Universities, University of Kragujevac is 4th ranked public University in Serbia [11], among total of 8 public universities.

Engineering in University of Brescia covers three main branches, related to the name of the departments: information engineering, mechanical and industrial engineering, civil, environmental and architectural engineering [12]. Engineering in University of Kragujevac covers the following main branches: mechanical engineering, IT engineering, electrical engineering, civil engineering and management engineering. At both of universities these broad areas of engineering are thought through variety of courses. The frequencies of university courses these fields of engineering across all levels of studies at both Universities are given in Table 3.

Table 3: The structure of university study programs in engineering at all levels of studies at University of Brescia and University of Kragujevac

	University of Brescia			University of Kragujevac		
	Bachelor	Master	PhD	Bachelor	Master	PhD
Information Engineering	1	2	4	2	2	2
Mechanical and Industrial engineering	2	3	4	6	5	2
Electrical engineering	1	1	1	1	1	1
Engineering management	1	1	/	1	1	/
Civil, Environmental and Architectural Engineering	3	4	4	1	/	/

At University of Brescia the Information Engineering's main competences range in the fields of automation, electromagnetic fields, electronics, physics of fundamental Interaction, information technology, electric and electronic measurements, condensed matter physics and telecommunications. Teaching and research activities for Mechanical and Industrial Engineering are chemistry for technologies, nuclear physics, technical physics, industrial and mechanical plants, economic and managerial, fluid machines and systems for converting energy, metallurgy, mechanical and thermal measures, science and technology of materials, sociology of economic and work processes. Study programs for Civil, Environmental and Architectural Engineering are focused on architecture, restoration of historical and modern buildings, building technology, structural analysis and design, seismic engineering, seismology, structural mechanics, geotechnical engineering, transportation, waste management, fluid mechanics, hydraulic structures and hydrology. Bachelor's level undergraduate study consists of 180 ECTS, Master's level of 120 ECTS and Doctoral studies of 180 ECTS.

At University of Kragujevac [13] Bachelor's level undergraduate studies with 240 ECTS are the most frequent in Electrical and Computer Engineering, Mechanical engineering, IT engineering, Industrial and management engineering, Military-industrial engineering and Urban engineering. Bachelor's studies with 180 ECTS are found only in Mechanical engineering (with variety of modules).

At Master's studies courses with 60 ECTS are the most frequent: Electrical and Computer Engineering, Mechanical engineering, IT engineering, Industrial and management engineering, Engineering management, Industrial engineering - Business information systems and Military-industrial engineering. Courses with 120 ECTS are also available at Master's level in Mechanical engineering (with variety of modules such as: Production engineering, Mechanical structures and mechanization, Motor vehicles and IC engines, Energy and process engineering, Applied mechanics and automatic control, Industrial engineering, Informatics in engineering and Road traffic engineering, Computer aided machine design, Production engineering, Automatic Control, robotics and fluid techniques, Power engineering and environment protection)

Doctoral studies of 180 ECTS are found only in Mechanical engineering, Electrical and Computer Engineering and IT engineering.

4. CONCLUSION

Academic offer in engineering education at University of Brescia, Italy, and University of Kragujevac, Serbia, was analyzed in this paper. Both universities represent medium size and quite solid medium-high quality universities in the national context of each country.

Overall it can be concluded that at both universities, regardless of the level of the studies, mechanical and industrial engineering courses are the most frequent ones, followed by IT engineering courses. The main difference was determined in the field of civil, environmental and architectural engineering: University of Brescia has more diverse offer in courses in civil, environmental and architectural engineering at all levels of studies. On the other hand, mechanical engineering courses are more developed in University of Kragujevac bachelor's and master's programs.

It can also be concluded that there are opposite trends from bachelor to PhD studies when it comes to total number of academic courses in engineering: at University of Brescia number of academic courses in engineering is increasing from bachelor to PhD programs (from 8 courses in the Bachelor degree to 11 courses for the Master and up to 13 courses for PhD study programs). However, at University of Kragujevac the trend is opposite: the number of academic courses in engineering is decreasing from bachelor to PhD programs (from 11 Bachelor's courses to 9 Master's course and up to 5 PhD courses).

All these similar features and few differences between the two university and, in an overview, between Italy and Serbia, allow the internationalization of higher education, that is becoming always more important for students and academic staff.

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[7] *http://www.kg.ac.rs/Docs/izvestaj_o_radu_2012-2015.pdf*
[8] *http://www.kg.ac.rs/Docs/Informator_o_radu_Univerziteta_u_Kragujevcu.pdf*
[9] Universita degli Studi di Brescia http://www.unibs.it/mission
[10] University of Kragujevac http://www.kg.ac.rs/eng/about.php
[11] Ranking Web of Universities – Serbia http://www.webometrics.info/en/Europe/Serbia
[12] Universita degli Studi di Brescia – Departments http://en.unibs.it/departments
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Seafarers' education and training in the context of improvement leadership and managerial knowledge and skills

Senka Šekularac-Ivošević[1]
[1] University of Montenegro, Faculty of Maritime Studies, Kotor, Montenegro
e-mail ssenka@t-com.me; senkas@ac.me

Abstract: *This paper presents the observations about changing conditions and circumstances affecting seafarers' professional lives, today and in the near future. The focus is on the Leadership and Teamwork Course in terms of its objectives, purpose, content and ways of implementation, all in the context of presenting the latest achievements in the field of education and training of seafarers. Furthermore, the paper provides an analysis of results of the survey performed in order to investigate how trainees of the Course are satisfied with some specific aspects of teaching process and staff at the Faculty of Maritime Studies Kotor.*

Keywords: *seafarer; leadership; teamwork; management*

1. INTRODUCTION

Educational systems in the area of maritime affairs differ from country to country. Due to this fact, International Maritime Organization's conventions and related recommendations have the goal to specify basic levels of knowledge and skill necessary to meet challenges in maritime industry. In 1978 the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW) was the first convention according to which were proposed the minimum standards of competence for seafarers. In 1995 this Convention was updated with aim to clarify the standards of competence required and provide effective mechanisms for enforcement of its provisions (IMO, 2016).

A comprehensive review of the STCW Convention was done in Manila, Philippines from 21 to 25 June 2010, where was adopted a significant number of amendments to the STCW Convention and STCW Code. These amendments, mostly known as the Manila amendments, which provide enhanced standards of training for seafarers, entered into force on 1st of January, 2012 (IMO, 2016).

In the literature seafarers are mostly considered as „the unsung heroes of an unsung industry", whereby 50,000 ships and 1.25 million seafarers carry over 90% of international trade (Global Maritime Education & Training Association, 2011). Every day, it loses two ships, pays out US$4 million in claims, which confirms that the global shipping industry is a dangerous place and radically changes the lives of hundreds of people for ever (Gregory and Shanahan, 2010). It was investigated that the accidents in maritime industry were mainly caused by human error, or there were no major technical issues. Namely, the reasons are as follows: a) outside control of crew – 19%, b) lack of skills – 10%, and c) crew management errors – 71% (Oxford Aviation Academy, 2011). Some of them are: a) preoccupation with minor technical problems, b) failure to delegate tasks and responsibilities, c) failure to set priorities, d) inadequate monitoring, e) failure to utilize available data, f) failure to communicate intent and plans, g) failure to detect and challenge deviations from SOP's, rules and safe actions (Cowburn, 2011; Oxford Aviation Academy, 2011).

All mentioned refers to conclusion that for the purpose of effective training of the operational level in the hierarchy on board it was necessary to organize a Course called Leadership and Teamwork. According to the conclusions from Manilla 2010 this Course is mandatory to be taken and passed until 2017 for all seafarers who currently sail worldwide, and what is more, its implementation will continue even after 2017 (IMO, 2014).

The aim of this paper is to show how effective training can improve the skills, knowledge, experiences of human resources who are essential factor in achieving safety and efficiency of the entire ship's passage operation. Below are given an overview of scope, objectives and the mechanism of delivering this Course, as well as presentation its practical implementation at the Faculty of Maritime Studies Kotor.

2. EDUCATION AND TRAINING BASED ON LEADERSHIP AND TEAMWORK COURSE

2.1. Scope, objectives and delivery of the Course

The model course is designed to meet STCW requirements, in accordance with the 2010 Manila Amendments, and has the intention to improve a person's knowledge, skill and understanding of leadership and team working at the operational level on board a ship.

After the successful completion of the course a trainee should be able to present sufficient managerial kind of knowledge, primary leadership and team working. Also, trainee will acquire the relevant skills to competently respond to the job requirements of officer in charge of a navigational watch on ships of 500 gross tonnage or more, as well as officer in charge of an engineering watch in a manned engine-room, or designated duty engineer in a periodically unmanned engine-room. Namely, the knowledge, understanding and proficiency should include, but not be limited to (IMO, 2014):

- Working knowledge of shipboard personnel management and training.
- A knowledge of related international maritime conventions and recommendations, and national legislation.
- Ability to apply task and workload management.
- Knowledge and ability to apply effective resource management.
- Knowledge and ability to apply decision-making techniques.

Depending on the methods, the outcome of the Course may be achieved using: a) classroom learning through presentations, b) group discussions, c) role play, d) simulations, and e) case study analysis. These methods can be used only in the way which will ensure that all trainees through interaction and expression of themselves in face-to-face cases get the opportunities to consider similar to those likely to occur when performing shipboard operations.

On the other side, an instructor is a person who has remarkable experience in interactive teaching of leadership and team working, with respect to the knowledge of shipboard situations, conducting the multicultural crews and overcoming barriers in communicating clearly in the English language, on board as well as with people based ashore.

In the case of the Faculty of Maritime Studies Kotor all mentioned prerogatives are sufficiently fulfilled, but what is more, its facilities for Course delivering include additional rooms for break-out discussion groups, as well as the usual equipment such as overhead projection, interactive whiteboard, flip charts and access to computer terminals. The trainees are provided with leadership and teamwork training presentations and hard copy handouts materials, and they are also addressed to relevant library books and other publications. Nautical and Marine Engineering simulators are at the disposal of the trainees and instructor when practicing individual's situational awareness, leadership and team working skills in various safety risk situations and decision making processes.

2.2. Course outline

The Program of the Course consists of 8 subject areas, where particular area has its own number of working hours, as given in the Table 1.

Table 1. *Leadership and Teamwork Course Program*

Subject Area	Description	Hours
1.	Introduction and administration	1,0
2.	Working knowledge of shipboard personnel management and training	4,0
3.	Need for international maritime conventions, recommendations and national legislation	1,0
4.	Ability to apply task and workload management	4,0
5.	Knowledge and ability to apply effective resource management	4,0
6.	Knowledge and ability to apply decision-making techniques	4,0
7.	Self-awareness, personal and professional development	1,0
8.	Conclusion	1,0
	Total:	20,0

Source: IMO, 2014.

According to the subject's areas from 1-8 the instructor is obliged to present the following topics (IMO, 2014; Global Maritime Education & Training Association, 2011; IMO, 2016):

- Subject area 1 comprises instructor's interpretation of the Course objectives and outline of the Program through introduction and administration.
- Subject area 2: It is necessary to describe the typical shipboard organization, explain the management, operational and support level, state positions and describe roles, as well as outline the chain of command.
- Subject area 3: It is necessary to introduce to international maritime conventions,

recommendations and national legislation (emphasis to be on human factors, not on technical factor regarding the SOLAS, including the ISM and ISPS Codes, MARPOL, STCW and MLC Conventions; describe the role of IMO with respect to maritime conventions and give examples of recommendations in accordance to the Montenegrin legislation dealing with human factors, as well).

- Subject area 4 comprises planning and coordination, personnel assignment, human limitations, personal abilities, time and resource constraints, prioritization, workloads, rest and fatigue, leadership styles, challenges and responses.
- Subject area 5 is referred to effective communication on board and ashore, decision making reflecting team experience, assertiveness and leadership, including motivation, obtaining and maintaining situational awareness, appraisal of work performance, short and long term strategies.
- Subject area 6: After passing this section, trainees will acquire knowledge about decision-making techniques, situation and risk assessment, judgement and emergencies and crowd management, and they will be able to identify and consider generated options.
- Subject area 7: Trainees will be introduced with self-awareness, personal and professional development, what is about acquiring knowledge of personal abilities and behavioural characteristics, as well as getting opportunities for personal and professional development.
- Subject area 8: The course is finished after the evaluation, individual assessments and advice and certificate presentations are performed.

The Course reflects the attitudes and impressions of the instructor in a sense, but it also imposes techniques to encourage trainees' involvement in interactive communication, such as break-out groups, workshops, panel and round table discussions, which only could be affirmative methods of improving leadership and teamwork knowledge and skills.

3. LEADERSHIP AND TEAMWORK COURSE EXPERIENCE AT THE FACULTY OF MARITIME STUDIES KOTOR

The Faculty initiated a program of lectures according to the Course on 13th of January, 2014. Since then, 1,135 trainee have been attending the Course. The instructors' task has been to ensure that trainees completing this course will be more competent in carrying out their role in the operation of a ship efficiently, safely, cleanly and securely, with a multi-cultural team where levels of knowledge, skill and competences differ very often. The intention of the Faculty and teaching/instructor staff was not to make a guarantee of production of leaders or effective members of a team on board; at best this Course delivery will create an awareness of the issue in matter, and initiate the self-development of the trainees and their motivation to succeed as a leader, as well.

It is also noted that individual differences of trainees result in their different approaches to leadership and team working. While some people express natural leadership abilities, others are supposed to be led. Regarding mentioned, the groups of seafarers undertaking these course have different characteristics and needs, hence the subject of management and leadership at the Faculty is best taught not through “ex cathedra” lectures, but stimulating trainees’ interaction.

Leadership and teamwork are fundamental to training in order to ensure competence at sea across the wide range of shipboard operations. Thus, simulators that Faculty offers are a good tool for reinforcement of what was learnt in the class over the period of Course implementation. Some of the applications were in the form of case studies, where instructor has been illustrating specific examples of maritime accidents, as the capsizing of the Herald of Free Enterprise off the Belgian Coast in March 1987 with the loss of 188 lives and the role of poor leadership and teamwork aboard and ashore that led to this disaster, etc.

During and after completion of the Course each trainee has been advised about his or her own progress. In respect to the Quality Management System of the Faculty it is mandatory to conduct the survey about trainees' satisfaction, as shown in questionnaire form (see Table 2).

Table 2. *Questionnaire form*

No.	Question
1.	Is the given literature appropriate for the content of the training?
2.	Was the instructor/lecturer well prepared for training sessions?
3.	Were the classes regularly performed according to the terms of timetable?
4.	Was the method of presenting course materials clear?
5.	Was the equipment functioning satisfactorily during the training?
6.	What is the relationship established between the instructor and the trainees during the training (interactivity)?
7.	Did the lecturer succeed to make the trainees of the course interested in the subject matter?
8.	What was the efficiency of utilization of the available time?
9.	Did the instructor test the level of the trainees' acceptance of matter during the training process?
10.	Were there any additional consultations?

Source: Internal documentation of the Quality Management System of the Faculty of Maritime Studies Kotor

Since the beginning of 2016 the Course has been carried out for 3 times, and trainees were obliged to give the answers regarding the questions in Table 2, using the Likert scale 1-5. The result is that 35 respondents expressed their attitudes about quality of the Course lectures as follows: an average score that represents trainees' satisfaction about the quality of the Course implementation at the Faculty of Maritime Studies Kotor is 4.945. This is very important data for the management and instructor staff at the Faculty, and at the same time strong motivation force to continue respecting international and national rules and regulations, improve human and material resources of the Faculty, as well.

4. CONCLUSION

In the contemporary environment quality seafarer could be only one who can ensure the provision of an efficient, safe, clean, secure running of the ship, fulfilling “triple E” requirements – running the business efficiently, economically and environmentally friendly. In such a situation, seafarers need to be continuously educated and trained. Maritime industry's competence requirement is leadership and team working on board. Through the attending of Leadership and Teamwork Course seafarers seriously raising the level of knowledge of situational and industry awareness, improve their soft skills and much better assess the competences.

Seafarers who pass Leadership and Teamwork Course at the Faculty of Maritime Studies Kotor are successfully supplied with the following topics related to managerial knowledge and skills on board: a) maritime conventions and regulations, b) effective workload management, c) resource-management techniques, d) communication and teamwork, e) leadership and motivation, f) situational awareness, g) decision-making process, g) fatigue and stress, i) cultural awareness, and j) situation and risk assessment.

Based on the results of continuous measuring trainees' satisfaction, it can be concluded that Faculty of Maritime Studies Kotor successfully realizes its mission, what means that this Institution is leader at the market of providing educational and training services in the local and regional environment.

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Financial literacy of the students of technical sciences

Milena Stanisavljević[1]
[1] Faculty of technical sciences Čačak, University of Kragujevac, Serbia
e-mail milena.stanisavljevic@ftn.kg.ac.rs

Abstract: *The terms and procedures of economics and finance may often seem unfamiliar for engineers, as they did not have much chance to learn more about these fields. Financial literacy could enable better understanding of their role in the organization and facilitate task accomplishment, as well as their professional development. The goals of this paper are to show the level of knowledge in finance, familiarity with financial products, level of financial planning and control, and the most often used ways for money saving. The paper emphasizes the need for improvement of this knowledge and skills. A few engineer competency models emphasized financial literacy as one of necessary skills for engineers in global, complex and dynamic world.*

Keywords: *finance, competence, engineer*

1. INTRODUCTION

Financial education as a need is recognized for several years now and it is being in the center of attention of the public and it requires much more attention of the public institutions and other relevant partners in society. The complexity of financial products and their greater access to wider audience suggest the necessity of financial literacy of users because of the very low level of understanding of basic financial concepts.

The diffusion and importance of financial services in modern economies and societies mean that individuals, who do not have access to them, are faced with great problems in meeting their everyday needs and fulfilling normal living. Financial literacy is now globally acknowledged as an essential complement to financial consumer protection, financial inclusion, financial regulation in support of economic and financial stability and development (OECD, 2014).

The financial education of youth is especially important because the youth, as future participants at financial market, will face even higher financial risks and even more complex financial products. The youth is excellent mediator and they will expand their habits and new culture among the rest of the population and they will affect to their surroundings – parents and family. The decisions they will make in the future will influence not only themselves and their close surroundings, but as well the wider social community. Because of growing importance of financial literacy, in general, and especially among youth, in this paper presents the results of a research conducted among students so significant conclusion about financial education could be given. The presented research was conducted with students of technical sciences, who usually did not have any formal course about finance, so recommendation about involvement of financial education could be given.

2. LITERATURE REVIEW

The education of the modern engineer and technical experts for the changing and demanding world of work in the 21st century must consist of a multi-disciplined integrated approach. Problem solving, computer literacy, technical artfulness, basic economic knowledge, management skills, communication skills must become an integral part of engineering education (McGarthy & Kennedy, 2013). The Engineer Competency model identifies the knowledge, skills and abilities needed for workers to perform successfully in the field of engineering (ETA, 2015). The model is presented as a pyramid with five tiers: personal effectiveness competencies, academic competencies, workplace competencies, industry-wide technical competencies, industry-sector functional areas, respectively. At the fourth tier, engineering economics are embedded as necessary area of competence for engineers. Engineering economics involve knowledge about economic analysis, time value of money, costs, budgeting, accounting, taxes etc. All of these topics are relevant for application to engineering projects, so it is necessary for engineers to have basic knowledge about these terms and concepts. The knowledge about these concepts could be measured through the level of financial literacy, and the results should be used for defining the possibilities of improvement of these skills.

2.1. Financial literacy

The International Network on Financial Education (INFE) of the OECD defines financial literacy as *a combination of awareness, knowledge, skill, attitude and behavior necessary to make sound financial decisions and ultimately achieve individual financial wellbeing* (OECD, 2014:32). Financial literacy is the ability to process economic information and make informed decision about financial planning, wealth accumulation, debt and pensions (Lusardi & Mitchell, 2014). Financial literacy reflects an individual's ability to understand financial concepts, financial products and financial services and provide an ability to control personal financial resources (Bahovec, Barbic & Palic, 2015). It should increase an individual's ability to manage and plan personal finances. It is consisted of financial decisions about money, inflation, savings, interest rates, investments, debt, credit and currency risks, all kinds of financial contracts and other financial instruments (Vehovec, Rajh & Škreblin Kirbiš, 2015).

People who have good financial literacy skills do better planning and saving for retirement and efficiently diversify risks. The benefits of high financial literacy include less fees and charges on credit cards, having a higher net worth, saving earlier for retirement and having less debt overall (Bartley, 2011). Financial ignorance carries significant costs. Customers who do not understand the concept of interest compounding spend more on transaction fees, run up bigger debts, incur higher interest rate on loans, borrow more and save less money (Klapper, Lusardi & van Oudheusden, 2015, de Bassa Scheresberg, 2013).

Recognizing the importance of financial literacy, a growing number of countries have developed and implemented national strategies for financial education in order to improve the financial literacy (OECD, 2014). Since 2014 more than 50 countries designed or implemented national strategies for financial education and many other countries are considering developing one. The strategy of National bank of Serbia for financial education in the period 2016-2020 was created with a goal to give guidance for improvement of financial literacy and knowledge of citizens in the field of financial education and financial inclusion (NBS, 2016). The relevance of this topic is confirmed with the fact that the Ministry of Education, Science and Technological Development of Republic of Serbia included financial literacy among the goals and outcomes of elementary education, as essential for further education and active involvement in society (Zakon o osnovnom obrazovanju i vaspitanju, 2013). In the first OECD recommendation it is especially stressed out that financial education should start from the earlier phase in life and that it is the long, continuous process.

Financial education is necessary for all participants at financial market. Responsible for improvement of financial literacy are educational system, from elementary schools to faculties, as well as chambers or associations interested in financial education and private companies. The growing importance on this matter represents the fact that this year will be held the 10th Annual Financial Literacy Summit in Chicago, with a main goal to discuss which financial literacy programs from around the world have made an impact and where innovation and technology is leading the industry (Financial Literacy Summit, 2016).

The development of financial literacy skills among young people is increasingly perceived by policy makers as essential. Young people are an important target group for financial education designed to strengthen financial inclusion. The financial products, services and systems became highly sophisticated and the financial risks are growing. The today's youth are likely to face more challenging financial decision than those of past generation.

2.2. Resent research results on financial literacy

In 2012 the OECD's Program for International Student Assessment (PISA) was expanded with a module on financial literacy (beside mathematics, science and reading). In doing so, PISA recognized financial literacy as a skill essential for participation in today's economy. Serbian students will be included for the first time in the research in 2018.

By the research done by Standard and Poor's in 2014, worldwide there are 33% of financially literate adults. There are only 38% financially literate adults in Serbia. The research results in former Yugoslav countries showed that highest results were in Montenegro (48%), than Slovenia and Croatia (44%), Bosnia & Herzegovina (27%) and Macedonia (21%) (Klapper, Lusardi & van Oudheusden, 2015). The most of respondents do not understand the effect of the cumulative interest rate, inflation consequences, are not capable to calculate the loan costs (Nenadović & Golicin, 2015). Several studies showed that only about 30% of young people have basic knowledge about finance (Lusardi & Mitchell, 2014, de Bassa Scheresberg, 2013).

3. METHODOLOGY

The research subject of this paper was the financial literacy among students of technical sciences, as they will soon join the work force and become significant part of economic and financial system.

The goals of this research were:

- to show the level of financial literacy of the students of technical sciences
- to compare these results with the results of similar researches
- to show the familiarity with financial products and its use among students
- to show the level of financial control and financial planning

- to show the most often used ways for money saving.

The research was conducted with third and fourth year students at the Faculty of technical sciences in Čačak during April of 2016. Data were collected using questionnaires. The sample was consisted of 106 students. Students were asked to fill out the questionnaires which were based on the OECD’s questionnaire for testing financial literacy (OECD, 2015), but adjusted to students (by the number and the content of questions). The questions are grouped in a few sections. First section included general information about sex, age, study program and year of studies. The next section included questions about financial products and the ways of their selection. The third and fourth sections were dedicated to financial control and financial planning. And the last part consisted from questions which were used to test the level of understanding and knowledge about interest rates, inflation and risk diversification. Before the first question about financial products, students were asked to evaluate their financial knowledge, and the same question was asked in the end of the questionnaire, so the results could be compared before taking the questionnaire and after answering to all of the questions.

Quantitative (descriptive analysis) and comparative analysis had been done. SPSS software was used for data analysis and presentation of results.

4. RESEARCH RESULTS AND DISCUSSION

There were 106 students who participated in this research, among them there were 44 students of third year and 66 students of fourth year of studies, and regarding sex structure, 31 female and 75 male. The financial products which are the most recognizable are the current account (100% of students knew what it is), a credit card (98.1%) and an insurance (98.1%). The least recognizable financial product are microfinance loan (44.3%) and unsecured banking loan (59.4%). Similar results were found in the research done in 2012, with difference on the most recognizable products, where saving account was the second (Ipsos Public Affairs, 2012). Students use the most a current account (79.2%), insurance (58.5%) and credit cards (42.5%). About 8.5% of students do not use any of financial products. Important is to emphasize that 51.9% students decided to use these product after considering several options of different companies, while 22.6% students did not consider any other option. Research in Croatia and Serbia showed this same order of possible behaviors when people decide to use some of financial products (Vehovec, Rajh i Škreblin Kirbiš, 2015, Ipsos Public Affairs, 2012). The most valuable information for decision making were those available on the internet (information about products and best buy information (70.3%)) and advices from family and friends working in financial institutions (69.3%). These results are almost expected, because young people spend a lot of time on the internet and usually do not have much experience with financial products and their first option is to ask someone they knew, friend or family member.

Students showed relatively high results on financial control, overall result was 67.4 (from maximum 100). They showed that they pay their bills on time, think before buying, personally take care about own finances and set long-term financial goals. These results are match with those from 2012 when overall score was 70 (Ipsos Public Affairs, 2012).

Students showed low results on financial planning, overall result was 31.38. Research done in 2012 showed that older people are more dedicated to financial planning then young people (Ipsos Public Affairs, 2012), so these results confirm that finding. Item “money is there to be spent" is supported by 35.8% of students, but there is high percentage (49.1%) of them who would be "prepared to risk some of own money when saving or making an investment", which show that results about financial planning are divided.

Students most often save money at home (79.2%) or at their current account (50%). Saving account is not so commonly used; 18.9% of students pay money into a saving account. Only 5.66% students said that they do not save any money.

Students had a chance to evaluate their knowledge about finance before filling the questionnaire and after, but the average grade was the same, 3.01, which means that they did good self-assessment. Very often respondents, given the question to assess their own knowledge about finance, overestimate how much they know (Lusardi & Mitchell, 2014).

The average score on financial knowledge was 62.89 (from 100). The overall score achieved by respondents included in the research conducted in 2012 was 62 (Ipsos Public Affairs, 2012). This is a relatively good result. Dividing money and interest calculation are familiar to the most of students. The lowest results students achieved for calculating compound interest rate and risk diversification, where achieved scores were 37.7 and 52.8 respectively. The overall score achieved for questions about inflation were 65.35, for risk diversification 62.725 and for questions about interest were 60.6. The highest results were found about the questions about inflation, which could be explained by our experience with this phenomenon, although students included in this research were often very young or not even born when Serbia experienced extremely high inflation rate. It could be assumed that family members could communicate much about those times and experiences to their younger generations. Risk diversification is not familiar to students, and they do not understand the principle by which if the investments are diversified, the risks are lower. These results could be explained with low participation of students in investment activities and lack of experience with savings in banks.

5. CONCLUSION

From the perspective of financial industry, improvement in financial literacy is exceptionally relevant because the most important clients are financially literate individuals and increased demand of financial products results in business improvement. From the perspective of individuals, financial literacy develops self-protection, reduces the risk of negative outcomes, increases the consciousness and knowledge about planning own wellbeing. Financial education leads to greater awareness and to increased knowledge, stronger customer protection and greater confidence towards the market of financial services. Introducing financial education in the programs of compulsory education could enable improvement of the level of financial literacy. Research results showed that the most of financial products are not familiar to young people (students), that they are not dedicated to financial planning while financial control is more important. Most students have some kind of savings. Their level of financial knowledge is at the average level, but it should be improved so they could better understand which opportunities exist on financial market, and which the best way of using those opportunities is.

Limitations of the research refer to the used method of the research, the questionnaire was quite long, so students often do not have enough patience to answer to all the questions with high level of attention. Another limitation refers to the possibilities of comparison. The results of this research were compared to the results of the research conducted on the bigger sample with respondents of different age and education level.

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Supporting education of engineers of 2020 through triple helix model

Nela Cvetković[1], Milovan Medojević[1] and Slobodan Morača[1]
[1] Faculty of Technical Sciences/Department of Industrial Engineering and Engineering Management, Novi Sad, Serbia
e-mail nela_cvetkovic@yahoo.com, medojevicm@uns.ac.rs, moraca@uns.ac.rs

Abstract: *This paper presents Triple Helix model and its appropriate key aspects (components, relationships and functions among helices) as the framework for collaboration among Universities-Industry-Government, with the overall objective to improve engineering education and formation of Engineers of 2020 and to overpass the most significant deficiencies of engineering education. This approach, with adequately defined roles of all parties, benefits and correlations, offers benefits for all model components and, in terms of education, facilitates overcoming deficiencies of traditional education.*

Keywords: *Engineer of 2020; Higher Education; Triple Helix model; Engineering education; Networking;*

1. INTRODUCTION

One of the main goals engineering education is striving for is to prepare students for encountering challenges in the future professional life [1] and to shape engineers fitting the industry demands [2]. Therewith, the higher education institutions are challenged to actuate students into the real-world situations and problems, enabling them to adapt and influence the fast changing future trends and needs, and to form students as future leaders and engineering professionals broadly educated, ethical and inclusive in all segments of society [3]. These future engineers, known as Engineers of 2020, can briefly be described by their main desired attributes: engineers with strong analytical skills, ingenuity, creativity, leadership skills, high ethical and professional standards and engineers who are lifelong learners [3]. The traditional learning has no capacities to fulfill these aspirations [4]. Completely opposite of the constant technology and industry changes, 'education has changed very little over the last half of this century' [5], which is testifying to the urgent need of improved and adjusted teaching methods. Thus, certain learning approaches within higher education started demonstrating effective results in preparation of Engineers of 2020. Work Based Learning (WBL), Problem Based Learning (PBL), and hands-on learning practice are few of the methods that have gained popularity within the engineering education, as significant instruments in concept: learning by doing, learning by using and learning by interaction [6].

The focus of this paper is to give an overview on engineering education challenges and to present our perspective on the adequate model of Triple Helix approach and its contribution to the improved education of Engineers of 2020 .

2. TRIPLE HELIX APPROACH AND ENGINEERS OF 2020

2.1. Engineers of 2020 and their education

In brief, Engineers of 2020 can be described as the next generation of engineers able to adopt to the fast changing future technology trends and beyond that, to contribute and participate in its going evolution. Related to that, the adequate engineering education has to constantly implement changes that are following the changes in technology and society.

The emerging question is if universities are capable of catching up with challenges, opportunities and rapidly developing technologies that are influencing and shaping the needs for future engineers with certain attributes. Furthermore, the concerning issue is 'What will or should engineering be in 2020? How engineers can best be educated to be leaders, able to balance the gains afforded by new technologies with the vulnerabilities created by their byproducts without compromising the well-being of society? Will engineering be viewed as foundation that prepares citizens for broad range of creative career opportunities? Can the engineering profession play a role in shaping its own future?' [3] Nowadays, there are certain identified deficiencies in engineering education and consequential engineering "skill deficiencies" among which the most significant are:

- The inability to work and discuss with others [4] and inability to work in team [1];
- The inability for creative problem solving and solving complex problems that require integration of social, economic, legal and technical factors [4],[7];
- Inability to communicate [1];
- Non awareness of workplace expectations [1];
- Lack of independent and critical thinking [7].

Considering the presented needs for engineers' skills improvement, foreseen guiding principles and trends that will shape engineering activities, the main desirable attributes of Engineer of 2020 are described as following [3]:

- Strong analytical skills;
- Practical ingenuity;
- Creativity;
- Leadership;
- High ethical standards and professionalism.

Furthermore, additional significant attributes that are recognized are:

- Lifelong learners;
- Good communication skills;
- Business and management skills.

Outlined attributes describe engineers who are broadly educated, see themselves as global citizens, can lead in business and public service, as well as in research, development and design, are ethical and inclusive of all segments of society.

Engineers of 2020 must not only be technically capable, but also to be able to understand the contextual requirements and consequences of their work [3]. In their book, authors [8] define contextual competence as 'an engineer's ability to anticipate and understand the constraints and impacts of social, cultural, environmental, political and other contexts on engineering solutions'. However, despite the importance this issue has gained during the previous years, it was found that engineering students were generally lacking in key aspects of this skill. This points to the need for improved education which emphasizes on understanding the organizational, cultural and environmental contexts and constraints of engineering practice, design and research [9].

In order to face this deficiency, certain approaches for integration of contextual competences and development of desirable engineer's attributes within higher education need to be identified.

Student's immersion in a real world community context and real-world projects [8], introduction of education system which emphasis hands-on learning, practice and risk-taking and failure culture [10] and generally, practical work and engagement on real-world cases, are approaches seen as valuable for improved education of engineers. Related to that, it is considered that the best way to learn and understand a theory is trying to see whether you can apply theory in engineering problem solving, applying so called Problem Based Learning (PLB) and furthermore, Work Based Learning (WBL) [1]. What makes PBL concept valuable for education of Engineers of 2020 is that it allows students to develop excellent analytic skills and "attack" complex engineering problems [1] which are among the key attributes of Engineer of 2020.

Considering this, co-operation between university (students, researchers) and industry is necessity to find enough relevant real life problems, practical learning context [1] and to enable development of analytic skills, problem solving capacities, creativity and team work skills. However, even though the connection with industry plays crucial role in improvement of education and its modification towards adequate engineering programs and curriculums, the government obtains an active role within the same process. Alongside of acting as policy maker, the continuing role of government rests on ensuring that education makes a contribution to the well-being of society and the economy.

As the fitting approach for proper involvement of all three mentioned instances in education of engineers of 2020 and improvement of their desirable attributes, we have recognized Triple Helix Model.

2.2. Triple Helix model in education of Engineers of 2020

Triple Helix approach is understood as interaction of University, Industry and Government which 'generates 'innovation system' format that highlights the key new sources of novelty and the dynamics of their interaction' [11]. However, Triple Helix model has proven its value for advancement of education as well; integrated work of higher education institutions and industrial enterprises turned out to be not only meaningful for raised professional level of scientists, developers, pedagogues, postgraduate student of the university but also for promotion of higher quality and demand for professionals graduated by the universities who are ready for efficient work in high-tech organizations of the real sector of the economy [12].

As already emphasized, today's rapid technology advances require universities to be more innovative to meet industry demands. In promotion of engineering education universities will not be successful alone, due to lack of resources; however, the Triple Helix approach brings collaborative opportunities [2]. Triple Helix model transfers theory to practice enabling innovative trainings [2], facilitates successful collaboration between industry sector, universities and government institutions, provides optimal incentives for students, empowers new technological developments and enhance the reputation of universities [13].

Furthermore, Triple Helix theory supports concept that learning by doing, learning by using and learning by interaction could not only increase efficiency of production [6], but also the quality of education of high-tech engineers [2]. According to [13] this kind of collaboration creates challenges for universities: instead of focusing on traditional manners of teaching and research activities, they start to concentrate on business. Consequently, the favorable environment for Problem Based Learning in engineering education is set up. One of the most successful examples of such a collaboration where one of the outputs are improved skills of graduated engineers is cooperation between IBM and universities, supported by government institutions. Within this collaboration, interdisciplinary Research Center is established, in order to gather students to address broad and real-world needs [14].

According to [11] so far there has not been provided explicit analytical framework for conceptualizing the systematic nature of Triple Helix approach. The authors define and extensively describe Triple Helix model as ‘a set of:

- *Components*: the institutional spheres of University, Industry and Government, with a wide array of actors;
- *Relationship between components*: collaboration and conflict moderation, collaborative leadership, substitution and networking;
- *Functions*: processes specific for Triple Helix spaces: Knowledge, Innovation and Consensus’.

Considering the focus on improvement and promotion of education of Engineers of 2020, the main current deficiencies in relevant education, and required attributes of Engineers, we propose following Triple Helix model, based on systemized key features of Triple Helix interaction presented by [11]:

1) *Components*

Universities involved in engineering and technological education, industry and government institutions.

- *University role*: collaboration with industries in order to provide students with real-life cases and problems, to enable Problem Based Learning and Work Based Learning; education of students according to the needs specified by the partners from industry; constant promotion of academic stuff; cooperation with industry sector and Government institutions in creation of education strategies.
- *Industry sector role*: cooperation with universities in order to increase its innovative and R&D capacities and incorporate in process of shaping the future engineers; including students in their real-life projects and problems.
- *Government institutions role*: facilitation of university-industry relation by adequate policies and regulations; involvement in education strategy development; support by government funding agencies.

2) *Relationship among components*

As interaction between components can take different forms, depending on economic, social and technology needs, we find Networking as the most suitable one in terms of education of Engineers of 2020 within Triple Helix model.

- *Networking*: networking into formal or informal structures on different levels (regional, national, etc.) is seen as effective structure in responding to changing conditions. Research networks have been found to be of critical importance socially, politically and economically in order to generate labor among participants in the network [15], in this case, to generate engineering experts.

3) *Functions*

- *Knowledge space:* represents the mix of knowledge generation, transfer, diffusion and other activities among components of Triple Helix model. The construction of this space is essential for definition of involved knowledge resources and to reduce duplication of efforts within the Triple helix [11].
- *Innovation space:* implies activities planned and undertaken by components according to the goals and purpose of collaboration establishment.
- *Consensus space:* "set of activities that bring together Triple Helix components to brainstorm, discuss and evaluate proposals for advancement" and its transformation towards collaboration.

These represent the most important and essential aspects and key features of Triple Helix model described in concerning the improvement of engineering education, with focus on Work Based and Problem Based Learning, student's engagement of real-life cases and real teams and life-long learning.

3. CONCLUSION

Education of Engineers of 2020, although having a great potential and even greater importance for industry, technology and generally, society development, demonstrates significant deficiencies. Consequently, these deficiencies in engineering education have been reflected on graduated engineering students' skills. The inability to work and discuss with others [4], inability for creative problem solving and solving complex problems that require integration of social, economic, legal and technical factors [4],[7], inability to communicate [16] and independently and critically think [7] are few of the most concerning shortages of engineering skills.

With respect to these ascertainments, foreseen future trends and guiding principles that will shape engineering activities, the attributes of engineers ready to adapt to ever changing environment and needs are identified and defined as 'attributes of Engineer of 2020' [3].

With aim to accomplish and prepare Engineers of 2020, universities have started improving and modifying approaches in engineering teaching and learning. Thus, work based and problem based learning have gain the importance and the significance of engagement on real-world projects and complex problems solving have proved to be valuable for transition of students into engineering professionals.

What we have seen as approach for integration of above mentioned solutions and vital framework is Triple Helix model, with the presented defined role of all the components (Universities, Industry and Government), their relationship (Networking) and functions inside the model. With Triple Helix components, relationships among helices, and functions adjusted and defined in accordance to the goals and needs of collaboration partners, this model represents valuable support for education of Engineers of 2020 and its constant melioration.

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Remote laboratory concepts: A conceptual model of remote laboratory for solar energy engineering

Milovan Medojević[1], Nemanja Sremčev[1], Slobodan Morača[1], Milana Medojević[1] and Nela Cvetković[1]
[1] Department of Industrial Engineering and Engineering Management, Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia
e-mail medojevicmilovan@gmail.com

Abstract: *The notion of remotely controllable laboratories (RCL's) is the practice of providing control of scientific instruments from remote locations. The devices which can be accessed remotely include variety of equipment. Bearing in mind the cost and complexity of these devices, many specialized scientific instruments cannot be reached by some institutions, while the institutions that pose such instrumentation, scheduling and other logistical issues prevent full utilization of those tools. Therefore, initiatives that offer remote access tend to address issues of access and efficiency, ultimately improving educational quality and student opportunities. Given the aforementioned, the aim of this paper is to provide an insight on the most common concepts of RCL's that are encountered in engineering practice. Furthermore, a conceptual model of RCL's for solar energy engineering (SEE) is briefly displayed and discussed. Lastly, potential advantages and disadvantages of RCL's are stressed out concisely.*

Keywords: *Remote laboratory; engineering education; solar energy; Moodle*

1. INTRODUCTION

The concept of RCL's firstly appeared in the late 1990s at universities all over the world and became enabler of slowly creating environment for development of remote engineering. The RCL's were designed and implemented to address the issues faced by the modern universities such as limited capacity, as well as to provide cost-effective laboratories [1], efficiently utilized, and most importantly, able to provide students with adequate access to perform experiments [2]. Having this in mind, remote engineering is becoming an import element in engineering education, while accordingly there is growing need for new learning media and tools. Likewise, RCL's provide students with 24/7 access via the Internet while pointing out opportunities to share expensive and/or specialist laboratories with other institutions. Additionally, instead of developing the same types of laboratories by different entities and institutions, remote labs could be shared globally wherever adequate Internet access is available. Therefore, the purpose of remote labs is not to replace real time practical experiments, on contrary they are aimed to enhance these experiments, using modern and available technology [3]. There have been many evaluations of possible laboratory experiments, but in recent years, the RL is at the forefront [4].

2. REMOTE LABORATORY CONCEPTS

Most remote laboratories are accessible independent of space or time using a computer with an Internet connection and a web browser. Video and sound transmission can be used for remote observations but human senses other than sight and sound are more difficult to convey. Most instruments have a remote control option, and human fingers can often be replaced by a remotely controlled manipulator, a so-called "telemanipulator", the level of sophistication of which may vary. The Internet is used as communication infrastructure. Each user's instrument settings and other data required to set up a desired experiment are sent from the user's computer to the lab server. The server sets up and performs the experiment and returns the result to the user's computer. A block diagram of such a laboratory is shown in Figure 1. It is important to mention that the number of client computers that can be connected and perform physical experiments simultaneously varies from laboratory to laboratory [5].

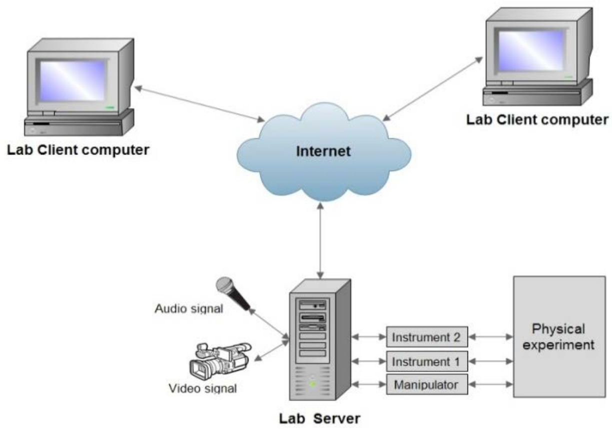

Figure 1. *Block diagram of a Remote Laboratory model*

In addition, most desktop instruments have a remote control connector for GPIB (General Purpose Interface Bus), which is often placed in the rear panel. In other cases, the instrument can be connected directly to the Internet through an Ethernet port. Computer-based measuring instruments consisting of a plug-in board, fitted with a tiny physical panel containing connectors and a software module in the host computer are frequently seen in laboratories today. There are instrument boards on the market that can be plugged into the mother board of a standard desktop PC. However, the normal PC chassis is a disturbing environment for an instrument board. The instrument platform used in the open electronics lab is PXI (PCI eXtensions for Instrumentation). Another platform which was introduced in 2005 is the LXI (LAN eXtensions for Instrumentation) which may become a LAN-based successor to GPIB. The software module displays a virtual front panel containing control knobs and buttons on the host computer screen. The user can turn the knobs and adjust the instrument settings with the mouse. The fact that the virtual front panel is separate from the plug-in board enables users to install this piece of hardware in the lab server and to display the virtual front panel on the screens of the client computers. The Figure 2 provides an insight to virtual front panel of a desktop measuring instrument.

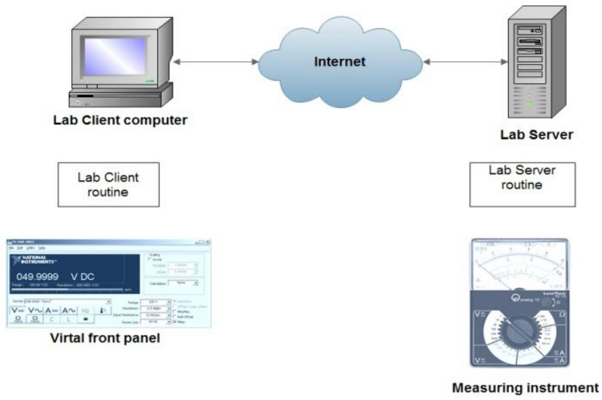

Figure 2. *Remotely controlled instrument*

Moreover, it is possible to combine a virtual front panel representing an instrument from one manufacturer with hardware from another as long as the performance of the hardware matches that of the depicted instrument. Additionally, another convenient alternative requiring only modest programming experience is to write these routines using LabVIEW, which is graphical software development environment for measurement and automation [6].

3. A CONCEPTUAL MODEL OF RCL'S FOR SOLAR ENERGY ENGINEERING

A model of RCL's for Solar energy engineering (SEE) consists of a solar energy conversion plant which consists of several flat plate solar collectors located on the flat roof of the facility, an insulated thermal storage tank located in the solar energy laboratory (SEL) and other auxiliary equipment and accessories. In addition, SEL should be equipped with all necessary instrumentation, control and communication devices which are needed for remote access, control, and data collection and processing. The schematic diagram of the solar facility system is illustrated in Figure 3.

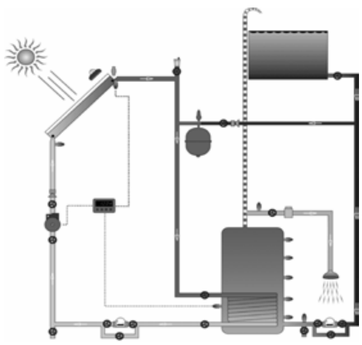

Figure 3. *Schematic diagram of the solar facility system*

Moreover, integrated hardware and software provide features for controlling external devices, responding to events, processing data, creating report files, and exchanging information with other applications. Likewise, specific weather data, as well as operational and output data of the system are being registered during an experiment and temporarily stored on the controlling PC, while being available for downloading for subsequent calculations and/or documentation. The main focus of this concept is to use Internet as a tool to ensure RCL's being accessible to engineering students and technicians located outside the facility premises. In this way, the SEL and its equipment and experimental facility will be available for sharing, resulting in reducing facility running and maintenance costs. Furthermore, this concept offers a unique opportunity to students from countries of poor sunshine to have access to real conditions experiments. The system will enable real-time, remote control, data acquisition and evaluation. Likewise, it allows remotely located students to conduct experimental work in an interactive and independent way.The system architecture consists of four different layers where each layer provides its services to the next lever by using the services of the layer below it. Figure 4outlines the different layers with a short description of their responsibilities.

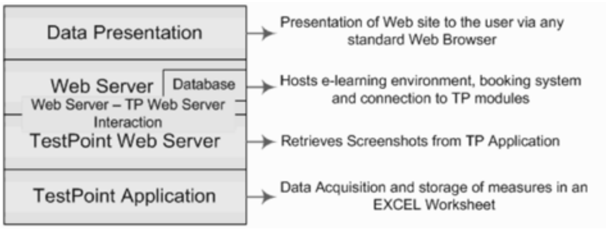

Figure 4. *The system architecture layers*

Having in mind that for the implementation of this architecture two different computers are needed, in the Figure 5, a graphically displayed architecture is shown where the previously mentioned layers are separated by dotted lines.

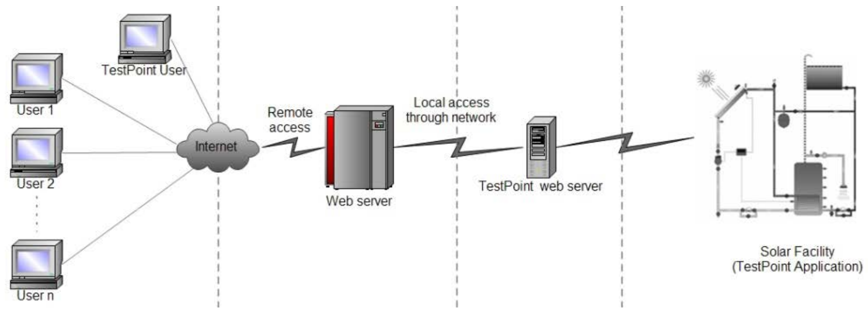

Figure 5. *The system architecture layers - graphically displayed*

3.1. Challenges, problems and overcoming solutions

Although the benefits and importance of this concept are obvious, there is one concerning issue common for all entities that offer their services through internet, and that is security. Having this in mind, the primary concern is security of both, the Main and the TestPoint Web server. The web server could be integrated under the university domain so the security mechanisms for the whole institution are inherited by the computer hosting the web server. On the other hand, additional security is needed at the Test Point web server hosting device.

If this device is also under the university domain, restrictions from within the university could be applied.

3.2. E-learning platform

Having in mind that the University of Novi Sad (UNS) has already integrated Moodle as an e-learning platform as a part of its standard teaching methodology, aforementioned RCL's could be hosted on it. Moodle, which is a course management system provided freely as Open Source software (under the GNU Public License), runs on any computer that can run PHP. In addition, it can support many types of database, particularly MySQL. Therefore, this choice allows flexibility in learning while providing various learning environments to fulfill the requirements of the various courses. So far, Moodle was used as a demonstration, a quiz and an experimental tool. However, Moodle capabilities could be enhanced and adapted in such a way that the running of the actual experiment is allowed only after the successful completion of the preliminary exercises or tasks. It is important to mention that with this platform the user can work both independently or as a part of research group.

4. CONCLUDING REMARKS REGARDING FUTURE SCENARIOS AND IMPLICATIONS FOR TEACHING AND LEARNING PROCESS

Providing remote access can improve scheduling for on-campus users, who can conduct experiments outside class or lab times, and promotes more efficient use of specialized equipment that might otherwise remain idle for long stretches, only to be swamped during peak times. Remote users benefit by having access to extremely rare or unique scientific instruments. In some cases, instruments can be quite expensive or specialized that there might only be a handful or even just one in existence. Exposing students to such equipment, allowing them to engage in authentic learning experiences rather than just simulations or canned exercises using archival data, creates more compelling learning opportunities. Working with the actual tools of a field deepens students' understanding of the concepts at work and prepares them for careers using those devices. Effective RCL's could save time and the expense of travel, preserving or even expanding access to scientific facilities in times of stalled or shrinking budgets. Moreover, by providing access to the general public or students, researchers may fulfill a requirement to disseminate publicly funded research as broadly as possible. As network infrastructure matures, it offers greater speeds, improved security, and increased access while opportunities grow for bringing experiences of genuine scientific instrumentation and work to a wider range of students. As institutions reap synergistic benefits of RCL's, higher education will likely undertake more partnerships in which universities maintain different pieces of scientific equipment and share access to those resources, maximizing their utilization while eliminating multiple purchases of similar hardware. As scientific instrumentation is increasingly controlled solely through computer interfaces, and as security measures and software to manage resources become more sophisticated, the number and kind of instruments available through remote channels will increase. In addition, as the means of connecting scientific devices to the Internet become simpler and less expensive, institutions will be more willing to give remote access to older instruments that have been replaced with new equipment but remain valuable for teaching purposes. RCL's have the potential to bring authentic learning experiences to a wide range of students, resulting in richer learning and a deeper understanding of the material at hand. It's the difference between simply reading about a principle in a textbook and being able to perform experiments that apply those principles. For some students, remote instrumentation opens the door to hands-on experiences they could not gain otherwise. For other students, remote instruments can add considerably to the amount of time they can work with scientific equipment, broadening the range of experiments they are able to conduct and the opportunities for learning. Likewise, RCL's could allow courses to be taught online that otherwise would have to be taught face-to-face because of their reliance on specific equipment, and faculty can include real-time demonstrations in lectures, bringing authentic examples of experimentation or problem-solving to students. Undergraduate learning in particular can benefit from linking course content to the tools and experiments of the discipline.

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Remote control of pneumatic circular manipulator using CompactRIO controller[1]

Vule Reljić[2], Brajan Bajči[2], Jovan Šulc[2], Dragan Šešlija[2] and Slobodan Dudić[2]
[2] Faculty of technical science/Chair of Mechatronics, Robotics and Automation, Novi Sad
e-mail vuketa90@uns.ac.rs

Abstract: *Pneumatic circular manipulator is a new experimental facility developed for testing different control methods and energy efficiency of automated systems with compressed air as a working medium. Also, the manipulator has the ability of remote control, via the Internet and thereby it is an important didactic tool for teaching in the field of pneumatic control with multiple actuators. In this paper, the realization of control is presented using the CompactRIO controller, which eliminates the need for a server computer.*

Keywords: *circular manipulator; remote control; CompactRIO*

1. INTRODUCTION

The latest researches in the field of remote control of real physical experiments confirms the hypothesis that remote laboratories are of great importance for a growing number of educational institutions, especially those that teach students in the field of mechatronics (Gadzhanov et al., 2014). For a certain time such laboratories and experimental facilities are being developed at the Faculty of Technical Sciences in Novi Sad, primarily in order to strengthen cooperation between universities and vocational schools in order to exchange valuable experience but also equipment that is not available for them. Examples of this are remotely controlled pneumatic spring (Reljić et al., 2015), remote laboratory for measurement tolerance of linear dimensions (Šulc et al., 2015), remote system for measuring geometric tolerances - roundness (Bajči et al., 2016) and remotely controlled pneumatic circular manipulator (Reljic et al., 2016). The practical realization of each of these devices brings with it its own specifics and what is typical for pneumatic circular manipulator is that, so far, for the remote control it has to be used, in addition to the client computer a server computer it was enabling only the connection between the client and the main controller - a programmable logic controller (PLC). That was the main drawback of the existing system.

This paper presents the implementation of remote control with the mentioned experimental facility using CompactRIO controller thus eliminating the need for using additional server

[1] *This paper presents the outcome of the NeReLa project "Building Network of Remote Labs for strengthening university-secondary vocational schools collaboration", No. 543667-TEMPUS-1-2013-1-RS-TEMPUS-JPHES, supported by The Education, Audiovisual and Culture Executive Agency (EACEA).*

computers, because the controller, in addition to their base purpose, control of the system, takes over that role too.

2. MECHANICAL DESIGN AND OPERATION MODES OF THE MANIPULATOR

Pneumatic circular manipulator is a new experimental facility consisting of multiple pneumatic actuators - 3 pneumatic double acting cylinder (one of which is a multi-position cylinder, and is realized by using two pneumatic double acting cylinder, identical characteristics, which provided three different positions) and a pneumatic gripper which is used for gripping and releasing of the workpieces. Practical realization of the manipulator is shown in Fig. 1. The supporting structure is a rectangular plate, dimensions 1300x1200x15 and made of PVC. Using screw connections the plate is connected with profiles, made by the manufacturer Bosch Rexroth and with the cross section area of 50x50, and thereby is achieved a stable equilibrium. Cylinders and the storage with workpieces are placed on the supporting plate using aliminum profiles and screw connections.

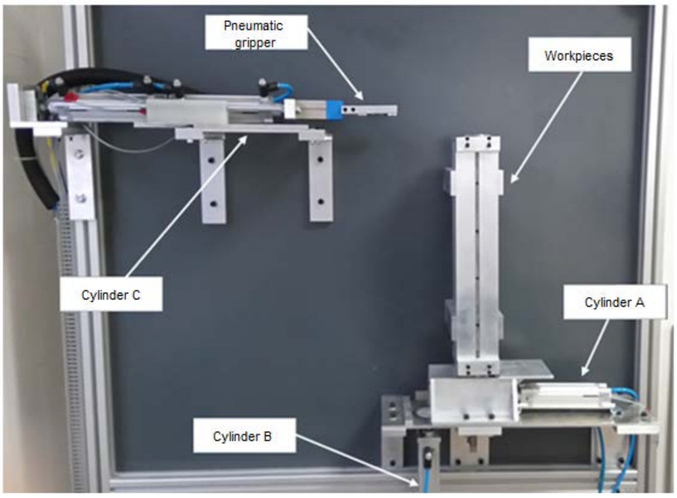

Figure 1. *Pneumatic circular manipulator*

Workpieces, with dimensions Ø80x100, are placed in the vertical storage unit. At the lowest point of storage unit, one horizontally mounted cylinder – cylinder A, pushes workpiece forward and places it above the vertically mounted cylinder – cylinder B. Cylinder B than raises it upwards, up to the level of the second horizontally mounted cylinder – cylinder C. Cylinder C is a multi-position cylinder, consisted of two cylinders mounted in series and enable realisation of several positions. At the end of cylinder C is mounted pneumatic gripper. Finally, cylinder C grasps the workpiece with the pneumatic gripper and moves it forward to the top of the vertical storage unit. Workpiece is sliding down through the storage unit with the help of gravity. When workpiece comes down to the initial position, one working cycle is ended. All pneumatic cylinders are from Festo manufacturer, where cylinders A and C have designation DNC-32-100-PPV-A, and the cylinder B has designation DNC-32-600-PPV-A. For easier explanation of manipulator operating mode, in Fig. 2 is shown the travel-step diagram, wherein the left and right cylinder of multi-position cylinder labeled C in the diagram respectively marks C and D. The detection of indented and drawn-out pneumatic cylinders piston rod positions was achieved using a magnetic reed relay.

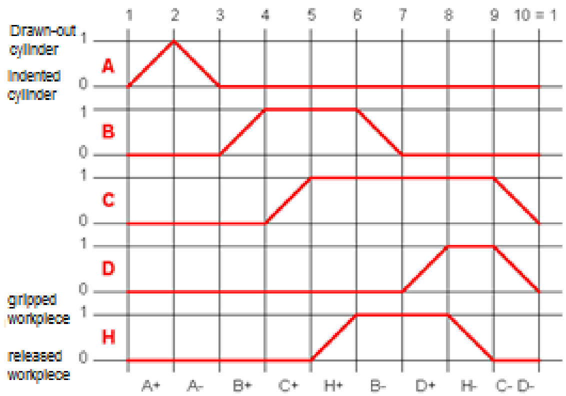

Figure 2. *Travel-step diagram*

3. REMOTE CONTROL USING THE COMPACTRIO 9074 CONTROLLER

CompactRIO 9074 controller, manufactured by National Instruments, whose is shown in Fig. 3, was used to control the manipulator. It is a modular system that consists of three main parts: the real-time processor, chassis and I/O modules. The real time controller has high processing power and data processing what makes this system very suitable for advanced applications management and high-speed data transfer. It contains a processor speed of 400 MHz. In addition, it contains a network port that is used to provide communication between the controller and a computer. Network communication contains HTTP and FTP protocols. Modular systems operates with a software package for graphical programming LabVIEW, which is used during the control realization. The controller also contains RS232 port, and is powered by 19-30 VDC. In our case, a 24 VDC power supply is used.

Figure 3. *CompactRIO 9074*

During the realization of remote control, it was necessary to do 3 things - design and connect electropneumatics control scheme based on the travel-step diagram shown in Fig. 2, set the controller and connect its input and output modules (in this case they are used for digital inputs and outputs) and make the client application for remote control and program the controller. Electropneumatic scheme is drawn in software package Fluid Draw and is shown in Fig. 4.

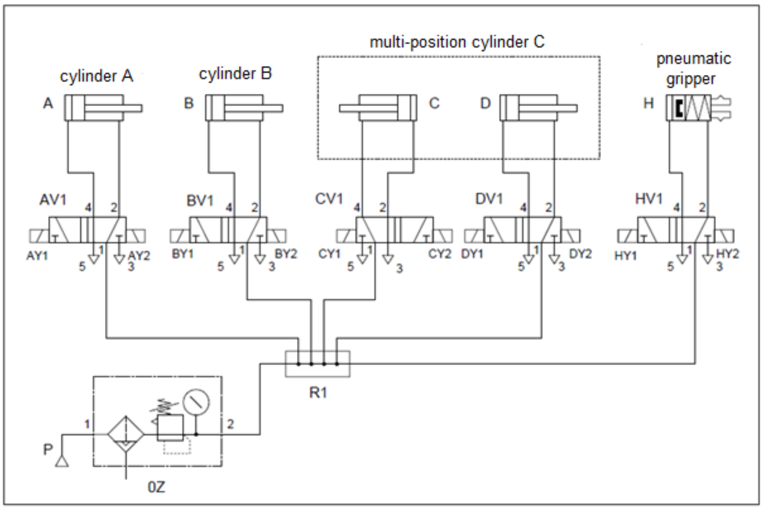

Figure 4. *Electropneumatic scheme*

Digital inputs and digital outputs are connected with I/O modules of the controller as shown in Fig. 5 and 6, respectively. It is important to note that under the symbol A+ (Figure 6) implies activation of coil AY1 (Fig. 4) and under the symbol A- (Fig. 6) activation of coil AY2 (Fig. 4), and so on.

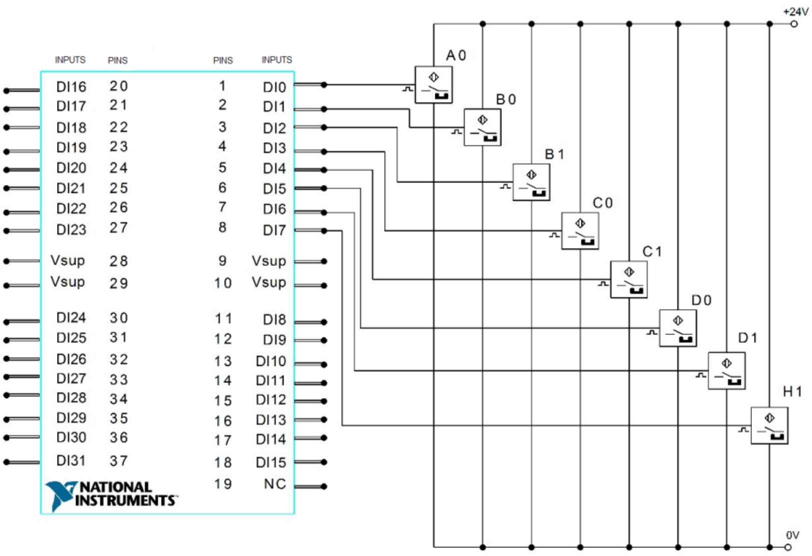

Figure 5. *Connecting of the digital inputs*

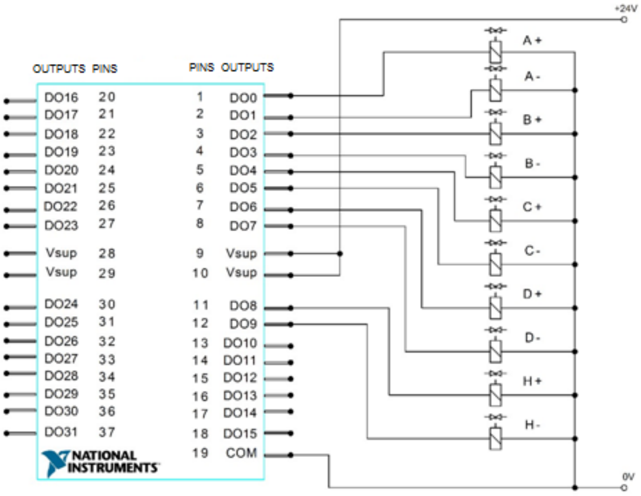

Figure 6. *Connecting of the digital outputs*

To communicate with the controller, which also represents the server, it is necessary for the client to possess a client application in which, first of all, we need to define the IP address of the controller and communication port. The client, by sending the appropriate commands through the Internet, via the controller, indirectly controls the pneumatic circular manipulator because the control of the cylinders piston rod is done by the controller. The client application is shown in Fig. 7. There is three modes available for the client – start one cycle (Fig. 7, the START 1 CYCLE button), start five cycles (Fig. 7, the START 5 CYCLE button) and start automatic mode (Fig. 7, AUT switch). Termination of work in automatic mode can be performed by turning off the AUT switch. In order to secure the device in the application are placed a total stop switch (Fig. 7, the button TOTAL STOP), which allows the execution of the program and then sets the actuators of the device in the safest position for the operator and the environment, as well as a stop button (Fig. 7, button STOP), which interrupts the execution of the program but only after completing his cycle. If the client activates any of two types of management at the same time, the cycle will be performed only once.

4. CONCLUSION

This paper presents the practical realization of the new experimental facility called pneumatic circular manipulator which is a very suitable didactic tool for those who deal with pneumatic control with a number of actuators for practical training (if they do not have adequate equipment in its educational institution, or if they want to learn more about this area) since it has the ability of remote control, via the Internet. In addition, this paper presents the possibility of remote control using CompactRIO controller, thus eliminating the need for additional server computer what was the main drawback of the existing system. Using CompactRIO controller, the programming of the system is facilitated instead, so far used, PLC and serial communication. CompactRIO programming is performed in LabVIEW (which is used for creating the client application) and there is no need to use additional programming languages.

Figure 7. *Client application*

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Using of remote controlled pneumatic spring in teaching[1]

Vule Reljić[2], Predrag Vidicki[3], Brajan Bajči[2], Dragan Šešlija[2] and Jovan Šulc[2]
[2] Faculty of technical sciences/Chair of Mechatronics, Robotics and Automation, Novi Sad,Serbia
[3] Faculty of technical sciences/Chair of Production Systems, Organization and Management, Novi Sad, Serbia
e-mail vuketa90@uns.ac.rs

Abstract: *The paper presents application of a new didactic resource - the remote controlled pneumatic spring in teaching at the Faculty of Technical Sciences Novi Sad in studies of Mechatronics and Industrial engineering. The paper provides basic theoretical background and description of the developed experiment as well as results of the student evaluation related to design, quality of use and application results of the presented remote experiment.*

Keywords: *remote experiments;pneumatic spring; evaluation*

1. INTRODUCTION

Remote laboratories become very important for a large number of higher education institutions, especially those that teach students in the field of Mechatronics [1] and Industrial engineering. Access to the modern laboratory equipment is a necessary prerequisite for quality of teaching and scientific research. Remote access is particularly important for institutions that are not able to independently provide the adequate equipment or, in terms of utilization, can not justify investment in expensive laboratory equipment. Remote access to laboratories is very important for the frequently marginalized group of people with special needs and for some it is the only means of access. The Faculty of Technical Sciences in Novi Sad, through participation in the Nerela Tempus project [2], provided the necessary equipment and installed the several experimental facilities with possibility of remote access. One of the developed experiments is shown in the next chapter.

2. DESCRIPTION OF EXPERIMENT

Remote controlled pneumatic spring is designed to simulate operation of mechanical springs under compression load, under different conditions using double acting pneumatic cylinders.

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Different conditions are obtained by changing the parameters which describe operation of spring. It is necessary to possess certain theoretical knowledge in order to achieve this.

2.1. Theoretical background

The force needed to extend or compress a spring by some distance is proportional to that distance (Hooke's law). It is stated with formula 1:

$$F = k \cdot x \quad [N], \tag{1}$$

where is k coefficient of spring stiffness and x elongationor distance from balance. Coefficient of spring stiffness is calculated from spring's geometry and shear modulus using formula 2:

$$k = \frac{G \cdot d^4}{8 \cdot n \cdot D^3} \quad \left[\frac{N}{m}\right], \tag{2}$$

where is G shear modulus of material, D mean diametar of spring, d spring wire diametar and n number of active coils.On the other side, a force which is created by compressed air in pneumatic cylindersis calculated using formula 3:

$$F = p \cdot A \quad [N], \tag{3}$$

where is p pressure in pneumatic system and A cross sectional area, which is calculated using formula 4:

$$A = \frac{d_1{}^2 \cdot \pi}{4} \quad [m^2]. \tag{4}$$

Diametar of pneumatic cylinderis marked with d_1. At the end, with the combination of the previous formulas (it's necessary to say that frictional force is neglected), the compressed air pressure in the piston side of pneumatic cylinder, in the transformation of forces in the pressure, or mechanical energy to pneumatic energy, can be easily calculated according to the formula 5:

$$p = \frac{G \cdot d^4 \cdot x}{2 \cdot \pi \cdot d_1^2 \cdot D^3 \cdot n} \quad [Pa]. \tag{5}$$

2.2. Description of experiment and activities for execution of the experiment

Practical implementation of remote controlled pneumatic spring is shown in Fig.1a. Programmable logic controller (PLC) is used for control of spring. PLC controls the operation of double acting pneumatic cylinders according to the predefined algorithm (it is based on electropneumatic control scheme which is shown in Fig. 1b) and thereby allows the simulation of spring.

As can be seen on control scheme, in initial moment, both monostable electrical actuated valve 3/2 (1V1 and 1V2) are actuated. Compressed air (a value of pressure is 6 bar) is brought from source to piston rod side of cylinder B and it is in a retracted position. On same way, compressed air (a value of pressure is equal value of secondary pressure from electrical pressure regulator and it lower than 6 bar) is brought to piston side of cylinder A, through electrical pressure regulator, and it is in a drawn position. When PLC deactives valve 1V2, cylinder B performs work stroke and pushes cylinder A by compressing air in its piston side. On that way, cylinder B simulates a force whish is needed to move the spring from its equilibrium position. The air in the piston side of the cylinder A is compressed (there is no possibility that the air released into the atmosphere because there is a non-return valve between the valve 1V1 and the pressure regulator 1V3). On that way, cylinder A simulates a mechanical spring. When PLC reactives valve 1V2 after defined time, cyilinder A pushes cylinder B which performs return stroke and returns in its retracted position. This is one cycle of simulation operation of mechanical springs.

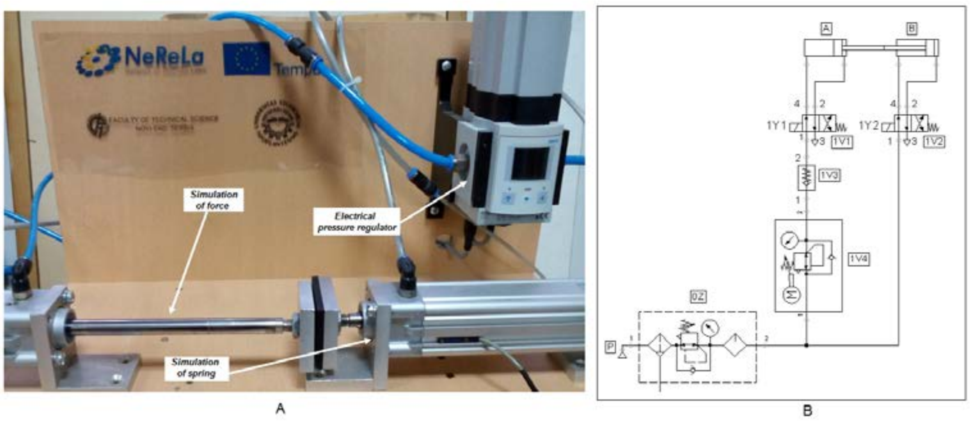

Figure 1. A) *Practical implementation of pneumatic spring* **B)** *Electropneumatic control scheme*

Remote control of pneumatic spring is enabled using applications which is made in object-oriented programmable language called LabVIEW. All users (clients) have to install client's application, which is shown if Fig. 2, on their computer. Clients must have username and password which is obtained by sending a request on the e-mail, too. After entering the parameters that describe the characteristics of the spring, clients is obtained a calculated value of secondary pressure of electrical pressure regulator and it is shown in application. This value forwarded to the server computer via the Internet. Server serves as a link between the client and the PLC. If it is correct, server forwards the received data to the PLC via serial communication. After receiving data, PLC controls the operation of pneumatic cylinders according to the previously described algorithm, and thus executes the process of remote control. Clients can monitor what is happening in system in live because web camera is placed near the system.

3. EVALUATION OF TEACHING MODULE

At the Faculty of Technical Sciences in Novi Sad, the remote-controlled pneumatic spring was used as a remote experiment in teaching of Mechatronics and Industrial engineering in courses Components of technological systems and Automation of work processes, respectively, in teaching modul Fundamentals of pneumatic systems. Before the experiment, the teacher presented basic theoretical background and necessary explanations to the students. The remote experiment set up was in the lab and students accessed it remotely, over the Internet, individually or in pairs. Upon completion of the experiment, each student completed the evaluation questionnaire. A total of the 60 students completed the questionnaire, 37 students of Mechatronics and 23 students of Industrial engineering.

Evaluation questionnaire consists of the 15 questions and the space provided for comments [5-6]. Questions are answered by numbers from 1 to 5 that must be entered on the appropriate place, where: 5 represents strongly agree and 1 represents strongly disagree. Questions in the questionnaire can be divided into three categories. Questions in first category are related to the design of the experiment, that is, whether the experiment is prepared at the appropriate technical level, whether it is easy for understanding and using, how useful and understandable attached instructions are and whether the experiment allows collection and storage of necessary experimental results.

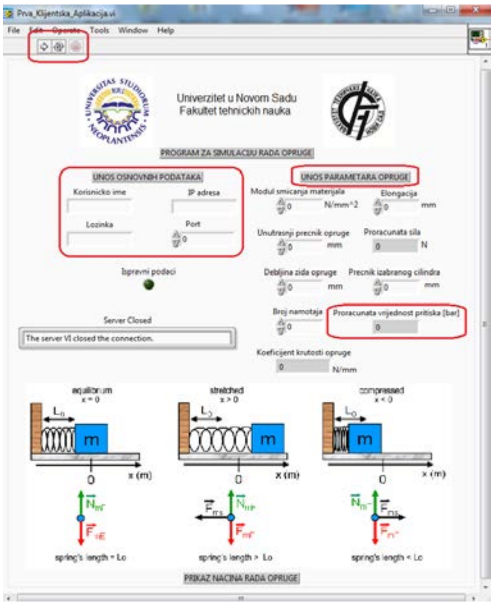

Figure 2. *Clients' application*

Second group of questions is related to the experience and usage quality of the remote experiment. It includes questions about the simplicity of user interface, the speed of response to commands, the quality of visual display and the appearance of problems and delays in execution of the experiment. The third group of questions is focused on the results of application, that is, whether the experiment help students to better understand the theoretical fundamentals, goals and outcomes of the teaching modules, whether it help them to better understand and use laboratory equipment and would they like to use remote experiments in other teaching modules.

Summary score for design of the experiment was 4.69 out of 5. Students of Mechatronics evaluated design with 4.72 out of 5, and students of Industrial engineering evaluated it with 4.65 out of 5. By examination of individual questions it can be noted that students of Industrial engineering evaluated question about simplicity and usage of the experiment and question on clarity of written instructions significantly worse than students of Mechatronics, which implies the lack of adequate knowledge in the field.

Summary score on quality of use for the remote experiment is 4.75 out of 5. Students of Mechatronics evaluated it with 4.83 out of 5, and students of Industrial engineering evaluated it with 4.67 out of 5. Students of Industrial engineering significantly worse evaluated the question about simplicity of user interface and two Industrial engineering students experienced some technical problems in the execution of remote experiment.

Summary score for application results of the remote experiment is 4.63 out of 5. Mechatronics students expressed a greater desire than Industrial engineering students to use remote experiments, while Industrial engineering students, probably because of the lower prior knowledge, demonstrated that remote experiment helped them more in understanding of the theoretical foundations.

Overall results of student evaluations are shown in Table 1.

Table 2. *Summary results of student evaluation*

Design of the experiment	II	ME
The remote experiment is easy to understand and use.	4.57	4.76
The remote experiment is prepared at the appropriate technical level.	4.70	4.73
The written manual is understandable and helpful.	4.39	4.76
Before starting I received an adequate explanation from the teacher	4.96	4.97
The experiment allows collection and memorization of the results.	4.65	4.41
Quality of use		
User interface of the remote experiment is easy to use.	4.70	4.95
Response speed to user actions in the experiment is satisfactory.	4.61	4.73
Quality of the visual display during the experiment is satisfactory.	4.74	4.68
During the work with the remote experiment there was no problems either stoppages.	4.65	4.97
Application results		
The remote experiment enabled me to better understand theoretical basis, objectives and outcomes of teaching modules.	4.70	4.65
The remote experiment helps me to better understand and use laboratory equipment.	4.52	4.57
I would like to use the remote experiments in other lessons.	4.61	4.73

Most common positive comments of the students are related to the possibility of remote access to the experiment and aid in understanding of the theory, while the negative comments are directed at the impossibility of simultaneous access to the experiment by a multiple users and inability of the experiment executor to independently eliminate the eventual malfunction. Several students proposed development of an mobile applications for the control of remote experiments.

4. CONCLUSION

Remote-controlled pneumatic spring is an experiment designed for the high school students and the students of technical universities, primarily to those that are dealing with automation. It is expected that by implementation of this experiment a pupil or a student is able to better understand the fundamentals of pneumatic systems, the basics of automatic control systems, the basics of programming and application of the programmable logic controllers and the basics of springs theory, as well as to understand the concept of transformation of forces to pressure or mechanical to pneumatic energy.

Based on the positive assessment of the experiment by the students, the positive comments about the possibility of remote access and help in understanding the theory, it can be concluded that the experiment has fully met the expectations and, as such, it became a important didactic tool for teaching at the Faculty of Technical Sciences in Novi Sad. This experiment can also be used by the students of Automation and control systems, Manufacturing and Design engineering, etc.

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Computable functions and lambda calculus

Marko Stanković[1]
[1]Pedagogical Faculty in Vranje, University of Niš, Vranje, Serbia
e-mail markos@ucfak.ni.ac.rs

Abstract: *The lambda calculus is one of the more known formulizations of the effective procedure and is widely applied in functional programing. In relation to this, the main goal of this paper is to show a way of interpreting some computable functions via lambda terms. Thus, the paper gives a special insight into interpreting Boolean functions, Church's numerals and the most important arithmetic operations with them. A review of some combinators which have been proven to be useful when dealing with lambda terms is also given. Finally, an idea of proofs is presented and it shows that the class of lambda computable functions is equal to the class of primitive recursive functions.*

Keywords: *lambda calculus; lambda definability; Church numerals; computability*

1. INTRODUCTION

The λ-calculus is a collection of several formal systems, based on notation devised by Alonzo Church during the 1930's. It is made to describe the simplest ways in which operators and functions can be combined so as to get new operators.

In practice, λ-system ha an infinitely big grammar structure, depending on what it is used, Some have additional symbols of constants, but most was achieved through syntax limitations (for example, by restricting them to exactly specified types).

In the development of the algorithm theory there have been several formulations of an effective procedure. The most famous formulations, apart from λ-calculus, are certainly Turing's machines, Unlimited Register Machine (URM), primitive recursive functions, μ-recurrsive functions, Post's systems etc. Although they all seem completely different at first, all procedures determine one and the same class of functions.

1.1. Primitive recursive functions

We say that the function $f: \mathbb{N}^k \to \mathbb{N}$ is computable only and if only there is an effective procedure that, given any k–tuple $(x_1, \dots, x_k)$ of natural numbers, will produce $f(x_1, \dots, x_k)$ (Enderton, 2002:209).

Definition. Class of primitive recursive functions contains initial functions:

- Zero function $z(n) = 0$, for each $n \in \mathbb{N}$,
- Successor of a natural number function n, $s(n) = n + 1$ and
- Projection function $u_i^n(x_1, \dots, x_n) = x_i$, $1 \leq i \leq n$,

And all functions which are derived through final number of applications of the basic operations:

- *compositions*, i.e. if the functions $g: \mathbb{N}^m \to \mathbb{N}$ i $h_1, \dots, h_m: \mathbb{N}^k \to \mathbb{N}$ are already defined, the function $f: \mathbb{N}^k \to \mathbb{N}$ is also defined so that it stands for all $(x_1, \dots, x_k) \in \mathbb{N}^k$: $f(x_1, \dots, x_k) = g\big(h_1(x_1, \dots, x_k), \dots, h_m(x_1, \dots, x_k)\big)$ and
- *primitive recursions*, i.e. if the functions $g: \mathbb{N}^m \to \mathbb{N}$ and $h: \mathbb{N}^{m+2} \to \mathbb{N}$ are already defined the function $f: \mathbb{N}^{m+1} \to \mathbb{N}$ is also defined so that it stands for all $(x_1, \dots, x_m) \in \mathbb{N}^m$:
$$f(0, x_1, \dots, x_m) = \quad g(x_1, \dots, x_m),$$
$$f(n+1, x_1, \dots, x_m) = \quad h(f(n, x_1, \dots, x_m), n, x_1, \dots, x_m) \text{ for } n \in \mathbb{N}.$$

Limitation of this class is its closure to the operation of minimization which must be bounded. “By eliminating this limitation (through the introduction of the unbounded minimization) we get a class of *partially recursive functions*, which coincides with computable Turing functions” (Ognjanović, Krdžavac, 2004: 27).

2. CHURCH’S NUMERALS, DEFINABILITY

2.1. Natural numbers

λ-calculus is a theory of functions and algorithms, so the only possible way for interpreting numbers in λ-computations is regarding the same as if they were algorithms. However, a number is not an algorithm, but a datum. Although the situations may seem impossible, it is still possible to regard a number for an algorithm. For example, number 2 can be “built” by applying zero twice in the successor function. Appropriate λ-term which describes this situation is $\lambda fx.f(fx)$. It is important to stress that the algorithm is independent from the actualities of zero and successor function.

Therefore, natural number n (and zero), marked n, is interpreted as $\underline{n} \equiv \lambda fx.f^n x$, where f^n is defined in the following way: $f^0 x = x$; $f^{k+1} x = f(f^k x)$. This type of natural number coding was created by Alonzo Church and terms are named because of him as Church’s terms. Church’s coding is one of many possible ways (there are also Mogensen-Scott coding, which got its name by Torben Mogensen and Dana Scott). The technique in which data is seen as algorithms can be expanded on all (inductively defined) data.

2.2. Lambda definability

For a function which can be interpreted by λ-terms we say is λ-definable and we formally define it in the following way.

Definition (λ-definability). We say that the function that partially recursive function $f: \mathbb{N}^k \to \mathbb{N}$ is λ-definable if for some term F stands:

$$f(n_1, \dots, n_k) = m \Rightarrow F\underline{c}_{n_1}, \dots, \underline{c}_{n_k} =_\beta \underline{c}_m$$
$$f(n_1, \dots, n_k) = \uparrow \quad \Rightarrow F\underline{c}_{n_1}, \dots, \underline{c}_{n_k} \text{has no normal form.}$$

We say that the term, λ-defines function f.

Also, it stands that

$$f(n_1, \dots, n_k) = m \Leftrightarrow F\underline{c}_{n_1}, \dots, \underline{c}_{n_k} =_\beta \underline{c}_m$$
$$f(n_1, \dots, n_k) = \uparrow \quad \Leftrightarrow F\underline{c}_{n_1}, \dots, \underline{c}_{n_k} \text{has no normal form.}$$

and

$f(n_1, \dots, n_k) = \downarrow \Rightarrow F\underline{c}_{n_1}, \dots, \underline{c}_{n_k} =_\beta \underline{c}_{f(n_1, \dots, n_k)}$.

Therefore, in much simpler case when $f: \mathbb{N} \to \mathbb{N}$ for f we say it is λ-definable only and only if there is a λ-term F so that $F(\underline{n}) =_\beta \underline{f(n)}$.

2.3. Boolean values

We define interpretations of Boolean values as $true$, $false$ and term which interprets if.

$$true \equiv \lambda xy.x \qquad false \equiv \lambda xy.y \qquad if \equiv \lambda pxy.pxy$$

In other words, $true$ is a function of two arguments which returns its first argument, and false is a function which returns its second argument. Term $ifPQR$ should be read "if P then Q else R". Also, it stands $ifPQR \rhd_\beta PQR$. Then, if $P = true$ we get:

$$if\ trueQR \rhd_\beta trueQR = (\lambda xy.x)QR \rhd_\beta (\lambda y.Q)R \rhd_\beta Q.$$

Similarly we get $iffalseQR \rhd_\beta R$. Previous deliberation stand for arbitrary term P so that $P \rhd_\beta true$ or $P \rhd_\beta false$.

Based on Church – Rosser theorem (Hindley, Seldin, 2008:14), it follows that $true \neq false$ because $true$ and $false$ are different normal forms. Conjunction, disjunction and negation we interpret:

$$\wedge \equiv \lambda pq.if\ pq\ false \qquad \vee \equiv \lambda pq.if\ p\ true\ q \qquad \neg \equiv \lambda p.if\ p\ false\ true$$

Definitions can be checked by simple calculations. For example, $\wedge\, true\, true \rhd_\beta true$. Often instead of $true$ we use **1**, and instead $false$ we use $\mathbf{0}$. "Notice that the Boolean $\mathbf{0}$ is the same term as the numeral $\underline{0}$, while Boolean **1** is different from the numeral $\underline{1}$" (Krivine, 1993:32).

3. ARITHEMTICS ON CHURCH'S NUMERALS

Let us define the interpretation of calculation functions with Church's numerals.

Function of *addition* we define as: $add \equiv \lambda mnfx.mf(nfx)$. Let us check the definition of adding in the following way:

$$\begin{aligned} add\ \underline{m}\underline{n} \equiv\ & \big(\lambda mnfx.mf(nfx)\big)\underline{m}\underline{n} \rhd_\beta \big(\lambda nfx.\underline{m}f(nfx)\big)\underline{n} \rhd_\beta \\ \rhd_\beta\ & \big(\lambda fx.\underline{m}f(\underline{n}fx)\big) \equiv \lambda fx.(\lambda gx.g^m x)f\big((\lambda hx.h^n x)fx\big) \rhd_\beta \\ \rhd_\beta\ & \lambda fx.(\lambda gx.g^m x)f\big((\lambda x.f^n x)x\big) \rhd_\beta \lambda fx.(\lambda gx.g^m x)f(f^n x) \rhd_\beta \\ \rhd_\beta\ & \lambda fx.(\lambda x.f^m x)(f^n x) \rhd_\beta \lambda fx.f^m(f^n x) \equiv \lambda fx.f^{m+n}x \equiv \underline{m+n} \end{aligned}$$

Function of *multiplication* we define as: $mult \equiv \lambda mnfx.m(nf)x$. Let us check the definition of multiplication in the following way:

$$\begin{aligned} mult\ \underline{m}\underline{n} \equiv\ & (\lambda mnfx.m(nf)x)\underline{m}\underline{n} \rhd_\beta (\lambda nfx.\underline{m}(nf)x)\underline{n} \rhd_\beta \lambda fx.\underline{m}f(\underline{n}f)x \\ \equiv\ & \lambda fx.(\lambda gx.g^m x)(\underline{n}f)x \rhd_\beta \lambda fx.(\underline{n}\,f)^m x \equiv \lambda fx.\big((\lambda hx.h^n x)\,f\big)^m x \\ \rhd_\beta\ & \lambda fx.(\lambda x.f^n x\,)^m x \rhd_\beta \lambda fx.(f^n)^m x \equiv \lambda fx.f^{m\cdot n}x \equiv \underline{m\cdot n} \end{aligned}$$

Exponentiation is defined by term $expt \equiv \lambda mnfx.nmfx$.

Function of *successor* of a natural number is defined with $succ \equiv \lambda nfx.f(nfx)$. Function $succ$ is defined in such a way so that reduction $succ\ \underline{n} \rhd_\beta \underline{n+1}$ stand. This is discussed in more detailed manner by Mazzola, Milmeiste and Weissmann, (2005:327).

Function which checks whether a numeral *equal to zero* is interpreted as $iszero \equiv \lambda n.n(\lambda x.\mathbf{0})\mathbf{1}$. Function is defined in such manner that reductions $iszero\ \underline{0} \rhd_\beta \mathbf{1}$ and

$iszero\ \underline{(n+1)} \rhd_{\beta} \mathbf{0}$.

Function *predecessor* of a natural number can be defined by a combination of some functions which were introduced before. Ordered pair (a, b) in λ-calculus can be interpreted by term $\lambda z.zab$. From the ordered pair we can isolate the first (second) element by using the $\mathbf{1}$ ($\mathbf{0}$). Function $\Phi \equiv \left(\lambda pz.z\big(succ(p\mathbf{1})\big)(p\mathbf{1})\right)$ is generated from the ordered pair $(n, n-1)$ (which is marked shortly with p), ordered pair $(n+1, n-1)$.

Sub-expression $p\mathbf{1}$ isolates the first element from the pair p. New pair is formed using this element, which in this case is enlarged by 1, while the second element is just copied in the new pair.

Predecessor of the number n is obtained by applying n times the function Φ on the ordered pair $(\lambda z.z\underline{0}\underline{0})$ and then it the second element of the ordered pair is isolated $pred \equiv (\lambda n.n\Phi(\lambda z.z\underline{0}\underline{0})\mathbf{0})$.

It should be noted that the value of the function $pred$ when it is applied to zero, is zero.

Function of *subtraction* is defined as $subtract\ \underline{m}\underline{n} \equiv \underline{n}\ pred\ \underline{m}$. The function will n times apply the function $pred$ on the interpretation of number m, which will give the desired result.

For example, we can now interpret the function of natural numbers f in λ-calculus. Let us presume that the function f is set with

$$f(n,m) = \begin{cases} 2+4m, & n=2, n=0, \\ n+5m, & \text{otherwise,} \end{cases}$$

then the appropriate λ-term[1] is:

$$\lambda nm.if\left(\vee\left(iszero\big(pred(pred\ n)\big)\right)(iszero\ n)\right)\big(add\ \underline{2}(mult\ m\ \underline{4})\big)\big(add\ n(mult\ \underline{5}\ m)\big).$$

Function for testing *equality* and *inequality*. Function which tests whether number x is bigger or equal to y is defined as $G \equiv \big(\lambda xy.iszero(x\ pred\ y)\big)$. This function is applies x times the function of predecessor on y and if the result is zero, then it follows that $x \geq y$. If $x \geq y$ and $y \geq x$, then $x = y$. This brings us to the definition of the function E which tests the equality of two numbers: $E \equiv \left(\lambda xy.\wedge\big(iszero(x\ pred\ y)\big)\big(iszero(y\ pred\ x)\big)\right)$. Interpretation of the functions $x > y$, $x < y$ or $x \leq y$ can be similarly defined.

4. COMPUTABLE FUNCTIONS IN LAMBDA CALCULUS

4.1. Combinators

Combinator is λ-term with no free variables. Intuitively, combinators can be understood as "completely determined operations", because they have no free variables.

Definition: For the term Q we say it is a fix point of term M if it stands $MQ =_{\beta} Q$.

Table 1. *Combinators*

$K \equiv \lambda x.(\lambda y.x)$	Combinator which forms a constant function

[1]Due to simplification $\vee$ is not substituted by appropriate term. Similar stands for function E later on in the text.

$B \equiv \lambda x.\left(\lambda y.\left(\lambda z.x(yz)\right)\right)$	Combinator which combines two functions
$S \equiv \lambda x.\left(\lambda y.\left(\lambda z.(xz)(yz)\right)\right)$	Operator of the stronger compositions
$C \equiv \lambda x.\left(\lambda y.(\lambda z.xzy)\right)$	Combinator which switches places with arguments
$Y \equiv \lambda f.\left(\lambda x.f(xx)\right)\left(\lambda x.f(xx)\right)$	Curry's combinator
$\Theta \equiv \left(\lambda x.\left(\lambda f.\left(f(xxf)\right)\right)\right)\left(\lambda x.\left(\lambda f.\left(f(xxf)\right)\right)\right)$	Turing's combinator

Curry's combinaotr Y has the property reduce YX and $X(YX)$ to the same term. Turing's combinator has the property that for each λ-term X and ΘX are reduced to $X(\Theta X)$. For more details see Hindley and Seldin, (2008:34).

Theorem (fixed point theorem): Every λ-term has at least one fixed point.

Proof: It should be proven that for every term F there is term X so that $FX = X$. Let $W \equiv \lambda x.F(xx)$ and $X \equiv WW$. Then $X \equiv WW \equiv \left(\lambda x.F(xx)\right)W = F(WW) = FX$.

4.2. Computability and definability

Theorem: Function f is computable if and only if it is λ-definable.

Proof: Let us show that initial functions, functions obtained by composition and recursion of initial functions, are λ-definable function. Initial function we can interpret in the following way:

- function $z(n) = 0$, is interpreted by term $\underline{0}$,
- function $s(x) = x + 1$ is interpreted by function $succ$,
- function of projection $u_i^n(x_1, \dots, x_n) = x_i$, $1 \le i \le n$ is interpreted with $u_i^n \equiv \lambda x_1, \dots, x_n.x_i$.

Let f be function with k variables and let $g_1, \dots, g_k$ be λ–definable function with n variables. Then $h(x_1, \dots, x_n) = f\left(g_1(x_1, \dots, x_n), \dots, g_k(x_1, \dots, x_n)\right)$ function obtained by composition of the function f and $g_1, \dots, g_k$. If F, $G_1, \dots, G_k$ are terms which interpret functions $f, g_1, \dots, g_k$, then function h is λ-definable and term which represents it is

$$H \equiv \lambda x_1, \dots, x_n.F\left(G_1(x_1, \dots, x_n), \dots, G_k(x_1, \dots, x_n)\right).$$

Now we will present the idea on how recursion can be interpreted in λ-calculus, and details of the proof can be seen in Hindley and Seldin, (2008:50). Let h be λ-definable function and let H be her interpretation in λ-calculus. Term F which interprets function f is defined in the following manner: $F \equiv \lambda ux_1, \dots x_n.(\boldsymbol{R}(Hx_1, \dots x_n)(\lambda uv.Huvx_1, \dots x_n)u)$, where $\boldsymbol{R}$ stands for recursive combinatory. This combinatory has the property that for all terms X, Y and k it stands $\boldsymbol{R}XY\ \underline{0} \rhd_\beta X$ and $\boldsymbol{R}XY\ \underline{(k+1)} \rhd_\beta Y\underline{k}(\boldsymbol{RXY}\ \underline{k})$.

Let G be the interpretation of the function g. Than the operation of minimization $\min\limits_m(g(x_1, \dots x_n, m) = 0)$ is interpreted by term

$$\left(Y\left(\lambda f.\lambda m.if\left(iszero\left(G(x_1, \dots x_n, \underline{m})\right)\right)\underline{m}\left(f(succ\ \underline{m})\right)\right)\right)\underline{0}.$$

This proves that the class of λ-definable functions contains all the initial functions and that it is closed for composition, recursion and minimization. Therefore, this class contains all computable functions. Let us present the idea of the reverse claim.

Let us suppose that function f is represented by λ-term X. If f is n-ary function, than let us suppose that her argument is $(x_1, \dots, x_n)$ and let us write down the term $X\underline{x_1} \dots \underline{x_n}$. Than reductions are done until we reach a numeral and we return this as an answer; by the way, the function is not defined. Based on Church's thesis, it follows that the function is computable.

5. CONCLUSION

Although Alonzo Church had designed λ-calculation as a basis for constructive logic, this formalization has become one of the models for computating functions with tremendous application in informatics. Because of his extreme expressiveness, lambda terms can express complex computer data such as numbers, Boolean values, binary trees and similar, while for computation of function β-reduction is used. Recursive functions can be interpreted based in the Fixed-point theorem and Y combinator. The connection between λ-calculus and programming is best shown in correspondence between λ-calculus and program language ALGOL 60 (Landin, 1965), as well as the fact that λ-computaion forms the basis of the program language LISP. Michaelson (2011) writes about the basics of functional programing and lambda computation.

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Mathematica as program support in the integral calculations

Biljana Zlatanovska[1], Aleksandra Stojanova[1], Mirjana Kocaleva[1], Natasha Stojkovikj[1] and Aleksandar Krstev[1]
[1] Faculty of computer science, "Goce Delcev" University, Stip, Macedonia
e-mail {biljana.zlatanovska, aleksandra.stojanova, mirjana.kocaleva, natasa.maksimova, aleksandar.krstev}@ugd.edu.mk

Abstract: *In this paper, we give a connection between the mathematical notions and using the computer as educational support at university level. Specifically, mathematical notions used in integral calculations will be explained with help of computer program. The notions, indefinite and definite integral, their calculations and their applications can be easily understand using the computer programs for their presentation. Images obtained with computer programs allows the students to better understand and learn integrals and also give them appropriate training to use this knowledge for current real problems. In this paper we will use mathematical package Mathematica, as computer program to help learning integral calculations.*

Keywords: *Indefinite integral, definite integral, Mathematica, application of integral calculations*

1. INTRODUCTION

In education at university level the most important is the relationship between students and teachers i.e. the way how to transfer information and knowledge from teacher to student. The transfer must be understandable and acceptable from students. This question is the basis of any science, even in mathematics. The development of computer science allows the mathematics teachers to make a connection between computer and mathematics for approaching of mathematical abstractions to the level of understanding among students.

Mathematics as a science especially at university level today cannot be imagined without the use of computer. Some bigger calculations, mathematical concepts and graphic visualizations that previously were treated as an abstraction now with a computer can easily be executed and presented. Also, the calculations which required too much time, as well as 2D graphical visualizations that have been drew manually on the board, can be made with computer in a very short time with much better looking and with wide range of tools for manipulating them. For this we need mathematical packages such as Mathematica [1], [2], [4], [5], [8], MatLab, etc. They are a great tool for education and provide significant improvement in the relationship teacher - student during lectures, as well as for independent work of students and their effective learning of teaching material.

In this paper we will use mathematical package Mathematica, as computer program to help learning integral calculations in the course Mathematics 2 [2], [6], [7]. The notion definite integrals, its calculation, and its application are a major problem for students and an even greater problem on the teacher how to explain that. Understanding of these notions is much easier using the computer support during teaching hours. Images obtained with computer programs allows the students to better understand and learn integrals and also give them appropriate training to use this knowledge for current real problems.

2. INDEFINITE AND DEFINITE INTEGRAL

Finding a solution $F(x)+C$ of an indefinite integral $\int f(x)\,dx$ should not be a problem for the students, but can be very time consuming. Sometimes, the choice of the method or choice of replacement for solving the integral is a real problem. Therefore, using Mathematica for solving indefinite integral is very simple. For example, the code for solving indefinite integral $\int \frac{2x-8}{\sqrt{1-x-x^2}}dx$ with more complex integrand function is $\int \frac{2*x-8}{\sqrt{1-x-x^2}}dx$ with solution in Mathematica, $2(-\sqrt{1-x-x^2}+\frac{9}{2}ArcSin[\frac{-1-2x}{\sqrt{5}}])$.

Analogue, the indefinite integral $\int \frac{x^7+x^3}{x^{12}-2x^4+1}dx$ have code $\int \frac{x^7+x^3}{x^{12}-2*x^4+1}dx$ with solution in Mathematica

$$\frac{1}{20}(-(5+2\sqrt{5})\,Log[-1+\sqrt{5}-2x^4]+10\,Log[-1+x^4]+(-5+2\sqrt{5})\,Log[-1+\sqrt{5}-2x^4])$$

where $Log[x]$ is $\ln x$. To note that Mathematica in the solution of indefinite integral omitted the constant C which is usually added to mark the set of functions as solution of indefinite integral.

For given not negative integral function $f(x)$ defined on a closed interval $[a,b]$, a definite integral $\int_a^b f(x)\,dx$ is defined as surface area of the revolution in xy - plane bounded by the graph of the function $f(x)$, the vertical lines $x=a, x=b$ and the x - axis. For example, the definite integral $\int_0^8 (\sqrt{2x}+\sqrt[3]{x})\,dx$ with code $\int_0^8 (\sqrt{2*x}+\sqrt[3]{x})\,dx$ has the solution $\frac{100}{3}$ in Mathematica. The geometrical interpretation is: the surface area of the revolution in xy - plane bounded by the not negative integral function $f(x)=\sqrt{2x}+\sqrt[3]{x}$, the vertical lines $x=a, x=b$ and x-axis is $\frac{100}{3}$ square units, is shown in figure 1,

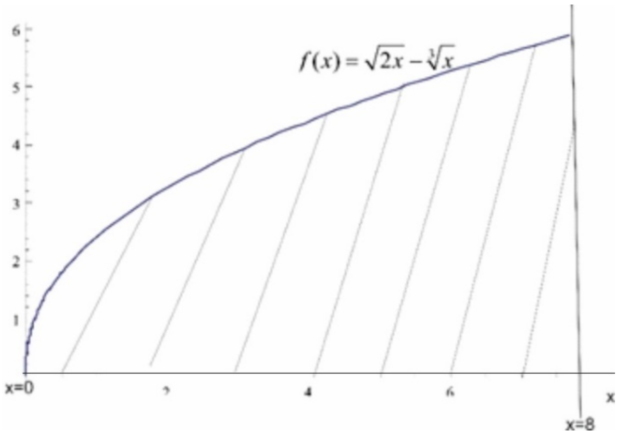


Figure 1. *The region for the definite integral* $\int_0^8 (\sqrt{2x}+\sqrt[3]{x})\,dx$

If the solution of definite integral is not integer, finite decimal number or cannot be represented as fractions, then we are changing the code in Mathematica. For example, for the definite integral $\int_0^{\frac{\pi}{4}} x\sqrt{tg\,x}\,dx$ with code $\int_0^{\frac{\pi}{4}} x * Sqrt[Tan[x]]\,dx\,//\,N$ we have the solution 0.233181 which is surface area of the revolution in the xy-plane bounded by the graph of the function $f(x) = x\sqrt{tg\,x}$, the vertical lines $x=0, x=\frac{\pi}{4}$ and x - axis is shown in figure 2.

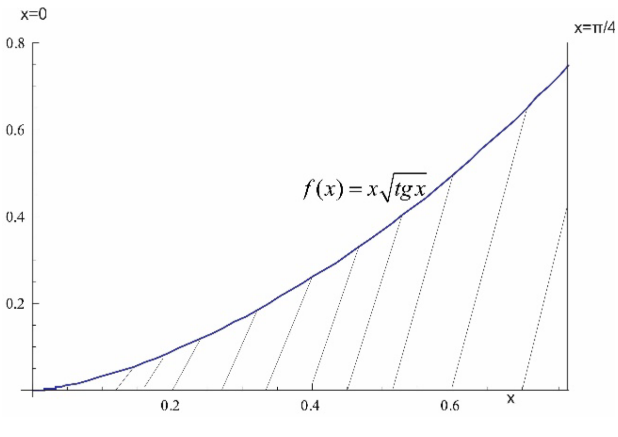


Figure 2. *The region for the definite integral* $\int_0^{\frac{\pi}{4}} x\sqrt{tg\,x}\,dx$

3. APPLICATIONS OF INTEGRAL CALCULATIONS IN GEOMETRY

Applications of integral calculations for calculate the surface area of planar figure that is bounded by the graphs of $f(x), g(x)\,(f(x) \geq g(x), x \in [a,b])$ and the vertical lines $x = a, x = b$ is given with the definite integral $\int_a^b (f(x) - g(x))\,dx$. For example, the surface area of planar figure that is bounded by the graphs of $f(x) = 2 - x^2, g^3(x) = x^2$ can be calculated in three steps as follows:

- We define the bounds of definite integral by finding the intersection of the curves $f(x) = 2 - x^2, g^3(x) = x^2$ with the code $Solve[y == 2 - x^2, y^3 == x^2, \{x, y\}]$ where we take into account only the real solutions $(-1,-1), (1,1)$;
- We draw the graphs of the functions $f(x) = 2 - x^2, g(x) = x^{\frac{2}{3}}$ as in figure 3 in order to find the area of integration. The function $f(x) = 2 - x^2$ is marked with blue color and the function $g(x) = x^{\frac{2}{3}}$ with red color.
- We calculate the definite integral $\int_{-1}^{1} (2 - x^2 - x^{\frac{2}{3}})\,dx$ with code $\int_{-1}^{1} (2 - x^2 - \sqrt[3]{x^2})\,dx$ which gives solution $\frac{32}{15}$ square units.

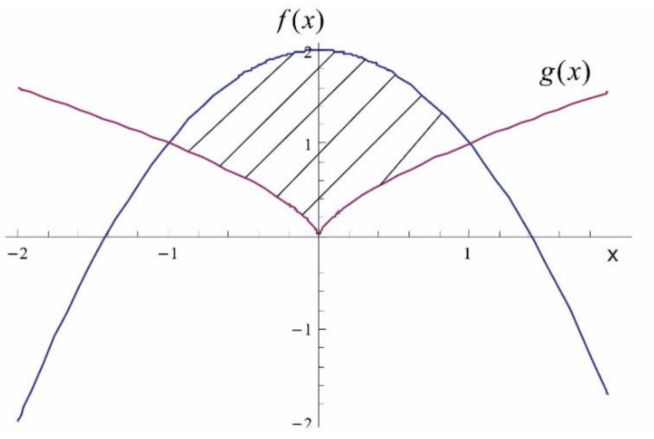


Figure 3. *The graphs of the functions* $f(x) = 2 - x^2, g(x) = x^{\frac{2}{3}}$

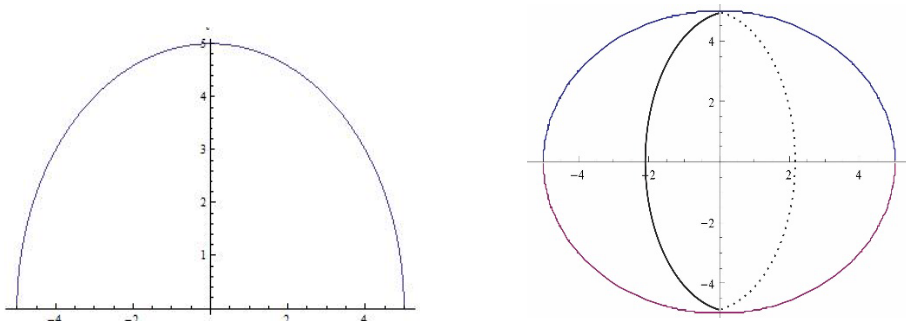
The integral calculation has application for calculating the arc length of curve $y = f(x)$ between two points in xy-plane with first coordinates $x = a, x = b, a < b$ and it is calculated with a definite integral $\int_a^b \sqrt{1+f'^2(x)}\,dx$. For presenting, we will use the curve with equation $y = \ln x$. For this curve we will calculate the arc length in the interval of $\sqrt{3}$ to $\sqrt{8}$ by the formula $\int_{\sqrt{3}}^{\sqrt{8}} \sqrt{1+(\frac{1}{x})^2}\,dx$ for $y' = \frac{1}{x}$. The code in Mathematica is $\int_{\sqrt{3}}^{\sqrt{8}} \sqrt{1+\frac{1}{x^2}}\,dx$, where $\partial_x Log = \frac{1}{8}$ give the solution $\frac{1}{2}(2+Log[\frac{3}{2}])$ for $Log[\frac{3}{2}]$ or $\ln\frac{3}{2}$.

Use of Mathematica in integral calculations for calculate a volume of rotary body and area of rotary body layer, gives more precise graphic visualization of the objects in 3D space.

The task to find the volume of the rotary body obtained with rotating of the graph of the curve $y = f(x)$ around x - axis on the interval $[a,b]$ is solved with the definite integrals $\pi\int_a^b f^2(x)\,dx$ and its surface area is obtained by definite integral $2\pi\int_a^b f(x)\sqrt{1+f'^2(x)}\,dx$, respectively.

For example if we want to find the volume of the rotary body and its surface area obtained with rotating of the graph of the curve around x - axis is the semicircle with the equation $y = \sqrt{a^2 - x^2}$, where $a > 0$ is its radius. In figure 4 a) is shown the graph of function $y = \sqrt{5^2 - x^2}$ and in figure 4 b) is shown the rotation around x – axis where rotary body is the ball.

Be brief and give most important conclusion from your paper. Do not use equations and figures here.



a) *b)*

Figure 4. *a) The graph for the curve* $y = \sqrt{5^2 - x^2}$ *b) rotating body - the ball*

By using integral calculation the volume of the ball is $\pi\int_{-a}^{a}(\sqrt{a^2-x^2})^2\,dx$ with code $\pi\int_{-a}^{a}(\sqrt{a^2-x^2})^2\,dx$ in Mathematica and has solution $\frac{4a^3\pi}{3}$ square units. The surface area is calculated with the definite integral $2\pi\int_{-a}^{a}\sqrt{a^2-x^2}\sqrt{1+(-\frac{x}{\sqrt{a^2-x^2}})^2}\,dx$ with code $2\pi\int_{-a}^{a}\sqrt{a^2-x^2}*\sqrt{1+(-\frac{x}{\sqrt{a^2-x^2}})^2}\,dx$ in Mathematica where the derivate of the function $y=\sqrt{a^2-x^2}$ with code $\partial_x\sqrt{a^2-x^2}$ is $-\frac{x}{\sqrt{a^2-x^2}}$. The solution of the definite integral is $4a\pi\text{Abs}[a]$ where for $a>0$ is obtained $Abs[a]=|a|=a$. Finally, the solution of the definite integral is $4a\pi Abs[a]=4\pi a^2$ that is solution obtained with the basic geometry for surface area of sphere with radius a.

The task is more complex for rotating body obtained with rotary of the plane figure boundary with two curves $f(x), g(x)\,(f(x)\geq g(x), x\in[a,b])$ and the vertical lines $x=a, x=b$ around x – axis where the volume and its surface area are calculated with the definite integrals $\pi\int_{a}^{b}[f^2(x)-g^2(x)]\,dx$ and $2\pi\int_{a}^{b}[f(x)\sqrt{1+f'^2(x)}-g(x)\sqrt{1+g'^2(x)}]\,dx$, respectively.

For example, the volume of rotary body obtained with rotation of the circle $x^2+(y-b)^2=a^2, (b\geq a>0)$ around x – axis, can be calculated in two steps:

1. From the equation of circle $x^2+(y-b)^2=a^2$ with radius a and center in the point *(0,b)* are obtained two different functions $y=b+\sqrt{a^2-x^2}, y=b-\sqrt{a^2-x^2}$. In figure 5, is shown the circle $x^2+(y-5)^2=2^2$ where the function $y=5-\sqrt{2^2-x^2}$ is marked with red color and the function $y=5+\sqrt{2^2-x^2}$ with blue color.

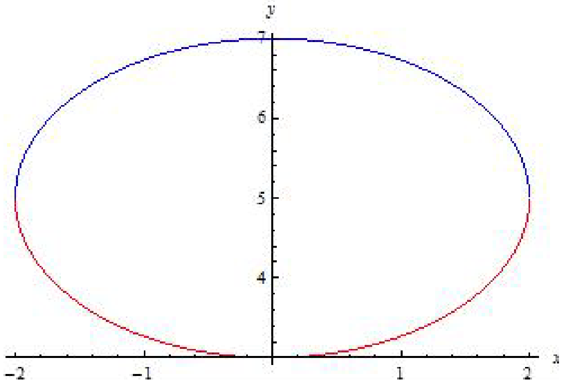


Figure 5*: The graphs of the functions* $y=5-\sqrt{2^2-x^2}$ *and* $y=5+\sqrt{2^2-x^2}$

2. By rotation of this area, we obtain the rotary body where the volume is calculated with the definite integral $\pi\int_{-a}^{a}[(b+\sqrt{a^2-x^2})^2-(b-\sqrt{a^2-x^2})^2]dx$ the code in Mathematica is $\pi*\int_{-a}^{a}[(b+\sqrt{a^2-x^2})^2-(b-\sqrt{a^2-x^2})^2]dx$. This definite integral has the solution $2a\sqrt{a^2}b\pi^2$ and for $a>0$, the finally obtained solution is $2\pi^2a^2b$.

To calculate the surface area of rotary body, we use the definite integral

$$2\pi\int_{-a}^{a}[(b+\sqrt{a^2-x^2})\sqrt{1+(-\frac{x}{\sqrt{a^2-x^2}})^2}-(b-\sqrt{a^2-x^2})\sqrt{1+(\frac{x}{\sqrt{a^2-x^2}})^2}]dx$$

with code

$$2*\pi*\int_{-a}^{a}[(b+\sqrt{a^2-x^2})*\sqrt{1+(-\frac{x}{\sqrt{a^2-x^2}})^2}-(b-\sqrt{a^2-x^2})*\sqrt{1+(\frac{x}{\sqrt{a^2-x^2}})^2}]dx$$

and obtained solution $8a\,\pi Abs[a]$ where for $a>0$, $Abs[a]=|a|=a$, therefore the solution is $8a\,\pi\,Abs[a]=8\pi\,a^2$. The first derivation for the functions $y=b+\sqrt{a^2-x^2}$ and $y=b-\sqrt{a^2-x^2}$ can be obtained by the codes $\partial_x(b+\sqrt{a^2-x^2})$ and $\partial_x(b-\sqrt{a^2-x^2})$, respectively in Mathematica.

The same steps used for x axes can be used for calculation of volume and surface area of rotary body obtained with rotation of planar curve around y-axis. In this case integral calculation will be made for variable y and sub integral functions will be $x = f(y), x = g(y)$

4. CONCLUSION

In this paper we give brief review of using Mathematica in educational purpose. Computer program Mathematica can be used by teachers as a tool for easily explaining integral calculation to students and also can be used by students to easily understanding these topics. This can help to improve student knowledge about integrals and its application in real problems.

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The application of Microsoft Excel in teaching courses of mechanical engineering

Milan Marjanović[1], Ivan Milićević[1], Snežana Dragićević[1], Marko Popović[1] and Stojan Savković[1]
[1] Faculty of Technical Sciences, Čačak, University of Kragujevac, Serbia
e-mail milan.marjanovic@ftn.kg.ac.rs

Abstract: *The applications of information technologies in the field of mechanical engineering are various and numerous. This paper presents the application of basic computer software i.e. Microsoft Excel in solving a series of calculations in the field of mechanical engineering which can be encountered during studies, or later in practice. Using the knowledge and literature both in these areas and in the field of information technology, this software is used through an interactive application to calculate the geometric characteristics of standard profiles, as well as the calculation of the efficiency and state parameters of the thermodynamic cyclic processes. The examples shown in this paper will provide students a great help in the preparation of assignments from these fields of study, and also teachers when reviewing them.*

Keywords: *geometric characteristics; cyclic processes; Microsoft Excel*

1. INTRODUCTION

The teaching process of mechanical engineering courses of the Faculty of Technical Sciences in Cacak is based on the theoretical lectures and exercises in which the practical problems are solved. In the exercises, students get homework, graphical and design assignments in which they are solving a variety of practical problems that they may encounter in the future.

Due to the increased number of students and wish to improve the efficiency of teaching, it is generated the need for using a variety of applications and tools to allow students to study more effectively and improving their skills, and enabling a more efficient work and review of students papers by a teacher.

As these practical problems can include a series of computing and can be very comprehensive, it is generated a possibility of using a certain type of tools to process data through a series of formulas and conditions that may be encountered in accordance to the diversity of students personal assignments.

Within the framework of this paper, it will be presented the application of Microsoft Excel tools for solving problems in the field of strength of materials, as part of the teaching course of the Technical Mechanics 2, and problems in the field of the thermodynamic cyclic processes in heat engines within the course of the thermodynamics.

2. IMPLEMENTATION OF TOOLS IN THE FIELD OF THE STRENGTH OF MATERIALS

2.1. Task description

In the field of Strength of Material, within the course Technical Mechanics 2, students receive a variety of tasks as problems that may be encountered in practice, among which is the determination of the geometrical characteristics of the flat cross-section (profile), i.e. a moment of inertia.

When bending, torsion beams, etc., stress and strain of the carriers, caused by the action of the force depends on the geometrical characteristics of the cross-section. These characteristics are precisely expressed as areas and moments of inertia of the cross section. [1]

In the context of the task that should be solved, students receive the appropriate configuration of complex cross-section composed of three defined standard profiles (L, U, I, or Z profile), and for the thereby obtained complex profile it is necessary to determine moments of inertia, the principal axes ellipse radii of inertia, and moments of inertia for the principal axes according to the calculated angle of rotation. The whole process is, for the practical reasons, performed in a tabular way. An example of a possible cross-section that student may receive are shown in Fig. 1.

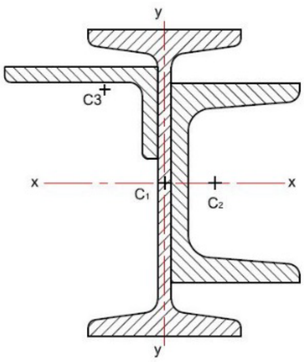


Figure 1. *An example of a complex profile composed of I, L and U profile*

The first step is to separate the complex profile into the standard profiles for which tabular geometric characteristics data and dimensions are known. From these tables shall be adopted areas, dimensions, axial and centrifugal moments of inertia for the center axis of gravity of standard profiles. [1-3]

The second step is to determine the center of gravity (centroid) of the complex profile (cross-section) in relation to an arbitrary adopted axes *x* and *y* over the term:

$$x_c = \frac{S_y}{A} = \frac{\sum A_i \cdot x_i}{\sum A_i}, \; y_c = \frac{S_x}{A} = \frac{\sum A_i \cdot y_i}{\sum A_i} \tag{1}$$

where S_x and S_y are static moments of inertia, A_i profile area, x_i and y_i distances from the centroid of the profile to the arbitrarily adopted coordinate system that are determined based on the dimensions and drawings of standard profiles which make up the complex profile.[1,2]

After determining the centroid of a complex section, the next step is to determine the moments of inertia of each individual profile for the arbitrarily adopted axes by using Steiner's theorem:

$$I_x = \sum I_{\xi i} + \sum A_i y_i^{\,2} \;\; ; \quad I_y = \sum I_{\eta i} + \sum A_i x_i^{\,2} \;\; ; \quad I_{xy} = \sum I_{\xi\eta i} + \sum A_i x_i y_i \qquad (2)$$

where $I_{\xi i}$, $I_{\eta i}$ and $I_{\xi\eta i}$ are moments of inertia of the individual standard profiles, with values which are obtained from tables [3], taking into account the position profile relative to its centroid coordinate system (if the standard profile is rotated by 90 degrees, then the positions of axial moment of inertia I_ξ and I_η are changed – as is the case with L profile in Fig. 1).

There is one more condition that must be fulfilled, which is that the centrifugal moment of inertia has a negative sign for the L and Z profile, if their legs are located in the second and fourth quadrant of the coordinate system of its focal axis. The cross-section shown in Fig. 1, contains the L profile that meets this requirement, and a negative centrifugal moment of inertia is generated in the table for this profile.

All the above conditions are taken into consideration when developing Excel document.

After the centroid of profile is determined – coordinates x_c and y_c relative to arbitrarily adopted axis, moments of inertia for the centroid axis can be determined according to the Steiner's theorem [1,2]:

$$I_\xi = I_x - y_C^2 \cdot A; \;\; I_\eta = I_y - x_C^2 \cdot A; \;\; I_{\xi\eta} = I_{xy} - x_C \cdot y_C \cdot A \qquad (3)$$

The principal moments of inertia are determined using the equation:

$$I_{1,2} = \frac{1}{2}\left(I_\xi + I_\eta\right) \pm \frac{1}{2}\sqrt{\left(I_\xi - I_\eta\right)^2 + 4I_{\xi\eta}^2} \qquad (4)$$

The position of the principal axes of inertia 1 and 2 determines by the angle α, in relation to the centroid axis of profile. This angle can be calculated according to the formula:

$$\alpha = \frac{1}{2} arctg\left(-\frac{2 \cdot I_{\xi\eta}}{I_\xi - I_\eta}\right) \; \left[rad\right] \qquad (5)$$

The ellipse of inertia radiuses can be calculated using the equation:

$$i_{1,2} = \sqrt{\frac{I_{1,2}}{A}} \qquad (6)$$

2.2. Application of Microsoft Excel tool for solving problems in the field of strength of materials

The reason for the creation of software tools which are used in solving problems is that the student can check their assignments in a quick and efficient way, but also to have the opportunity to examine the utilization of a given cross-section that is used for a specific purpose in a structure, or to adopt such a dimension of profiles that are needed to achieve the functionality of the designed profile with a minimum cost of material.

To be suitable for use, it is necessary that such a software tool be as much interactive as possible in a relation between user and computer.

For example, in the configuration shown in Fig. 1, the dimensions of any I, L and U profiles cannot be classified, because it can lead to collisions between the profiles I and U, if, e.g., the dimension between the arms of I profile is less than the height of U profile. According this, another condition is introduced, which goal is to prevent the user to make such a mistake. If this condition is true, the field 1 will contain the text "OK", Fig. 2. If an incorrect entry occurs, the text will appear as shown in Fig. 3.

PRESEK BROJ 1

1			2	3	4	5	6	7	8	9	10	11	12
OK			A_i	x_{ti}	y_{ti}	S_y	S_x	I_x		I_y		I_{xy}	
								sopstveni	položajni	sopstveni	položajni	sopstveni	položajni
								$I_{\xi i}$	$A_i y_{ti}^2$	$I_{\eta i}$	$A_i x_{ti}^2$	$I_{\xi\eta i}$	$x_{ti} y_{ti} A_i$
	Oznaka profila		cm^2	cm	cm	cm^2		cm^4		cm^4		cm^4	
1	I profil	I 20	33.5	0.0	0.0	0.0	0.0	2140.0	0.0	117.0	0.0	0.0	0.0
2	U profil	U 14	20.4	2.1	0.0	43.4	0.0	605.0	0.0	62.7	92.1	0.0	0.0
3	L profil	L 60x40x5	4.8	-2.3	7.9	-11.2	37.8	6.1	298.9	17.2	26.1	-6.0	-88.4
Σ			58.7	-	-	32.2	37.8	2751.1	298.9	196.9	118.2	-6.0	-88.4
							Σ	3050.05		315.13		-94.34	

Rešenja:

X_c= 0.55 cm
Y_c= 0.64 cm
I_ξ= 3025.7 cm^4
I_η= 297.5 cm^4
$I_{\xi\eta}$= -115.1 cm^4
I_1= 3030.5 cm^4
I_2= 292.7 cm^4
α= 0.04 rad
α= 2.41 °
i_1= 7.19 cm
i_2= 2.23 cm
φ= 10.0 °
φ= 0.175 rad
I_u= 2947.9 cm^4
I_v= 375.2 cm^4
I_{uv}= 468.2 cm^4

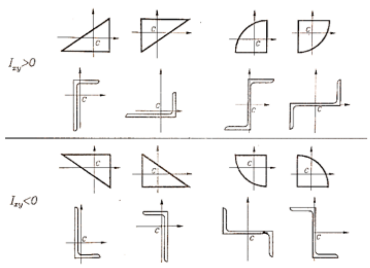
Potrebne dimenzije profila iz tablica:

d_1= 0.75 cm | d_2= 0.7 cm | e_{x3}= 1.96 cm
h_1= 20 cm | e_{y2}= 1.75 cm | e_{y3}= 0.97 cm
t_1= 1.13 cm | h_2= 14 cm

Centrifugalni moment Za L profil:

$(I_1)_L$= 3.5 cm^4
$(I_2)_L$= 19.8 cm^4
$I_{\xi\eta 3}$= 5.98 cm^4

*znak centrifugalnog momenta inercije za L profil je sa znakom minus na osnovu pravila sa slike



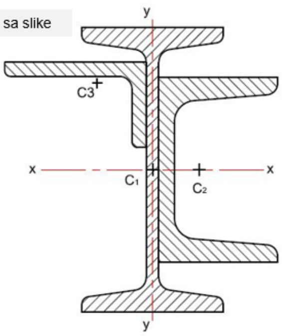


Figure 2. *The appearance of the table for calculating geometric characteristics of profile*

1			2	3	4
Greška! Kolizija između U I I profila. Kako bi izbegli grešku smanjite U profil ili povećajte I profil			A_i	x_{ti}	y_{ti}
	Oznaka profila		cm^2	cm	cm
1	I profil	I 20	33,5	0,0	0,0
2	U profil	U 20	[illegible]	2,4	0,0
3	L		[illegible]	-2,3	7,9
			[illegible]	-	-

U 16
U 18
U 20
U 22
U 24
U 26
U 28
U 30

Potrebne dimenzije profila iz tablica:

d_1= 0,75 cm | d_2= 0,85 cm
h_1= 20 cm | e_{y2}= 2,01 cm
t_1= 1,13 cm | h_2= 20 cm

Figure 3. *An example of error due to inappropriate selection of standard profiles*

The drop-down menu for each profile is made using "Data Validation" [4], and selecting the appropriate of profile from the worksheet containing the database table of standard profiles.

The required dimensions and characteristics of the profile are automatically generated from the table after selecting profile from the drop-down menu by using the tool "VLOOKUP" which uses a profile name as key and table of appropriate profile on the other table database worksheet [5,6].

Shaded fields are interchangeable, which means that it is enough to choose the standard profiles from the drop-down menu, and the program automatically calculates all the geometric parameters of a given complex profile.

3. IMPLEMENTATION OF TOOL IN THE FIELD OF THE THERMODYNAMICS

Thermodynamics is available to students within the course of Thermotechnics, in which students, among other things learn thermodynamic cyclic processes.

Students in this course have homework in which they receive the corresponding cyclic process and its input parameters. Based on these data, the students are calculating the remaining state parameters of characteristic points in the process - p, v, T , change of internal energy - Δu , amount of work - w and the amount of heat - q for the each state change as well as the efficiency of a given cycle process - η . [7]

Cycles are closed processes that consist of the four changes of state. Every change of state are derived from the general polytropic change of state $p \cdot v^n = const.$ [8]

Table 1. *Values of the polytropic exponent of each state change [7]*

State change	General polytropic $p \cdot v^n = const.$	Isochoric $v = const.$	Isobaric $p = const.$	Isothermal $T = const.$	Isentropic (adiabatic) $s = const.$
Polytropic exponent *n*	n	$\pm\infty$	0	1	κ

For similar reasons as in course of the strength of materials, we came to idea for creating a tool in Microsoft Excel to calculate the thermodynamic parameters of a series of cycle processes.

The users of this tool can easily check their data calculations by entering the input parameters of the process and choosing an ideal gas that runs the process from drop-down menu. In addition to checking the accuracy of solving the original problem, a developed program allows the user to make an analysis of the effect of the input parameters and different types of ideal gas on thermodynamic efficiency of the process simply by changing it. [7,9]

The window layout of used tool for calculating the parameters for the Otto-cyclical process is shown in this paper.

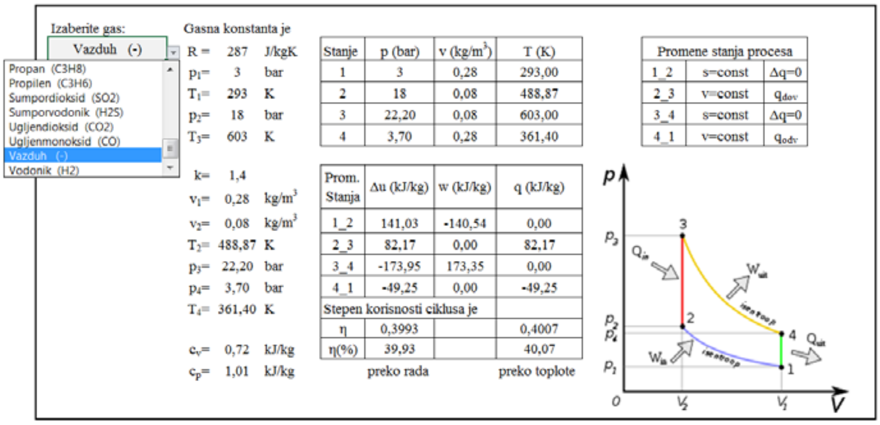


Figure 4. *Window layout for calculating parameters and utility of Otto-cyclical process*

4. CONCLUSION

This paper presents the possibilities of applying Microsoft Excel software in teaching techniques which not only that allows a very simple and quick way of resolving particular problems, it also allows interactive impact analysis of various parameters on the outputs of the developed tool. In this way it is possible to carry out a series of analysis and selection of the best profile dimensions in the problem of the Strength of Materials, as well as certain thermodynamic conditions that will result in a maximum efficiency of the cycle processes within the field of thermodynamics. Developed programs include many examples of both cases and cover a large part of the theoretical and practical problems.

This software tool could be improved by expanding the database of input data, in order to render the centroid axes, principal axes and the ellipse of inertia as well as automatic drawing *p-v* and *T-s* diagrams of the cycle processes according to the already entered the calculated data parameters.

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UDK: 004:621.39]:37.026 Professional paper

Realization of sensory mobile platform "WEGY" and possibilities of use in education

Miloš Božić[1], Vojislav Vujičić[1] and Goran Đorđević[2]
[1]Faculty of Technical Sciences, Čačak, University of Kragujevac, Serbia
[2]Faculty of Electronic Engineering, University of Niš, Serbia
e-mail milos.bozic@ftn.kg.ac.rs

Abstract: *This paper discusses the design, implementation and features of simple mobile robot system, WEGY, and introduces possibilities of use in education, research and popularization of engineering. WEGY drives are in the form of WHEel+leG configuration, shorten WHEG, which gives system the ability to move easily on the open and uneven terrain. Crossing the barriers is easier than with wheels. The platform has a small mass, and compared with a caterpillar drives is much more efficient. Robots elements with a description of options will be shown. The main controller of the robot is Arduino Mega. The platform can integrate a large number of sensors and actuators so it`s suitable for different teaching modules, such as sensors, actuators, automatic control, mobile robots and others. The platform allows specific application problems to be solved, which also represents an adequate way to adopt engineering knowledge, according to the method practical-theoretical-practical (PTP).*

Keywords*: robot; wheg; sensor; arduino*

1. INTRODUCTION

For education of engineers, practice has shown that the combined method practice-theory-practice (PTP) provides the best approach [1,2]. By using this method, teacher first presents the problem to students, which needs to be solved. Students then perform an analysis of the problem, after which they learn theory that is directly related to the problem. After that, students return to a solving problem. To support this approach for students from the Faculty of technical sciences in Čačak at the Laboratory of Mechatronics and Laboratories EMPR [3,4] and in cooperation with the Laboratory of Robotics from Faculty of Electronic Engineering in Niš [5] the existing mobile robot platform is modified. Robotic platform will primary find application in education and research works of students. The name WEGY is derived from the structural solution of drive mobile robot platform. For drive is selected form WHEEL - LEG configuration - known as WHEG, which brings the benefits of both concepts. WEGY represents a very rich platform in terms of sensors and actuators, so it allows the various practical problems to be solved. Through this platform and usage of PTP method, students can get acquainted with the basic elements such as applied electric circuits, applied programming, applied modeling etc. This concept should attract students to technique and make them more interested for teaching modules which will come later during studies. The assumption is that the introduction of this optional subject with PTP access to the first year would increase the attractiveness and interest of students for the upcoming teaching modules on higher years. This is already the practice in some universities in the world [6].

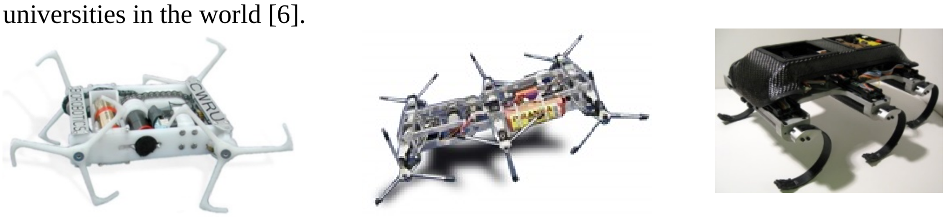

Figure 1. *Robot with wheg concept: a) Mini-Whegs b) WHEGS I [7] and c) Edubot [8,9]*

2. BASIC ELEMENTS OF ROBOT WEGY

Figure 2 presents a 3D model of a WEGY robotic platform and the appearance of the realized robot. All plastic parts are made on a 3D printer using PLA plastics. The time required to create such system is short (about 2 days). The dimensions of the robot are 50x33x18 cm and its weight is about 3 kg.

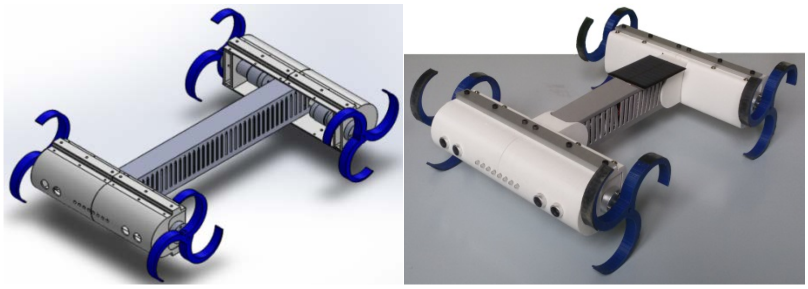

Figure 2. *3D model of the robot and realized robot*

WEGY robots block diagram is given in the following figure.

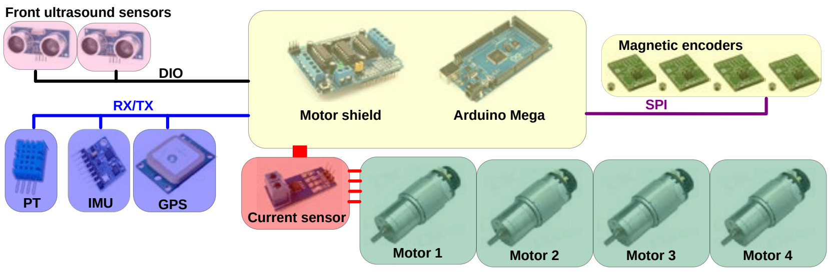

Figure 3. *Block diagram of the robot WEGY*

Each of these modules will be a briefly described with it specific purpose on the WEGY platform.

2.1. Arduino MEGA2650 controller

The microcontroller has 54 digital input/output pins (14 can be used as PWM outputs), 16 analog inputs, 4 serial ports, a 16 MHz crystal oscillator, power connector, ICSP connector. It easily connects to computer via a USB cable. There is a large number of additional modules - shields that can be added to this controller. For making of robot additional driver for motor control was used. Programming can be performed in a development environment for microcontrollers [10] and also supports the programming of the microcontroller in LabVIEW and MATLAB software.

2.2. DC motors with gearboxes and encoders

For platform drives, DC motors with brushes are chosen [11]. The appearance of the used motors is shown in figure 4.

Figure 4. *The used motor with encoder*

Table 1. *Characteristics of used motor*

Rated voltage	12	V
No load speed	4300±10%	rpm
Rated speed	3000±10%	rpm
Rated current	480	mA
Max torque	230	gcm
Gear box ratio	1:34	
Encoder resolution	41	ppr

In order to improve system performance additional magnetic encoder is added.

2.3. Module Magnetic Encoder

Magnetic rotary encoder AS5048A [12] has 14-bit resolution for angle measurement (0-360º). The sensor measures the absolute position of the rotation of the magnet. Main parts of sensor are Hall sensor, A/D converter and controller for digital signal processing. The angle is directly mapped to the PWM output of the sensor, and the angle can be read by using SPI communication. Technical characteristics of sensors are given in the table below.

Figure 5. *Sensor's plate layout*

Table 2. *Sensors characteristics*

Power supply	5 VDC or 3,3VDC
Power consumption	< 15 mA
Dimensions	5 x 2,5 x 3cm
Communication	SPI, PWM
Resolution	14-bit

2.4. The module for motor control

Module provides the necessary voltage and current levels for motor control. It amplifies pulses from microcontroller to appropriate levels. The platform uses shield with two integrated circuits L298N. Each of IC L298N on this shield is a double H-bridge, so this shield can control up to four DC motors. [13].

Figure 6. *Module for motor control*

Table 3. *Drivers characteristics*

Input voltage	7-35V
Output voltage	5-35V
Max output current per bridge	2A
Max Output Power	25W

2.5. Module with ultrasonic sensor

Module allows the detection and avoidance of obstacles. Ultrasonic sensor HC-SR04 [14] measures the distance between the sensor and the object that is in front. Distance can be measured to the objects which are static as well as the moving objects. The module is designed in the form of separate emitter and receiver on one board, and works in diffuse mode. Technical characteristics of the sensor are given in the table below. WEGY has two ultrasonic sensors placed on the front on the left and on the right side.

Figure 7. *Ultrasonic sensor HC-SR04*

Table 4. *Characteristics of ultrasonic sensor*

Power supply	5 VDC
Power consumption	< 2 mA
The angle detection	< 15º
Dimensions	4,5x2,0x1,5 cm
Measurement range	2 cm – 500 cm
Resolution	0,3cm

2.6. Module for current measurement

Module allows the measurement of the motor current. This allows calculating of consumed energy. ACS712 sensor principle of work is based on the Hall effect. [15] It allows detection of blockade of rotor in case of obstacle that cannot be overcome. Based on this measurements robot can make appropriate maneuver.

Figure 8. *Current sensor*

Table 5. *Characteristics of the current sensor*

Response	5 µs
Bandwidth	80 kHz
Error	1.5% on 25°C
Resistance	1.2 mΩ
Voltage supply	5.0 V
Sensitivity	66 do 185 mV/A

2.7. Module for measuring temperature and humidity

On the platform there is humidity and temperature sensor DHT11 [16]. The sensor is factory calibrated and does not require additional components so it can be immediately used for measurement. It consists of a capacitive humidity sensor, a thermistor for temperature measurement and electronics to communicate with the environment.

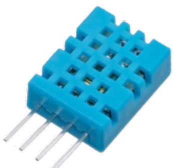

Figure 9. *The temperature and humidity senzor*

Table 6. *Characteristics of sensor*

Power supply	3-5,5VDC
Power consumption	2,5mA
Temperature range	0-50°C±2°C
Humidity range	20-90%RH±5%RH
Sampling rate	1KHz
Resolution temperature / humidity	1°C/1%
Dimensions	15.5×12×5.5mm

2.8. Module with compass, accelerometer, gyroscope

The purpose of this module is orientation and dynamics measurement of the robot. Sensor GY-87 [17] was used. The sensor unit represents IMU (inertial measurement unit), a sensor node that can detect 10 different parameters. This unit consist of three sensors HMC5883L (three-axis digital compass), MPU-6050 (three-axis gyroscope and three-axis accelerometer) and BMP085 (atmospheric pressure). Technical characteristics of the sensor are given in the table below.

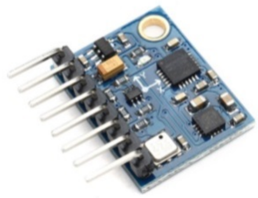

Figure 10. *IMU senzor*

Table 7. *Characteristics of IMU sensor*

Power supply	3-5VDC
Communication	I^2C
Digital compass	±8 Gauss, 12-bit
Gyroscope	±250,±500,±1000,±2000°/sec,16bit
Accelerometer	±2, ±4, ±8, ±16g, 16-bit
BMP085	300-1100hPa, 16-bit

2.9. GPS module

The module provides tracking of the geographical position of the robot. Module GY-NEO6MV2 [18] is used. This is a standard GPS module which uses serial communication for data exchange. This module can monitor a global position of the robot, speed, angle in relation to the north (compass), information of the time and date (*real time clock*).

Figure 11.*GPS module*

Table 8. *Characteristics of GPS sensor*

Power supply	2,7-5VDC
Power consumption	45mA
Communication	Serial (9600bps)
Positioning accuracy	2,5m
Velocity	0,1m/s
Precision angle	0,5°
Dimensions	25 mm x 35 mm

2.10. Power module

Power is provided with LiPo battery 5000mAh, 14.8V voltage. The platform also has a second battery to power sensors which are charged by a solar panel mounted on the upper surface of the robot so that in case of a power failure on the main battery and no possibility of movement of the robot, the sensors can continue to operate and provide necessary information.

3. CONCLUSION

The paper presents the realized WEGY robot and its possibilities for use in education. Low price of the installed components guarantees the wide availability of the robot in school environments. In further work on this robot will be tested its features. Furthermore, the aim is to create teaching material for the modules that process the components on the robot, using the PTP approach. Further steps will be to put this teaching material on the first year of studies as an elective course where students could explore one complex robotic system with top to bottom approach in fully applicative way and get familiar with the basic elements of electrical engineering, electronics, automation, drives in one interesting way. This should result in greater interest of students for items that await them in the higher years. The platform will be upgraded with additional modules, and in terms of construction, the armor will be made in the appropriate IP protection so it can be outdoor even in the case of high humidity.

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Up-to-date approach to design of mechatronic systems

Slobodan Aleksandrov[1], Milomir Mijatović[2] and Radica Aleksandrov[1]
[1] Engineering School Trstenik, Trstenik, Serbia
[2] College of Applied Mechanical Engineering, Trstenik, Serbia
e-mail aleksandrovs@yahoo.com, milomir.mijatovic@vtmsts.edu.rs i radica09@gmail.com

Abstract: *Rapid development of software tools for modeling and simulation along with the implementation of new technological achievements in engineering require a new approach to design of mechatronic systems. The paper presents modern approaches to design in mechatronics which are based on the application of software for three-dimensional modeling and simulation. It also shows the methods of designing an industrial robot according to constraint-based modeling and model-based design. Special attention is paid to the importance of developing a simulation CAD model of the robot, the integration of mechanical, electrical and software components in the process of developing the model of mechatronic systems and automatic generation of control algorithms.*

Keywords: *mechatronics; modeling; simulation, robot*

1. INTRODUCTION

Design of mechatronic systems implies a complex approach in the research work, the use of modern software tools for modeling the system elements, the integration of elements in a single mechatronic systems, modeling and simulation of the system, integration of the model, testing and verification. Due to multidisciplinary nature of mechatronics, development and design of mechatronic systems is a very complex process. There are different approaches to the design of mechatronic systems. Isermann [1] shows the development of methods of designing mechatronic systems with special reference to V model. The scheme of this model includes the distribution of tasks among the hydraulic, pneumatic, mechanical and electronic components. The method involves modeling and simulation of system components, system prototyping, testing the system parameters and their adjustment, signal analysis, creation of algorithms, system programming and testing. For theoretical and physical modeling and simulation of heterogeneous components, the following software tools are used: DYMOLA, MODELICA, MOBILE, VHDL-AMS, 20 SIM, MATLAB/SIMULINK.

2. DESIGN OF MECHATRONIC SYSTEMS

2.1. Constraint-based modelling approach

Mechatronic systems present the integration of mechanical, electrical, electronic and software components. Design of mechanical components demands the knowledge of mechanics, machine parts and elements, kinematics and dynamics, fluid technology,friction computation, determination of the force, moment of inertia,and torque. Electronics includes measuring systems, sensors, actuators and control systems. Information sciencecomprises the application of software packages and information and communication technology for the design, modelling and integration of mechatronic systems. Design of mechatronic systems requires the integration of mechanical and electrical access so the feedback on implemented modifications is automatically receivedduring the entire process of designing. Each modification of the machine part leads to a change in the electrical system and vice versa, so there are various constraintsin the design of mechatronic systems. This approach is known as constraint-based modelling approach. Detailed analysis of this approach is shown in [2]. Design of mechatronic systemswith regard to constraints is similar to semantic networks, where constraintsand connections can be represented as nodes and relationships, respectively. The components of mechatronic systems are modelled as objects with attributes whilemutual constraints are identified and modelled. The relationship of object constraints between mechanical and electrical components at the level of concept design is shown in Fig. 1.

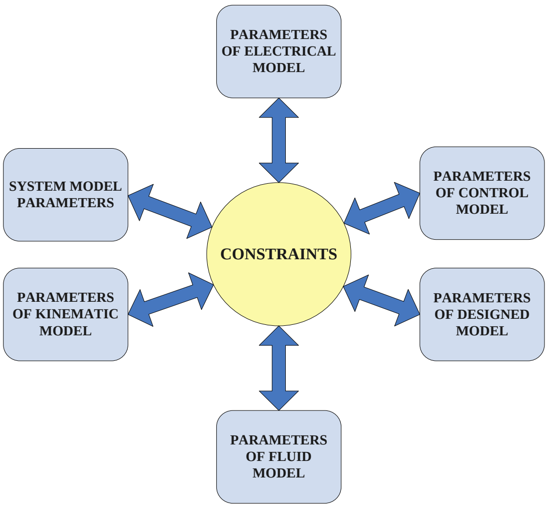

Figure 1. *Constraints among all domains at the level of concept design*

Different mechanical and electrical CAD tools are used to model, simulate and test components. Software package EPLAN Electric is often used to create electric models while Solid Works is usually used to model machine parts and elements. In the process of modeling it is necessary to take MCAD/ECAD constraints into account. Atypical approach to design and development of mechatronic systems is shown in Fig. 2.The first phase includes the analysis of technological requirements, research and definition of necessary specifications. Designers of different profiles independently make selection of necessary electrical and mechanical components, develop algorithms and create programs. The process of research and definition of specifications is largely separated by areas of research. The next phase involves design and implementation of defined model of mechatronic system. The integration and testing of the mechatronic system are done in the final phase [3].

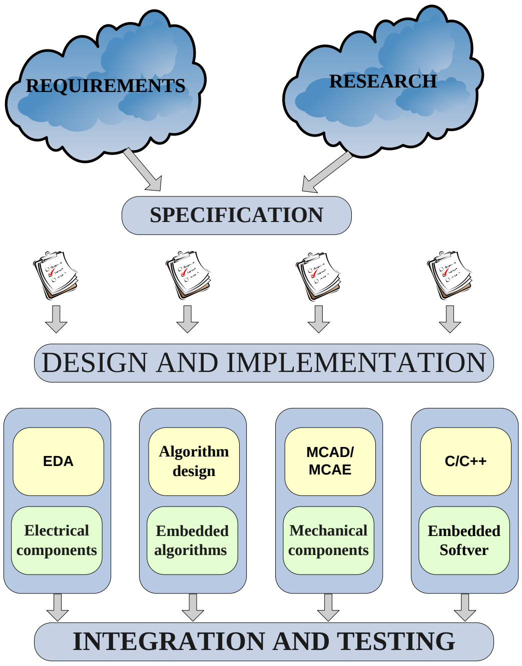

Figure 2.*Traditional process of designing a mechatronic system [2]*

The method is based on constraint modeling and consists of the following phases:

1. Creation of the list of all elements of the mechatronic system with their attributes and classification of elements into the mechanical or electrical domain,
2. Making connections between the constraints of mechatronic components within the domain on the basis of the component attributes,
3. Making connections of the elements constraints between mechanical and electrical domains,
4. Creation of the table of constraints of the mechatronic system which contains all elements of the mechatronic system and connections between constraints of the system elements.

The process of constraint modeling was created on the model of industrial robot Mitsubishi RV2AJ which is a part of the laboratory equipment in the Engineering School in Trstenik. The robot is 'vertical' with five degrees of freedom and maximum load of 2 kg. The working tool of the robot is a pneumatic handle. Figure 3 shows the constraint modeling of the industrial robot Mitsubishi RV2AJ. Mechanical, electrical, and mutual constraints are indicated by symbols M1-M9, E1-E10, and C1-C6, respectively. Mechanical constraints include geometric dimensions of the elements, base coordinates, reference coordinates of other elements, link lengths, range of link motion, type and characteristics of materials, moment of inertia, gravitational acceleration and the like. Constraints in the electrical domain include the type of engine, maximum speed, maximum load moment, encoder resolution, type of controller, power to servomotor and solenoid valve. Multidisciplinary constraints define the connections between mechanical links, joints and engine, maximum torque, force, maximum load, range of motion, control of robot tools, and the like. The constraints being defined, the size, dimensions, power, speed and control mode of the engine are selected.

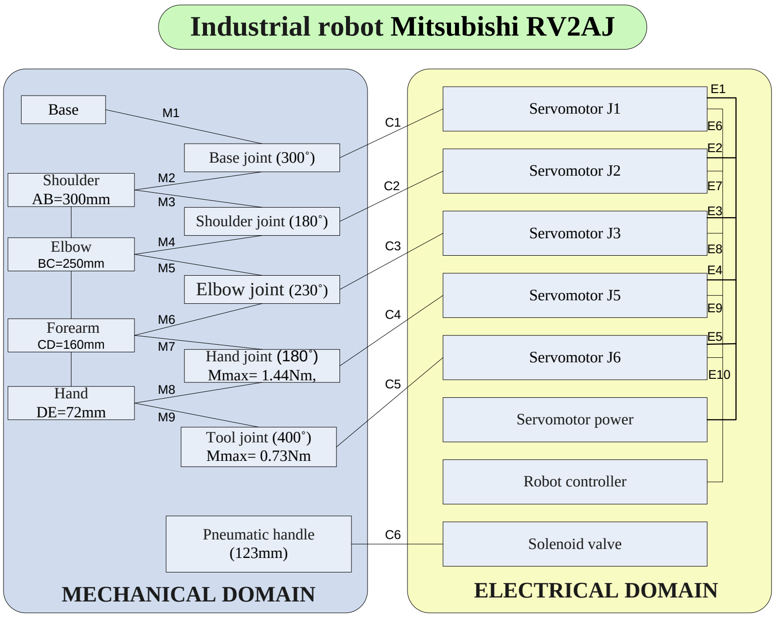

Figure 3.*Constraint modeling of Mitsubishi RV2AJ*

The process of designing is mostly done separately so the feedback on the changes of components is late whereas the testing of integrated system is done at the end of the process. This approach has the following constraints:

- Complex analysis and complex procedure of changes,
- Misinterpretation of requirements,
- Complex system of project integration,
- Incomplete and expensive system,
- Testing cannot be done by levels of development,
- Lengthy process of error detection,
- Limited transportability,
- Limited monitoring from design phase to integration phase.

2.2. Model-based design

Up-to-date multidisciplinary approach to design of mechatronic systems is based on integrated development environment which enables creation, modelling and testing of mechatronic systems. Today's trends in the design of mechatronic systems are based on the system modelling, three-dimensional modelling, simulation and implementation of the model in real industrial systems. Festo company has developed a control system based on MATLAB and Simulik for model-based desing, model implementation of the model in programmable logic controller (PLC) using Simulink PLC Coder [4].

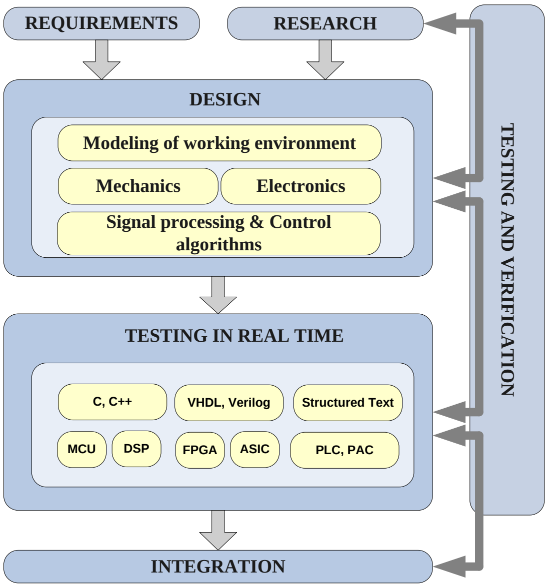

Figure 4. *Modern approach to design of the mechatronic system – Model-based design [3]*

This approach provides the model simulation, code generation for PLC programming in the same programming environment. Procedure of model-based design is shown in Fig. 4. Based on defined requirements and constraints,we research and design the simulation CAD model of the robot which generates SimMechanics model (XML file). Modelling of electrical and mechanical assemblies, signal processing and creation of control algorithms are integrated in the design phase. After creatingall models, we simulate the model in MathWorks software package, test the model and generatethe control STL code for the PLC using Simulink PLC Coder [5]. The system parameters are tested and verified during the entire process. A change of any element or parameter automatically leads to a change of other parameters so that thesystem maintains designed characteristics. This approach enables multidisciplinary cooperation over the entire process of design in real-time, as well as testing, verification and validation ofthe model in all phases of the project, thus reducing the time and cost of developing new systems and improving the product quality.

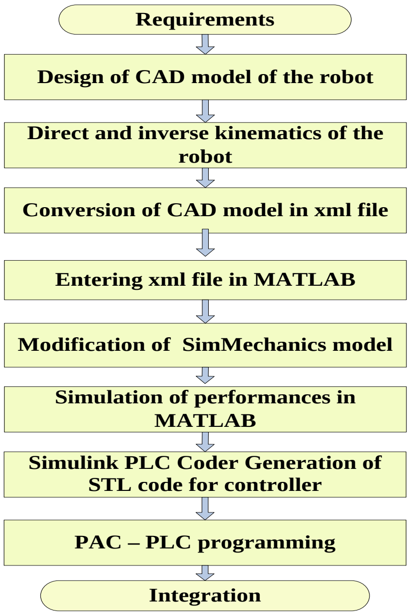

Figure 5. *Algorithm of model-based design of the mechatronic system*

The algorithm of design of the industrial robot is shown in Figure 5. Integration of the system is done after its testing and verification.

3. CONCLUSION

The paper presents the current trends in the design of mechatronic systems. Modern software tools are applied to design the model of industrial robot. Special attention is paid to the specific qualities of mechatronic approach to design, analysis mechanical and electrical of constraints, and their integration into a single mechatronic system. Application of up-to-date software packages enables fast and safe way in the development and design of new mechatronics components and systems.

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Simulation model of direct torque control with discretized voltage vector intensities[1]

Marko Rosić[2], Milan Bebić[3], Nikola Đorđević[3],
Miroslav Bjekić[2] and Marko Šućurović[2]
[2] Faculty of Technical Sciences Čačak, University of Kragujevac, Čačak, Serbia
[3] School of Electrical Engineering, University of Belgrade, Belgrade, Serbia
e-mail marko.rosic@ftn.kg.ac.rs

Abstract: *This paper describes the development process for direct torque control algorithm with multiple voltage vectors aiming to reduce torque ripple as a main drawback of DTC algorithm with discrete voltage vectors and switching tables. The idea and the selection principle of voltage vectors with different intensities that need to provide torque ripple reduction is given in Section 2. In Section 3, the developed Simulink model of the proposed DTC algorithm is described in detail and simulation results for different numbers of voltage vector intensities are shown. The model of proposed algorithm is convenient for students who attend the course of control of electric drives in order to comprehend DTC principle more easily. Experimental results of the proposed DTC method are presented in section 4, followed by the conclusion at the end of the paper.*

Keywords: *direct torque control, discretized voltage intensities, simulation, torque ripple reduction, EMF compensation.*

1. INTRODUCTION

Direct torque control (DTC) from the moment of its appearing until today, suffered a number of modifications to eliminate its shortcomings of which the most important is a large torque ripple. In DTC algorithms that use discrete voltage vectors torque ripple can be reduced by applying voltage vectors with more intensities. A number of papers have been published so far concerning this topic. For instance, in [1],[2] the authors have presented DSVM-DTC algorithm which uses three basic voltage vectors in one switching cycle. In this way, it is possible to define a large number of resulting voltage vectors of different intensities and directions. By further increasing the number of voltage vectors, the switching table becomes more complicated and duration of the calculation cycle should be extended in order to prevent too high switching frequency (change of four or more voltage vectors in one cycle). For that reason DSVM-DTC method is limited in terms of ripple reduction because of the consequences brought by further increase of the available voltage vectors number. It can be said that the development of converters with higher voltage levels provided further existence

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and development of algorithms that use DTC switching table especially when it comes to multilevel inverters and multi-phase drives [3],[4],[5]. Despite the simplicity of these algorithms excessive number of available voltage vectors can lead to problems in terms of the complexity of the switching table. Switching table for inverters with more than three voltage levels becomes very complex and therefore their application in practical implementations is rare. More complex structures of multi-level inverters also introduce challenges related to their configuration and control.

On the other side DVI-DTC algorithm (Discretized Voltage Intensities DTC) presented in [6] has been developed for standard two-level voltage source inverter. DVI-DTC algorithm retains the application of simple conventional switching table that defines the direction of one of the six basic voltage vectors. The intensity of the selected basic voltage vector is determined from the torque error according to the multilevel torque comparator. This enables decoupled selection of direction and the intensity of the voltage vector. The method offers easy upgrading, even automatic adaptation of algorithm and predefining of voltage vectors depending on the desired number of their intensities without changing the basic switching table. The main topic of this paper is the simulation model of DVI-DTC algorithm in *Matlab/Simulink.* The simulation is used prior to implementation on the real drive and helps students to better understand the principles of DTC. The basic DTC theory is described first and Simulink model of the proposed DVI-DTC algorithm is described in detail afterwards. At the end of the paper simulation and experimental results are shown confirming reduced torque ripple.

2. THEORY OF DIRECT TORQUE CONTROL WITH DISCRETIZED VOLTAGE VECTOR INTENSITIES

Conventional DTC algorithm [7] relies on the use of switching table (Table 1) that provides optimal choice between six basic active voltage vectors and two zero vectors (Fig.1a) on the next switching period Δt.

Table 1. *Switching table (selection of voltage direction)*

S_ψ	S_m		
	1	0	-1
1	U_{i+1}	U_7 or U_8	U_{i-1}
-1	U_{i+2}	U_7 or U_8	U_{i-2}

DVI-DTC algorithm with multiple voltage intensities uses the same switching table (Table 1) to select the direction of the voltage vector depending on the flux and torque requirements (S_ψ and S_m) where i stands for number of sector (i=1…6) where stator flux is located. The selection of voltage vector intensity that depends on the value of the torque error is provided by multilevel torque comparator.

Fig. 1a shows defined three intensities of the voltage vectors using PWM, whose selection depends on the value of the torque error. By involving higher number of voltage intensities, the torque ripple can be significantly reduced. The torque response is highly influenced by the intensity of the induced EMF, which leads to the steady state torque error depending on the motor speed. The influence of induced EMF on DVI-DTC algorithm was analyzed in detail in [8]. To eliminate the influence of induced EMF it is necessary to add the appropriate voltage (Fig. 1b) that should compensate its effect on torque error.

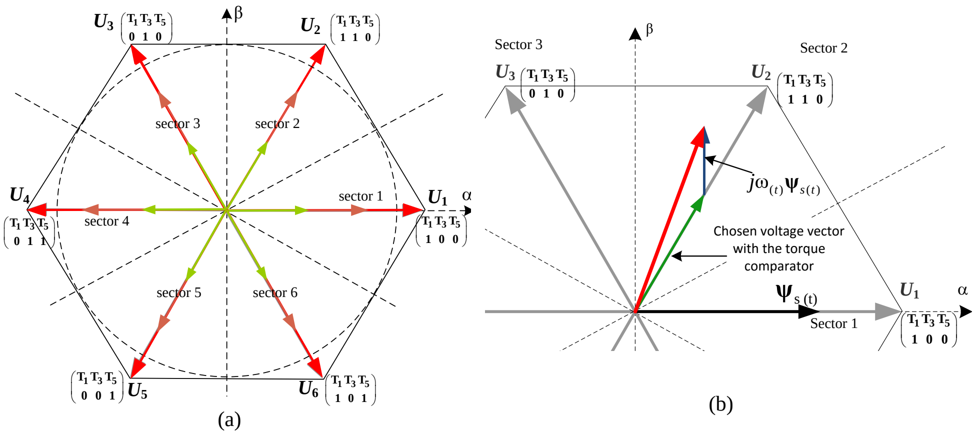


Figure 1. *Defined discretized voltage intensities (a) and resulting voltage vector aiming to compensate EMF (b)*

3. SIMULINK MODEL OF THE DVI-DTC ALGORITHM

Modeling and simulation of control algorithms is very important. Simulation allows us to test and examine developed algorithms before implementation in the real-time DSP systems [9]. Also, simulations are very useful in teaching the control of electric drives [10].

A simplified block scheme of the proposed DVI-DTC algorithm is presented in Fig. 2. As it has already been mentioned, selection of the voltage vector direction (two zero and six active vectors) is based on outputs of conventional flux and multilevel torque comparators. Selection of the voltage vector intensity is based on the value of torque error ΔT_e.

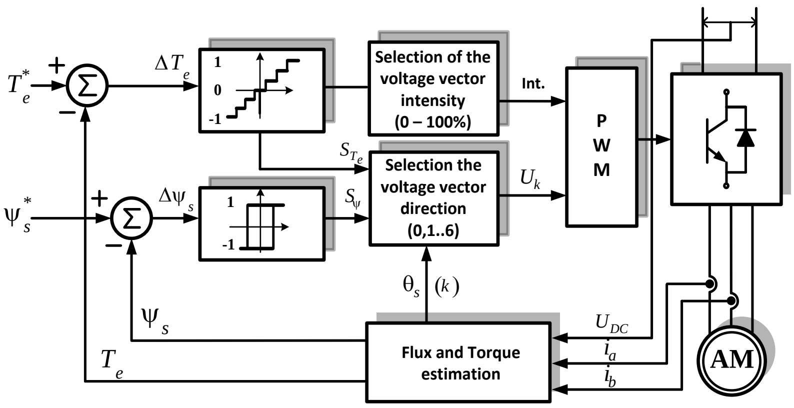


Figure 2. *Block scheme of DVI-DTC algorithm*

The simulation model of proposed DTC algorithm is made in *Matlab/Simulink* and the main window of the model is presented in Fig. 3.

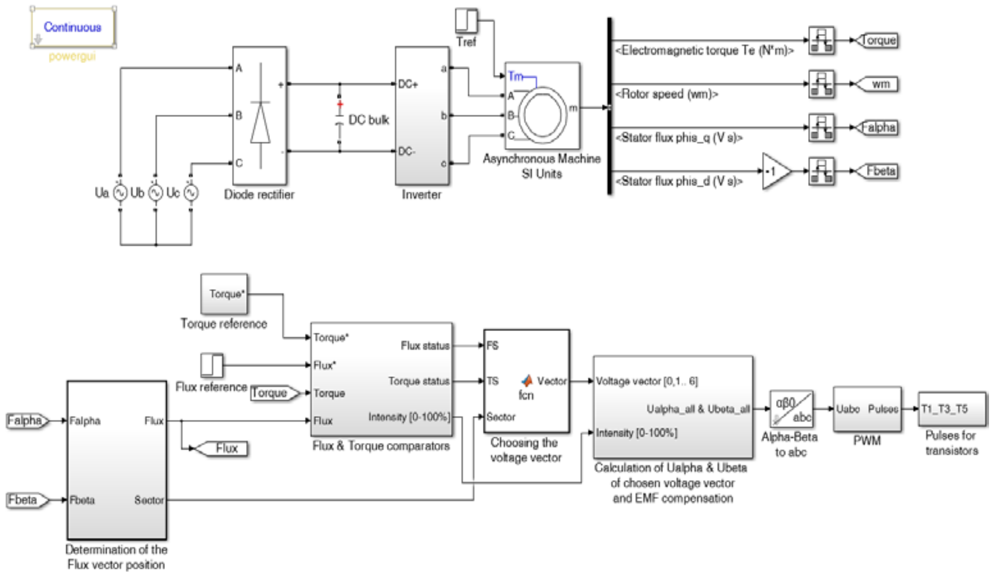


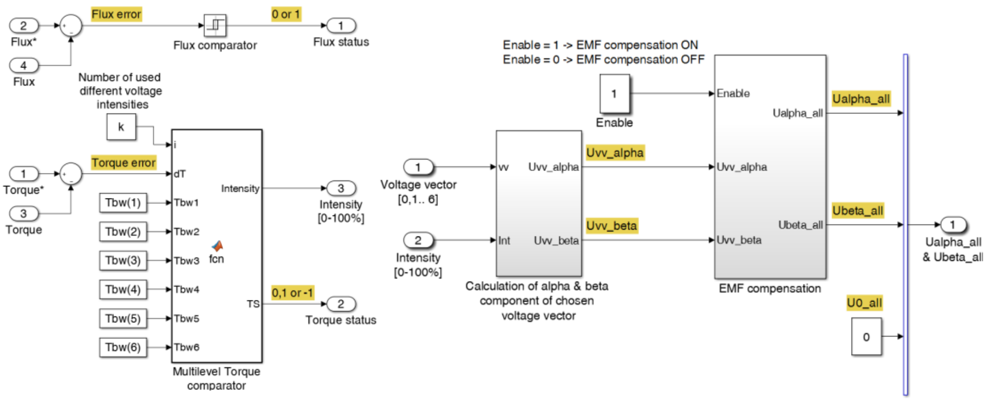
Figure 3. *Main window of simulation model of DVI-DTC algorithm in Matlab/Simulink*

Model of hardware (three-phase grid voltage supply, diode rectifier, DC bulk capacitor, inverter and Asynchronous machine) is made by using *Sim Power Systems* toolbox and is shown in the upper part of Fig. 3. At the output of mathematical model of the asynchronous machine automatically estimated values of torque, speed, α and β components of the stator flux are used and it is not necessary to make estimators for these quantities particularly. This simplification of the model can be justified by the fact that the estimation of motor quantities is not the topic of the paper. Besides, all estimators shown in [11], [12], [13] provide sufficiently accurate results given the adequate motor parameters. The influence of parameter deviation and measurement uncertainties was the topic of many papers [14], [15], with clear recommendations for application in real systems.

The proposed control algorithm is presented at the bottom of Fig. 3. The first subsystem (from left to right) calculates the magnitude and argument of the stator flux. Based on the argument of the flux, determination of sector (1 to 6, as presented in Fig. 1a) of the flux vector location is done.

The next subsystem shown in Fig. 3 contains two-level (classical) flux comparator and multilevel torque comparator. Inputs to the subsystem are torque and flux references and estimated torque and flux values. Flux and torque comparators are presented in Fig. 4a. Input to the flux comparator is the flux error and inputs to the multilevel torque comparator are torque error, specified number of used different voltage intensities (k) and comparator limits (in this specific case for k=6 voltage vectors torque comparator limits are set form $Tbw(1)$ to $Tbw(6)$). The initial script file (M-file) automatically determines limits of torque comparator for desired number of voltage intensities before starting the simulation. The M-file allows the user to choose different number of voltage vector intensities ($k=1\ldots6$) as shown in Fig. 1a (case of three voltage vector intensities). Output of the flux comparator (*Flux status*) may either be 0 (demand to reduce) or 1 (demand to increase the flux). Outputs of torque comparator are intensity of the applied voltage vector and the *Torque status*. In the case of using 4 different voltage intensities, algorithm chooses 25%, 50%, 75% or 100% of the selected voltage vector and *Torque status* which takes values of -1 (demand to reduce), 0 (to hold) or 1 (to increase the torque).

Based on the flux and the torque status, and the sector where stator flux vector is located, the appropriate voltage vector is chosen and it is presented with function block in Fig. 3.



(a) (b)

Figure 4. *Subsystem Flux & Torque comparators (a) and subsystem Calculation of Ualpha & Ubeta of chosen voltage vector and EMF compensation (b)*

The next subsystem presented in Fig. 3 is *Calculation of Ualpha & Ubeta of chosen voltage vector* and *EMF compensation*. The interior of this subsystem is presented in Fig. 4b. It contains two subsystems (*Calculation of alpha & beta component of chosen voltage vector* (left) and *EMF compensation* (right)).

The first subsystem calculates α and β component of chosen voltage vector (*Uvv_alpha* and *Uvv_beta*), as shown in Fig. 5. If the voltage vector is not zero voltage the switches (*Switch 1* and *Switch 2*) pass through upper inputs (*Uvv_alpha* and *Uvv_beta*) respectively, but if voltage vector is zero the switches pass through bottom inputs (*U0_alpha*=0, *Uvv_beta*=0).

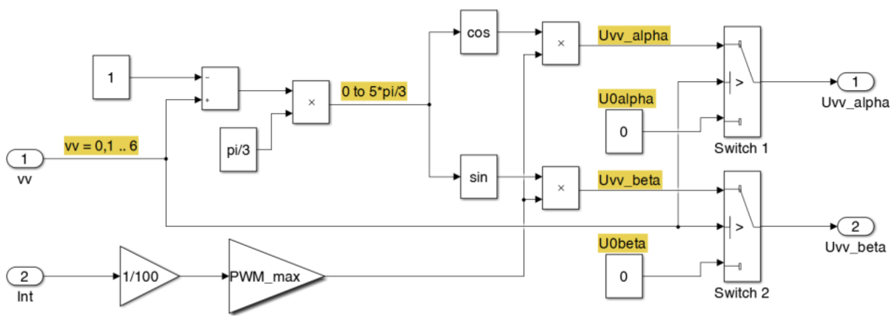


Figure 5. *Subsystem Calculation of alpha & beta component of chosen voltage vector*

The EMF compensation is presented in Fig. 6. Inputs of the subsystem are previously calculated α and β components of chosen voltage vector (*Uvv_alpha* and *Uvv_beta*), estimated α and β components of the stator flux vector (*Falpha* and *Fbeta*) and angular frequency (*wm*) – motor speed. Results of multiplying α and β components of the stator flux with angular frequency are subtracted/summed with previously calculated α and β voltage components as it is presented in Fig. 6. This way α and β voltage components (*Ualpha_all* and *Ubeta_all*) of resulting voltage vector (Fig. 1b) are determined. If the magnitude of resulting voltage vector is greater than allowed maximum value (*PWM_max*), switches 3 and 4 pass the upper inputs (*Ualpha_max* = *PWM_max* · *cos(arg(U))* and *Ubeta_max* = *PWM_max* · *sin*(*arg*(*U*))), otherwise pass *Ualpha_all* and *Ubeta_all*. This subsystem also contains logical input (*Enable)* that enables the EMF compensation (switches 5 and 6 pass a new calculated α and β components of voltage vector that should be applied when the *Enable* is logically high, otherwise the EMF compensation is not in use).

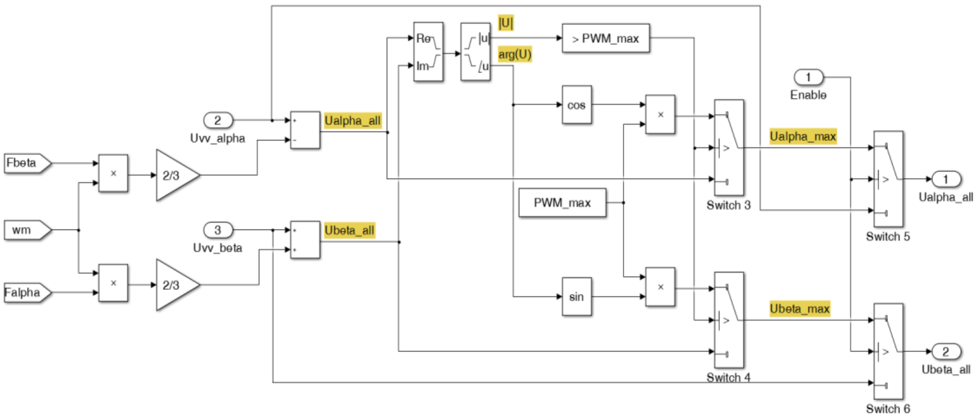


Figure 6. *Subsystem EMF compensation*

After determination of α and β components of voltage vector that should be applied it is needed to convert them to three phase *abc* system and to modulate with PWM, as presented in Fig. 7. The PWM subsystem also contains part responsible for magnetization of the machine. Magnetization is realized with active vector U_1 (inverter transistor T1 is switching with 20% duty cycle and transistors T3 and T5 are off; the states of T2, T4 and T6 transistors are the inverted states of T1, T3 and T5 respectively) until stator flux reaches its reference.

When the estimated flux reaches its specified reference value, *Switch 7* passes the upper input (PWM pulses to the inverter transistors).

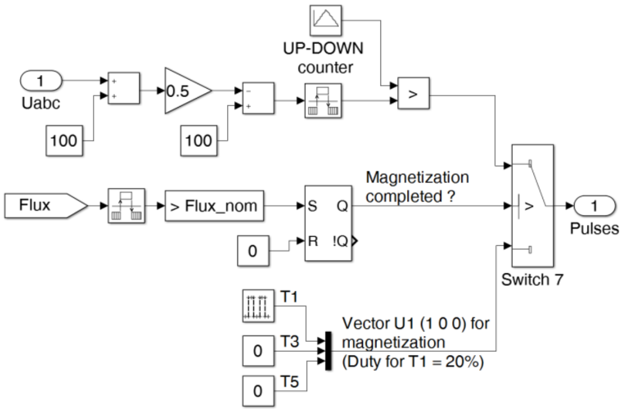


Figure 7. *Subsystem PWM*

To confirm efficiency of DVI-DTC algorithm in torque ripple reduction, simulations are done with not loaded motor for the case of only 3 different active voltage intensities. Torque reference is set to ±0.3 p.u. (±0.387 Nm) with cyclic change every 0.12s. The EMF influence is not compensated. The results of simulations are presented in Fig. 8. Fig. 8a shows estimated torque, torque reference and the corresponding comparator limits. Fig. 8b presents estimated stator flux and its α and β components. The motor speed is presented in Fig. 8c and α and β components of stator currents are shown in Fig. 8d. Nevertheless, Fig. 8a shows significant EMF impact to the torque resulting in deviation of torque from its reference at high speed.

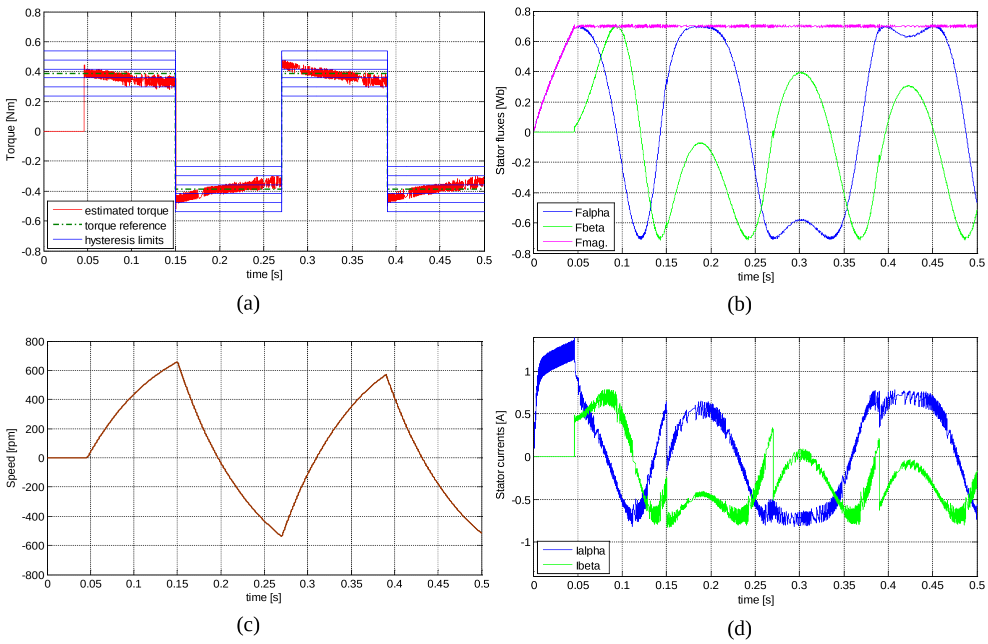


Figure 8. *Estimated torque (a), stator flux (b), speed (c) and stator currents (d), for proposed DVI-DTC algorithm for 3 voltage intensities without EMF compensation*

In order to present torque ripple reduction, as well as much better response of the torque in the case when EMF compensation is included, the DVI-DTC is tested with 4, 5 and 6 voltage vector intensities with and without EMF compensation. The results are presented in Fig. 9. The results show significant torque ripple reduction as a number of available voltage vector rises.

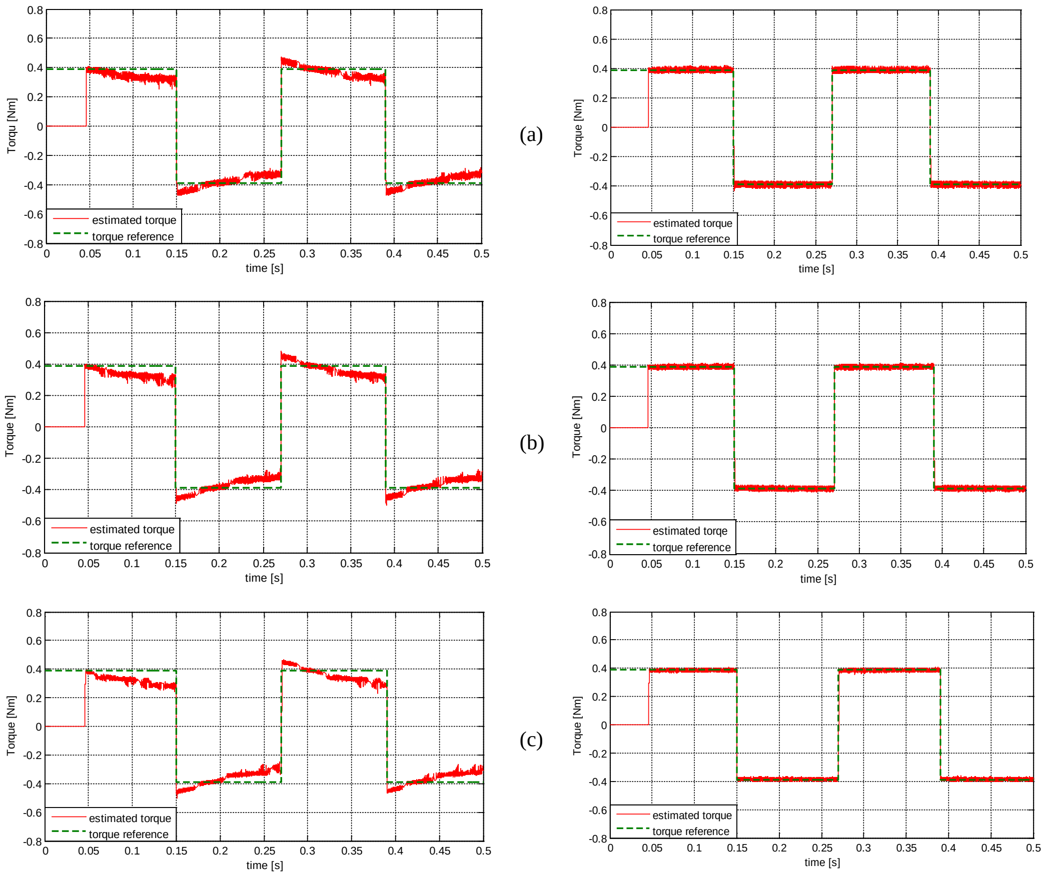


Figure 9. *Torque response with 4 (a), 5 (b) and 6 (c) voltage vector intensities (simulation results) without compensated EMF (left) and with compensated EMF (right)*

4. EXPERIMENTAL RESULTS

Proposed DVI-DTC algorithm is implemented and tested on Technosoft MSK2812 DSP platform combining ACPM 750W power module and TMS320F2812 processor. Detailed description of experimental setup and experimental results with reduced torque ripple related to different number of defined voltage vector intensities can be found in [6].

Experimental results obtained under the same conditions as in the simulations are presented in Fig. 10. The detailed description of flux and torque estimator is given in [16].

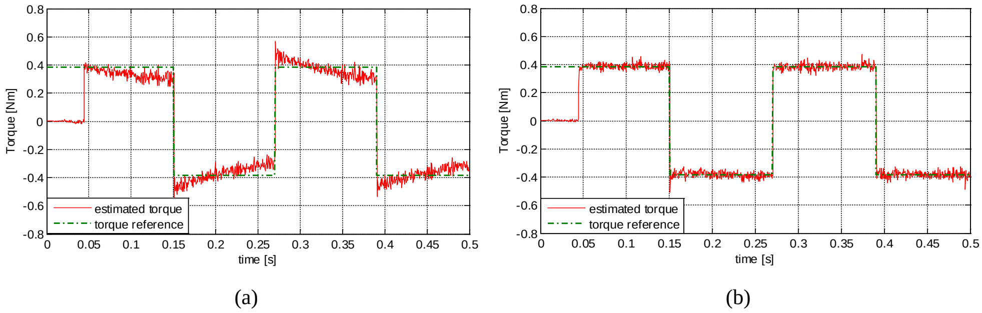


Figure 10. *Torque response with 5 voltage vector intensities (experimental results) without compensated EMF (a) and with compensated EMF (b)*

The experimental results show good consistency with the results of simulation as well as significant torque ripple reduction by increasing the number of different active voltage intensities.

5. CONCLUSION

This paper presents the simulation model of DVI-DTC control method using multiple discretized voltage vector intensities. The theoretical background of conventional DTC and DVI-DTC is presented at the beginning of the paper. Based on the theoretical background, simulation model and the most important simulation results were further presented. Results show significant torque ripple reduction with DVI-DTC method as number of defined discretized voltage intensities increases. Presented experimental results obtained on real DSP platform confirm simulation results. This design approach by developing and testing the control system by means of simulation before experimental verification provides better overview and understanding of the whole system. Simulation model allows us to test DTC control algorithm in different working conditions and to predict system behavior in critical operating points. This is extremely important in the process of predicting potential problems and obtaining their solutions during the development. Also, development and testing the DTC algorithm in simulating conditions allows students to better understand principles of DTC whilst exploring courses of electric drive control. Furthermore, these kind of simulations in engineering provide safe space for improvement and testing of control algorithms before practical implementation in real DSP systems.

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ODROID-XU4 as a desktop PC and microcontroller development boards alternative

Jovan Ivković [1], Alempije Veljović[2], Branislav Ranđelović[3] and Vladimir Veljović[4]
[1] Technical Faculty „Mihajlo Pupin“, Zrenjanin, Serbia
[2] Faculty of Technical Sciences, University of Kragujevac, Čačak, Serbia
[3] Institute for Education Quality and Evaluation, Belgrade, Serbia
[4] Giudance DOO Beograd, Belgrade, R. Serbia
e-mail jovan.eps@gmail.com, alempije.veljovic@ftn.kg.ac.rs, brandjelovic@ceo.gov.rs, veljo99@gmail.com

Abstract: *This paper presents an ODROIN - XU4 SoC computer, for whom even now we can say that has pioneered Nano computer revolution, present computing and the Internet of things.*

Keywords: *ODROID - XU4, information systems, sensor systems, Internet of things.*

1. INTRODUCTION

The idea of a general purpose computer, small in size with an affordable price was born in 2006 by a group of professors from the University of Cambridge. The reason for such computers was concern about the level of prior knowledge of young people who have signed up for computer studies. Unlike students from the eighties and nineties who were working on the ZX Spectrum, Commodore64 and Amiga microcomputers, whom possessed sufficient knowledge in the fields of computer hardware systems and system programming, 21st century students were familiar with the IT world only through the prism of Web applications, PC and gaming consoles.

The basic idea was to develop *something* that would cause interest among young people in the field of computer hardware systems, but at the same time raise the level of knowledge for the software skills. With the advent of the first processor for mobile devices in 2008 it had become clear that the project will get off the ground quickly. The initial idea of teaching aid has evolved, so that today all over the world there are whole armies of programmers from beginners to veterans and hardware enthusiasts. The principle of open source community projects is to exchange ideas aimed at developing mobile and Nettop solutions.

ODROID - XU4 is a SoC computer built by a South Korean company Hardkernel[1]. It was introduced to the market in the summer of 2015 as the most affordable ARM Octa - Core big. LITTLE high performance computer board. Before we move to the presentation of the model, it is important to note that unlike the Raspberry Pi SoC computer[2] which is followed by a large community of users with a host of advanced software applications and programming libraries, ODROID is a platform for experienced professionals which enables the development of applications for the currently most popular operating system Android, and it is supported by Samsung through the implementation of their own Exynos microprocessor.

1.1. ODROID – XU4

ODROID - XU4 is the latest generation of ultra-fast Octo - Core 5422 based compact single board computer. It is powered by ARM big. LITTLE technology the heterogeneous Multi – Processing (HMP) solution. With a smaller form (82x58x22 mm) ODROID-XU4 represents a computing device with more powerful and more energy-efficient hardware. As a product made for the open source community board can run various flavors of Linux, including officially supported Ubuntu Mate 15.10, Android 4.4.4 (v 3.5), also can provide unofficial support for Android 5.1.1 Lollipop, Android 6.0.1 Marshmallow , Kali Linux 2.0, Debian Jessie and others.

A hardware configuration comprises:

Processor: Samsung Exynos 5422 Cortex-A15 2 GHz and Cortex-A7 1.4GHz Octa-Core CPUs made in 28nm technology

GPU: Mali-T628 MP6 with 6x processing units supporting OpenGL ES 3.0/2.0/1.1 and OpenCL 1.1 with Full profile. Clocked at 533MHz it can generate up to 102.4 GFLOPS (FP32)

RAM: 2GB LPDDR3 RAM in 32bit dual-channel configuration at 933MHz provide throughput up to 14.9 GB/s.

Storage devices controllers: eMMC5.0 HS400 Flash Storage in range of sizes from 8 to 64GB and faster microSD UHS1 standard connector (on USB 3.0 controller)

Peripherals I/O: 2 x USB 3.0 Host, 1 x USB 2.0 Host, 4pin Serial UART, Two GPIO ports (30pin and 12pin, 2mm spacing) for I^2C, HSI^2C(High speed), SPI, UART, 2x12-bit analog-to-digital converter,

Network: Gigabit Ethernet port IEEE 802.3ab with RJ45 port

Video and audio out: HDMI 1.4a for display and audio out

2. COMPARATIVE PERFORMANCE ANALYSIS

2.1. Model measurement

In order to present the position of ODROID - XU4 in its characteristics and performance in relation to the Desktop/Laptop PC computers with a microcontroller and SoC development systems on the other side, we will do a series of tests that should provide a more complete picture of the relationship of performance in different applications. It should be noted that in practical applications of microcontrollers it is not expected to exert significant mathematical data processing, since there are DSP and FPGA circuits, so that we will not see them in tests of classic computer processing. In addition, due to limited RAM and flash capacity they are not intended for multimedia and Web content. Their primary role is to provide a reliable process management and support sampling analog electrical quantities in real time. For the above purposes they are equipped with a large number of directly controllable input / output ports aka. GPIO ports. SoC computer systems have similar ports as microcontroller development platforms, but they are less robust with narrower and lower threshold of tolerance for the height and size of electrical oscillations. On the other hand PCs do not have similar hardware input/output ports, and to provide similar functions it would require the purchase of specialized processing card, from that reason PCs will not be discussed in this domain.

In applications that require processor performance, i.e. the speed of working with Web content, HTML5 and Java-script application, the use of microcontroller is either impossible or inappropriate for such applications due to their performance levels, which are usually below a 100MIPS. Another limiting factor is the small working memory, which does not allow them the luxury of the classic PC Web browser with the memory requirements of tens or hundreds of MB.

Given that, computers and SoC development systems (such as Raspberry Pi, ODROID etc.) are used on both sides their value as a learning tool will grow. Through their use, students are given the opportunity to gain a broader insight from computer hardware technology all the way to the Web application levels.

2.2. Comparative results

In the field of direct process control application i.e. electronic circuits and sensors for sampling electrical quantities, we will try to present and compare the performance of microcontroller development system and SoC computers. The main emphasis will be comparing the performance that are achieved using microcontrollers versus SoC computer development systems while controlling individual input/output GPIO ports successive setting and deleting its condition[3]. In addition we will compare the speed at which systems can sample analog values and their electrical voltage through use of analog digital converters.

It should be noted, that from the microcontroller unlike SoC computers it is expected to provide real-time response to the trigger time and its end, which makes them suitable for use in real-time mission critical applications. Unlike them SoC systems are multi core SMP computers in which multiple processes are taking place at the same time. In SoC systems OS avoids providing exclusive rights to certain processes over resources, otherwise it could stop or significantly impede the work of all other threads. Besides microcontrollers have a much wider area of tolerance to input/output value of the operating voltage compared to SoC systems.

Using a simple sequence in programing code directly sets the state of GPIO port 11 to 1 and then deletes it i.e. set to 0 with the help of an oscilloscope SainSmart DDS140 and frequency-UNI-T UT61E, we have monitored generated sequence values, and the summarized measurement results are presented in Table 1.

A key part of the sequence of code that is executed by the C (or like it in Python) is:

```
INP_GPIO(11);
OUT_GPIO(11);

  while(1) {
    GPIO_SET = 1<<11;
    GPIO_CLR = 1<<11;
  }
```

Table 1. *GPIO performance comparison of major SoC and 32bit MCU dev. Platforms*

Platform		***Raspberry Pi 1 B+***	***Pi 2***	***Pi 3***	***Odroid XU4***	***Arduino DUE***	***PIC32MX 250Fxx***
Language (Used Library) for control of GPIO	Shell	2.8 kHz	6.2 kHz	12.92 kHz	125Hz	/	/
	Python (RPi.GPIO)	70 kHz	190.23 kHz	322.5 kHz	/	/	/
	Python (wiringpi)	28 kHz	105 kHz	168.9 kHz	206 kHz	/	/
	C (Native library) /Asembler for MCU	22 MHz	42.16 MHz	55.8-57 MHz	22.5MHz hardware limit	201.7kHz <45 MHz for all GPIO port	<40MHz (>33ns, <25ns)
	C (WiringPi normal GPIO)	4.1 MHz	9.76 MHz	13.83 MHz	710kHz (max 3.9-5.25MHz)	/	/
Analog to digital converting	ADC port numbers and resolution	/	/	/	2ch, 12bit	16ch, 12bit	9ch, 10bit
	Speed of conversion	/	/	/	600kSPS	1MSPS	1.1MSPS
Computing power	Instruction speed in DMIPS[1]	875	2019.41	3039.87	8302.97	125	66-83
Working range	Voltage	3.3V +/- 5%	3.3V +/- 5%	3.3V +/- 5%	1.8V +/- 3%	2.0-3.6V	2.3-3.6V
	Current	max 16mA per port max 50mA for all GPIO	max 16mA per port max 50mA for all GPIO	max 16mA per port max 50mA for all GPIO	max 4mA per port	15mA per pin, 130mA max for all I/O pins.	25mA per port, 300mA for all port pins

From Table 1. it shows that the SoC computer systems may somewhat be paralleled with 32-bit industrial microcontrollers performance[4][5] in the field of direct control of the input/output ports. This provides an opportunity for the development of projects in which students develop creativity through play, but also acquire the basics in the field of electronics. Since SoC systems have network connectivity and sufficient processing capacity to host internet services and applications students are given the opportunity to develop sensor networks and IoT systems[6]. Another area of application is the ability to work with the Internet Web development environment and programming code. SoC systems in this area provide energy-efficient (low-power) alternative to the traditional PC systems, which can be seen from Table 2. where they presented the performance of SoC and the PC system through the Web benchmark tests.

[1] Dhrystone Benchmark 2.1 Opt 3 32 Bit, VAX MIPS rating, compiled for ARM v7

Table 2. *Performance SoC and PC computer systems, applicative web application*

Tests	Platforms				
	Raspberry Pi 2 *32bit 4x core ARM Cortex A7 - 1GHz*, RAM 1GB DDR2 500MHz, V.Core IV, 32GB uSD UHC1 100Mbit NIC)	**Raspberry Pi 3** (64bit 4x core ARM Cortex A53 - 1.2GHz, RAM 1GB LPDDR2 900 MHz, V.Core IV 32GB uSD UHC1, 100Mbit NIC)	**Odroid XU4** 8x core ARM Cortex A15 1.4-2.0GHz, RAM 2GB LDDR3 933MHz, Mali-T628, 64GB eMMC v5, Gbit NIC	**Desktop PC** Intel P4 D 3GHz, 4GB DDR2, HDD 500GB 7200rpm, ATI HD6850, Gbit NIC	**Laptop PC** Intel Core 2 Duo 2.2GHz 8GB DDR3 , HDD 500GB 7200rpm, ATI HD 5650, GbitNIC
SunSpider 0.9.1	1923.6ms +/- 2.2%	1300.9ms +/- 7.9%	726.3ms +/- 1.7%	406.3ms +/- 1.8%	367.1ms +/- 1.1%
Sunspider 1.0.2	1901.4ms +/- 1.9%	1240.7ms +/- 2.5%	683.9ms +/- 1.4%	408.2ms +/- 1.2%	362.9ms +/- 1.0%
JetStream 1.1 (score)	12.944 ± 1.0765	17.443 ± 0.80750	37.443 ± 2.1004	73.583 ± 0.56971	72.783 ± 2.8112
Octane 2.0 benchmark	1794 Points	2895 Points	6896 Points	12533 points	11359 Points
Peacekeper	413 points	656 Points	1000 Points	1544 Points	1766 Points
OS	Raspbian Jessie (Debian Linux 4.1) 32bit		Ubuntu Mate 15.10 armhf	Ubuntu Mate 15.10 64bit x86	
Network transfer	94.2 Mbit/s	94.1 Mbit/s	672 Mbit/s	868 Mbit/s	841 Mbit/s

All tests were done in Mozilla Firefox v45.0 and Iceweasel v38.7.1 for Raspberry Pi, and Raspberry Pi2* was overclocked to 1GHz. Transfer speed is measured on client with "`sudo iperf -c`" server was a PC with 1GB NIC server for PC measurements was Odroid-XU4. Table 2. The difference in performance is further decreased if compared to the same PC systems under Windows 7sp1, 8.1 and 10, as Java script based Octane 2.0 benchmark on the specified PC laptop system in the same Web browser gives no more than 7500 points

Figure 1. *Odroid XU-4 SoC and Arduino DUE ARM-M3 based microcontroller development board*

3. CONCLUSION

The paper presents the comparison, usable SoC development of computer systems with Desktop / Laptop PC computers and Microcontroller / SoC development systems. With two built-in 12bit ADC port Odroid-XU4, initially provides features like microcontrollers, while in the field of web-desktop computer application a significant lead over other active SoC solutions from Raspberry Pi family. Following the results Odroid-XU4 is on average 2-3x faster than Raspberry Pi 3 and less than 50% slower than the full PC platform. Time is on among the ideal solution that can not only take over other SoC solutions and 8bit microcontroller, but also weaker PC workstations in laboratories and classrooms.

The main advantage of Odroid-XU4 platform is the ability to develop solutions that it would enable direct hardware and software compatibility with the Samsung netbook, and tablet platforms under the Android OS, as a most popular global operating system for smart devices.

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6. međunarodna konferencija, Fakultet tehničkih nauka, Čačak, Srbija, 28–29. maj 2016.

UDK: 004.5:371.333 Professional paper

Some spects of using the XBOX Kinect technology in the human – computer interaction class[1]

Đorđe Damnjanović[2], Dejan Vujičić[2], Marina Milošević[2] and Dijana Jagodić[2]
[2] Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia
e-mail djordje.damnjanovic@ftn.kg.ac.rs

Abstract: *The technological development has lately provided a large spectrum of its application in different areas of everyday life. The principles and education methods that were used before are still being implemented, but the technology greatly affect them. One of such improvements is XBOX Kinect, which can be easily used in every structure of education system. By using interesting and visually appealing manner of teaching, the students' interest in taught subjects increases. XBOX Kinect has been applied in the Human – Computer Interaction class, where the aforementioned interaction has been emphasized. This paper describes the use of XBOX Kinect in this class in order to have better approach to teaching theoretical basics in more interesting and efficient way. The paper brings the possibilities of Kinect, with the analysis of its application in education so far and description of software that comes along. Also, the difficulties in its implementation are given as well.*

Keywords: *XBOX Kinect; Education; Human-computer interaction*

1. INTRODUCTION

The last fifty years have brought a vast number of technological accomplishments and progress like no other period in human history before. All of that wouldn't be possible without transistors and semiconductors. Since then, the development of computers and computer technology has been increasing exponentially and reached scales that were possible only with the science fiction writers from the beginning of last century.

Modern Hollywood blockbusters have in some way influenced the designers and engineers of modern computers and user interfaces. One of them is Minority report by Steven Spielberg from 2002. In this movie, the protagonist played by Tom Cruise controls the computer with gestures. A few years later, the vision of this movie's director came true and the device that enables the control of computer by gestures has been introduced. In this

[1] *Research presented in this paper is supported by Serbian Ministry of Education, Science and Technological Development through national projects "Infrastructure for electronically assisted learning", III-47003*

case, it was the game console Nintendo Wii, with Wii Remote controller, publicly shown in 2006. This controller was able to track the position of the player and control the virtual character by user's gestures. Its presence was the turning point in the development of this type of devices. Later on, in 2010, Microsoft has announced Microsoft Kinect, supplement to the XBOX 360 console. Its popularity is based on the possibility of connection to the computer, thanks to the published drivers and Software Development Kit (SDK). In this way, it is possible to use it in the areas that are not strictly related to the entertainment industry. Since the devices that Kinect belongs to can be classified as gesture tracking devices, this type of user interface is known as NUI (Natural User Interface) [1].

One of the basic elements of the human – computer interaction is the user interface, which is supposed to bring the feeling of comfort while using computer, and to facilitate the usage of computers. This is the main reason why the development of user friendly interface is of big importance in computer science. The goal of human – computer interaction on the user interface level is to perform operations effectively, the control of the device operations, and to get feedback from machine that helps operator in decision making process [2]. User interface is the system upon which the users interact with the machine. It involves hardware and software components. User interfaces often reflect the general philosophy of the operating systems makers, and are also the trademark that distinguishes them on the market [3]. The development of user interfaces, also with the development of all components of operating systems, is determined by and in course with the development of computers themselves.

One of the most important moments in software development is turnover from design that was primarily targeting intensive computations to the design targeting intensive presentation [4]. The history of this development process can be divided in three eras: batch processing (1945 – 1968), command line usage (1969 – 1983), and graphical user interface (GUI) era (after 1984). The story begins with the development of digital computer. The starting dates of next two eras represent the occurrence of interactive time sharing and GUI.

This development process was followed by the science and education growth, so some technological accomplishments were of big importance to the development and advancement of teaching process. Along with the use and development of computers, the education system has included the devices that were not imagined to be such an important part of the teaching process. These devices are numerous, and this paper describes one of them that has potential to become very important to the education process.

2. XBOX KINECT AS EDUCATION TOOL

2.1. The working principle of the device

The gesture tracking is the based on series of observations of human activities and environmental conditions in order to achieve main goals of the recognition process [5]. The gesture recognition requires sensor that generate and receive signals. The software that can interpret sensor readings is required as well. The gesture recognition is based on past events. Through the learning process, the software can predict future positions. The goal of gesture tracking is the detection and observation of objects in motion via the sequence of recorded images [6]. When multiple images are recorded using camera, the first step is to differentiate moving objects from static background. The working principle is following [7], [8]:

- The projector emits known pattern of infrared (IR) light to the surrounding objects.
- The sensor observes the scene and detects changes in the projected pattern, which depend on the distance and shape of an object.
- The sensor sends received data to the control logic (computer system) for further processing.
- The received data are processed and 3D map of object is formed (3D map in this context represent the collection of 3D coordinates that form the surface of observed object).

In Fig. 1, the appearance of XBOX Kinect is shown. Also, its main parts are labeled (RGB camera, IR projector, and IR sensor).

Figure 1. *Locations of IR projector, sensor and RGB camera on XBOX Kinect*

2.2. The usage of Kinect in education

The potential that Kinect has as a gesture tracking device in education is large. Kinect can support kinesthetic pedagogic practice in order to develop bigger somatic – kinesthetic intelligence among students. Even though it facilitates the creation of meaningful interaction in the classroom [9], Kinect has to be integrated with the computer, projector, and compatible software. From the teaching tool aspect, due to the multiple types of interaction it supports, Kinect has a potential to improve interaction, the student participation in the teaching process, capabilities of teachers to present and manage multimedia materials, and to create discussion models. As an addendum, students can use information received from Kinect to create highly interactive multimedia solutions. Because of the intractability aforementioned, the Human – Computer Interaction class can be improved and advanced in relation to the standard models of teaching methods applied in this class.

By using software tool Avatar Kinect, it is possible to animate distance learning, cooperation on projects, and socialization between students. Avatar Kinect uses gesture tracking together with facial recognition in order to assign a special avatar to each student and onscreen representation of student in real time, which imitates the way the user smiles, talks, and behaves. It can be connected to upon eight persons on different physical locations. By using this tool, much less bandwidth is needed comparing to the regular video calls, since the real time animation of avatar needs a bit larger bandwidth than to transmit voice call [10].

However, with aforementioned possibilities, one of the main advantages of Kinect is the possibility of studying programming techniques. Students would write programs in an interactive way, creating real time avatar control applications, where they would use techniques of object – oriented programming [11]. In this way, by doing an animation of interactive processes in an efficient and interesting manner, students would gain desire for further learning. Fig. 2 shows the example of controlling avatar using Kinect.

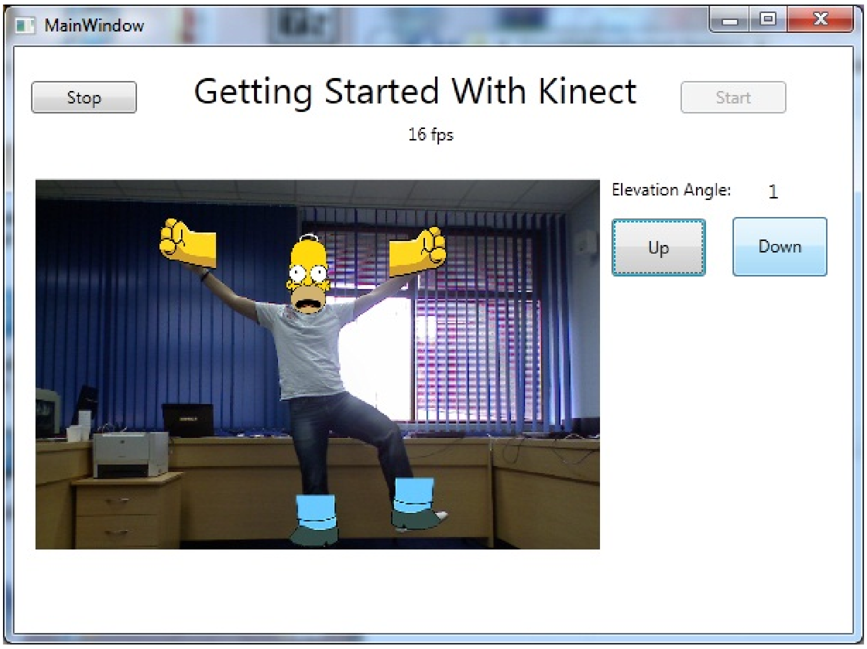

Figure 2. *The control of avatar using Kinect*

2.3. The usage of Kinect in classroom

1) Kinect as teaching tool

Kinect, along with other types of devices, tends to adapt to large spectrum of requests that has been facing. The most common activities and elements that one such device needs to accomplish are flexibility, universality, multimedia support, efficiency, interactivity, etc. The usage of Kinect needs to be planned in advance, and the device needs to be put in the classroom so the interaction with students is at maximum. The teachers need to think of activities that will be done using Kinect. The main obstacles in using Kinect are teaching curricula, which are in some part in oppose to using kinesthetic practice. By connecting it to the computer and projector, Kinect can enable doing some activities by gestures, which improves the cognitive possibilities of a human. The possibilities of Kinect can be used in activities such as determination of trajectory of an object, where students in person can check the results [9],[11]. Some of main characteristics of Kinect as teaching tool are:

- Flexibility,
- Multiuser support,

- Animation of students.

2) *Kinect as learning tool*

The main quality of Kinect important for learning process is its motivating capabilities. Kinect can be integrated into simulated environments and in this way to increase the possibilities of such environment. Second main quality of Kinect is its communicability. By using multimedia options and kinesthetic memory, student is enabled direct visual contact with teaching material. The third possibility of Kinect is software compatibility. In this way, Kinect with used software support development of personal knowledge and capabilities.

In Fig. 3, the example of Kinect Explorer window is shown. It can be seen the way Kinect recognizes human gestures by mapping certain points on human body. This is crucial for understanding the working principle of Kinect.

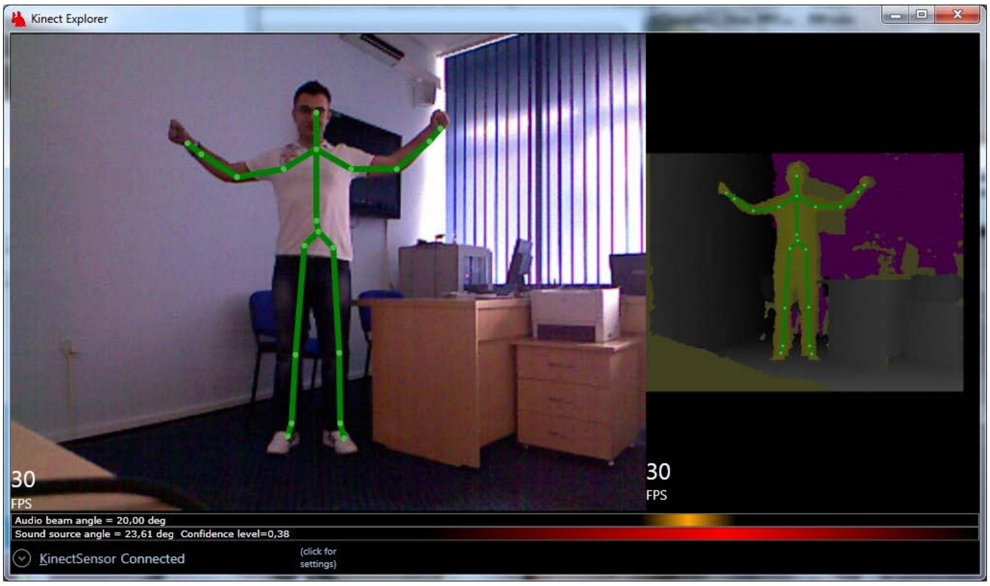

Figure 3. *The appearance of Kinect Explorer window*

2.4. Limitations of Kinect

Technical limitations can be due to required space for classroom in which Kinect can work undisturbedly. Recognition can be done only on two actors, while other participants have to be out of working area. The price of the device can be the problem somewhere, too.

One of the problem is that not large number of teachers would engage into changing teaching curricula and adapt them to the new technologies. However, in the Human – Computer Interaction class, Kinect is of great importance. In order to prevail the gap between old teaching methods and new ones, Kinect can be used as tool in laboratory exercises. In this way, both the teachers and the students, would get used to new teaching methodologies.

3. CONCLUSION

Following the development of modern computer user interface, the user has gain full control of human – computer interaction. This type of interaction is natural and intuitive, based on gestures and voice, and represent step through in human perception of interaction with machine. At the beginning, the voice and movement recognition algorithms were quite imprecise, but in time, they were improving and today, they have satisfactory percentage of success.

The aforementioned analysis of usage of Kinect in education clearly suggests that the use of this device is desirable and it improves creativity and willing to work among students. However, Kinect is needed to be integrated with other devices, such as computer or projector. Beside hardware, the usage of appropriate software is important as well. The future use of Kinect will depend primarily on future software solutions and the dynamic of their development. With all the difficulties, Kinect is capable of being the device that will improve learning process.

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Educational set up for measurement of photovoltaic modul electrical parameters

Marko Šućurović[1], Miloš Božić[1] and Snežana Dragićević[1]
[1]Faculty of Technical Sciences Čačak, University of Kragujevac, Čačak, Serbia
e-mail marko.sucurovic@ftn.kg.ac.rs

Abstract: *This paper presents educational set up for practical teaching about photovoltaic systems. The paper gives theoretical aspects of photovoltaic panels with description of the current-voltage characteristic. Measuring of electrical parameters using conventional measurement instruments and data acquisition system are shown. Usage of the measuring data acquisition systems speeds up obtaining important characteristics of photovoltaic panel. The main focus is on the processing and analysing of results, not on reading the data from conventional measurement instruments. The LabVIEW software automatically generates a report after completing the measurement. Ideas for further development of set up and enhance the teaching of photovoltaic modules are also given.*

Keywords: *photovoltaic cells; photovoltaic module, I-V characteristics, LabVIEW*

1. INTRODUCTION

Besides other technologies of renewable sources, photovoltaic (PV) systems have a significant part in the electricity production. Total global installed capacity of photovoltaic systems at the end of 2014 was 177 GW [1]. The increasing usage of PV sources require a greater number of teaching units at secondary schools and faculties for teaching this technical field. Students on courses about renewable energy sources should equally have theoretical classes and practical exercises. In this way, students better understand working principles of generate electricity using renewable energy sources. Secondary schools and faculties should improve their teaching with practical work as much as possible. This primarily refers to work in the laboratory and practical work in industry, if possible. Because the use of real system in the laboratory improves the quality of teaching.

2. ELECTRICAL CHARACTERISTICS OF PHOTOVOLTAIC CELL

The most important characteristic of photovoltaic cells and panels is current-voltage (*I-V*) characteristic. This characteristic give information of some important PV cell/panel parameters. PV panel is modelled by electric equivalent circuit, and *I-V* characteristic is described by a mathematical function. The dependence of certain values can be confirmed by measuring witch also gives the mathematical model of the system [2]. Electrical values measured using data acquisition equipment can be easily processed. So, these example can be further developed through the concept of distance learning [3].

Photovoltaic cell can be modelled with a current source, anti-parallel diode, a shunt resistance and a series resistance (Fig. 1b). Current source I_{Ph} represents photo current and it is proportional to irradiance and PV cell area.

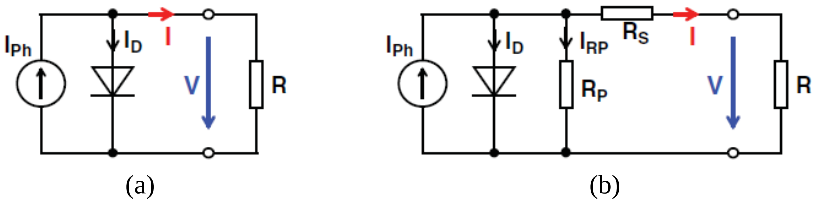


Figure 1. *Equivalent circuit for loaded ideal (a) and real (b) PV cell [4]*

PV cell without a shunt and series resistance becomes ideal PV cell (Fig.1a). Load current of ideal and real PV cell are:

$$I = I_{Ph} - I_D = I_{Ph} - I_s\,(e^{eV/nkT} - 1) \tag{1}$$

$$I = I_{Ph} - I_s\,(e^{eV/nkT} - 1) - (V + I \cdot R_S)/R_P \tag{2}$$

where I_s is the saturation current of the diode, e is the charge of electron ($1.6 \cdot 10^{-19}$ C), n–is diode quality factor, (usually n=1), k is the Boltzmann constant ($1.38 \cdot 10^{-23}$ J/K), T is the absolute temperature in K.

Output voltage of PV cell is obtained from the equation (1):

$$V = (nkT/e)\ \ln\{1 + [(I_{Ph} - I)/I_s]\} \tag{3}$$

Fig. 2 presents current-voltage characteristic and power-voltage characteristic with a PV cell area of 102 cm^2, irradiance amounting to 1 kW/m^2 and 25 °C cell temperature [1]. These characteristics represents some values which are the most important parameters of the PV cells/panels: I_{SC} is the short circuit current, V_{OC} is the open circuit voltage, P_{MPP} is maximum power point, I_{MPP} is the current at this maximum power point, V_{MPP} is the voltage at this maximum power point. These parameters are commonly given on nameplate of each PV panel. MPP point at the I=f(V) function is the point of maximum power at known irradiance and temperature value.

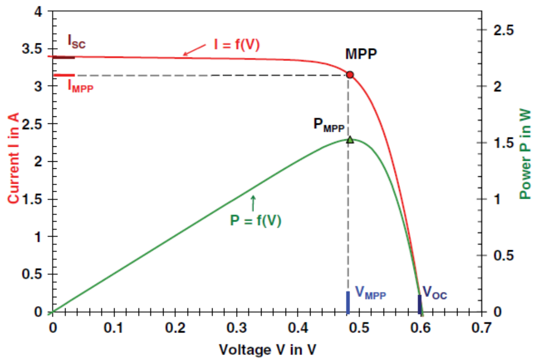


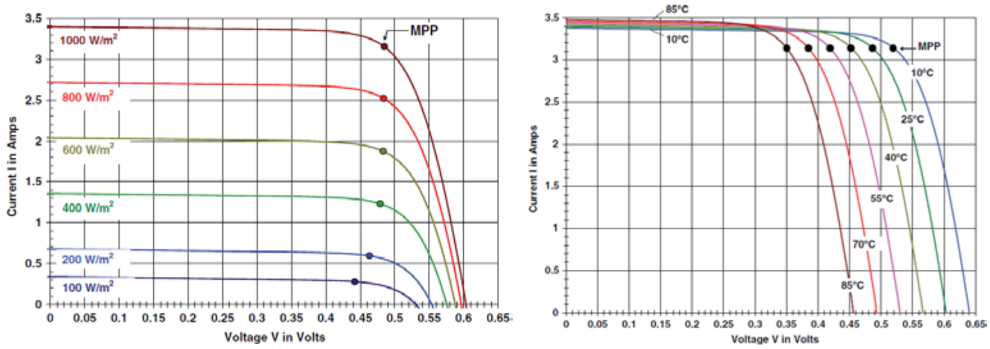
Figure 2. *Characteristic curves I=f(V) and P=f(V) of photovoltaic cell [4]*

Fig. 3 shows the current-voltage characteristics of PV cells for different values of irradiance and cell temperature. The value of short circuit current largely depends on irradiance, while the open-circuit voltage depends on the cell temperature. The V_{OC} and I_{SC} values as a function of temperature in %/°C are often given on the nameplate of PV panels.

Beside efficiency, fill factor (FF) shows the quality of PV cell [4,5]. Power P_{MPP}, or the product of voltage and current at MPP is always less than the product of open circuit voltage V_{OC} and the short-circuit current I_{SC}. Fill factor is given as ratio of these two powers:

$$FF = P_{MPP}/V_{OC}\cdot I_{SC} = V_{MPP}\cdot I_{MPP}/V_{OC}\cdot I_{SC} \tag{4}$$

Fill factor is mainly in the range of 60 to 80%.



(a) (b)

Figure 3. *Characteristic I=f(V) for photovoltaic cells at different irradiance (a) and temperature (b) [1]*

3. MEASUREMENT OF PV MODUL ELECTRICAL PARAMETERS

3.1. Measuring with classic measurement instruments

The simplest methods of measuring the electrical parameters of the PV panels can be realized using conventional measuring instruments. Besides PV panels ammeter, voltmeter and variable load resistance R are needed. Power of applied resistors mast be less or equal to the maximum power of the panel. Measuring the temperature of the panel can be made by any sensor for temperature measurement (thermocouple, Pt100 sensor). Input power (irradiance) is provided by direct sunlight exposure, or more practically, using artificial light sources. Usage of the artificial light sources allows much easier control of input power irradiance. The measurement can be realized at any time of day. Panels can be connected in series, parallel or mixed. In this case, the *I-V* characteristic is defined with: the short circuit current $m\cdot I_{SC}$, where m is the number of parallel connected panels; and the open circuit voltage $n\cdot V_{OC}$, where n is the number of series connected panels.

3.2. Measurements using the virtual instrumentation and data acquisition equipment

Traditional work in the laboratory is based on the use of classical instruments in the form of analog or digital ammeters, voltmeters and thermometers. Today, when everything runs on computers and mobile devices, still further laboratory work starts on the traditional setups with basics devices. With such assumptions the basic principles can be learned. Also, all those basic knowledges that were moved in the background with electronic devices can be seen. After the use of traditional instruments for measurement, data acquisition systems can be introduced. In modern measuring stations traditional devices are replaced with a data acquisition device (DAQ). For that reason, identical setting is formed, by using acquisition card and PC. Block diagram of such setup is shown in Fig. 4.

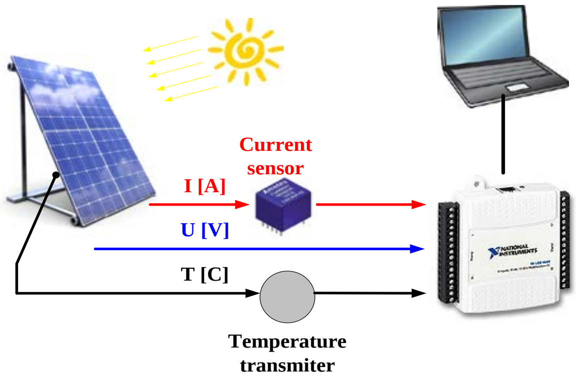


Figure 4. *Block diagram for measurement of PV panels parameters by using DAQ system*

In Fig. 5 can be seen PV panels and measurement acquisition card USB type NI6009 [6]. As this type of acquisition card has only voltage inputs with measuring range of ± 10 V, it is necessary to adjust all input voltage levels. Therefore, voltage divider is used to scale down the voltage, while the current sensor is used to measure current [7]. Current sensor works on the Hall effect principle and current value of 0 - 2.5 A is converted into a voltage signal of 0-5 V. To measure the temperature Pt100 sensor is used. Pt100 is connected to the acquisition card by using transmitter. The transmitter ensures that signals in mV from Pt100 is converted into a voltage signal up to 10 V [8].

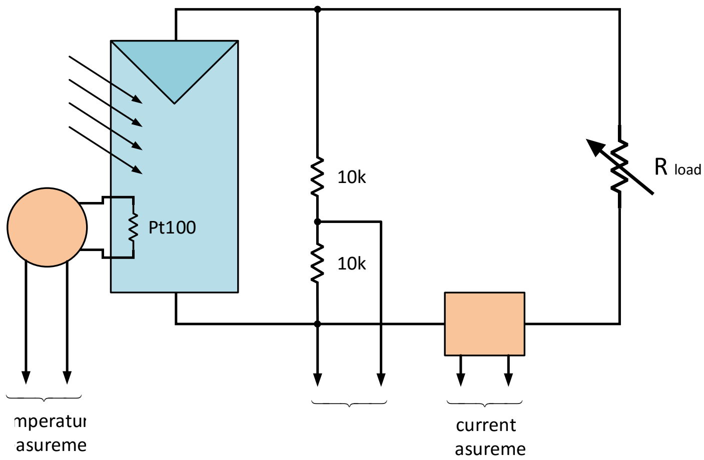
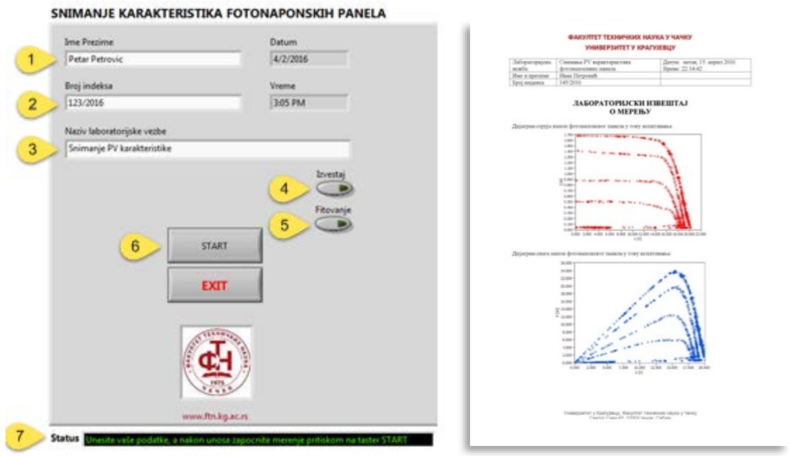


Figure 5. *Electrical circuit of DAQ system*

To speeds up the process of obtaining measurements and characteristics of PV panel, an application is made in LabVIEW program. Application automatically generate report after the measurement, and can store data over a long period of time. The application enables to monitor parameters of PV panel from a remote location. Monitoring of parameters is usually needed when the solar power plants are on the locations outside the settlements, and there is no need for the physical presence. In this way, students will learn about the concept of remote monitoring of the PV panels parameters, and some possibilities of SCADA systems.

After starting the application student can see the display as shown in Fig. 6 (a). Student need to enter some data like, it's first and last name (1), the index number (2) and the name of the measurement to be performed (3). There is a choice whether they would like to create a report (4) and whether it wants to perform fitting obtained characteristics (5). At any time, information about the current status of the application can be tracked at the status line (7). Generated report is shown in Fig. 6 (b). The appearance of the report can be easily adapted to the needs of practical exercises, and can add other necessary data which are essential when performing exercises.



(a) (b)

Figure 6. *Start window for data entry and options selection (a) and generated report (b)*

After data entry application can be run on the START button. Student can choose between measurements of the current and voltage values in time or *I-V* characteristics and power-voltage (P-V) characteristics. This part of the application is shown in Fig. 7.

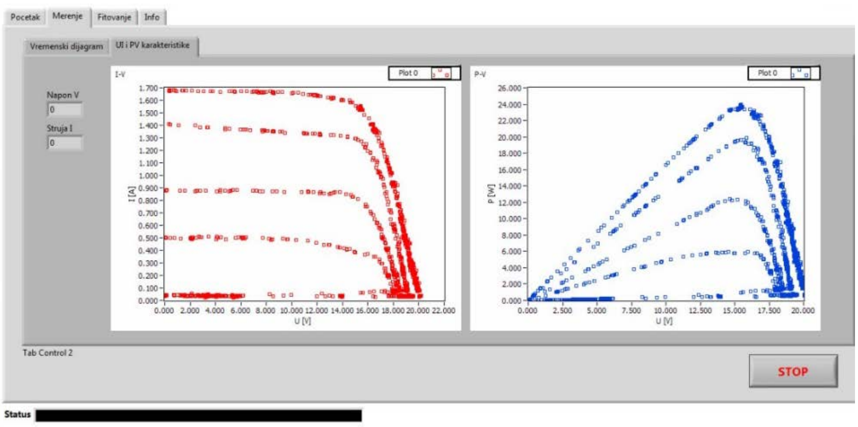


Figure 7. *Application tab for the measurement of I-V characteristics*

4. CONCLLUSION

Practical classes significantly affect the understanding of certain teaching unit witch students study during theoretical teaching. The purpose of this laboratory setup is that students in the subject of renewable energy, get better acquainted with the functioning of these systems. Also wish is to extend theoretical classes with as many as possible practical application examples. Recording *I-V* characteristics of the PV panel is one of the basic exercises in a series of practical exercises of PV systems. Further development of this application will go in the direction of the monitoring and storage parameters remotely. For monitoring of specific parameters like elevation, azimuth, altitude and GPS location sensors will be added. That will allow students to see how characteristics of PV panels changes with these parameters. Sun trucking system also will be implemented so beside measurement students will have possibility to control PV system in order to achieve the highest insolation. The creation of a remote experiment will increase the availability of laboratory setup, which would allow students to comfortably perform lab exercises from another remote location without the presence in the laboratory.

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Automated noise measurement technique of petrol engine

Goran Jovanov[1]
[1] International University, Faculty of Traffic Engineering - Brčko, BiH

***Abstract**: Economy, prevalence, open architecture and high computational capabilities provided by the PC led to the rapid development in the field of measurement, automation and instrumentation. Computer technology has found a variety of applications in automatic measurement of physical quantities, but all options are yet to be exhausted, so that in the future further development of this branch of the measurement techniques can be expected.*

***Keywords:** Automated measurement techniques, methods of measuring noise*

1. INTRODUCTION

Noise has been present from an early age and its importance is even more obtained in this modern age of civilization development. With the advances of techniques, the man created a new sphere that is now popularly called the techno sphere, with a number of advantages in comparison with the period when the jobs were performed manually or semi-automatically at a later time. In addition to these advantages, in the setting of techno sphere, some phenomena that are harmful to human health and the environment in general come to the surface. One of the side effects is the noise as well, which is the research problem in this paper, but it is particularly evident in the developed parts of the world, while the struggle and the striving to reduce the noise level becomes our everyday life.

There are more conceptual definitions of the term noise, but none of them is strictly specified. Noise can be treated as any unexpected or incomprehensible signal, which cannot be interpreted as a regular information. It can be defined as the murmur produced by interference or a similar phenomenon. Murmur is noise flickering which consists of a continuous range of frequencies, and therefore represents the physical size that is easily noted, measured and can be suppressed. However, the murmur is only one part of the noise, and it is necessary to access noise with a greater degree of attention to determine it on a generally acceptable level.

The term automated measurement technique signifies computer controlled measuring systems, which have due to its economy, now become an indispensable part of any system of automatic control.

The advantages of this measurement system are:

- In a short period of time it is possible to collect and process large amounts of data,
- The measurements are performed automatically,
- Calculating and documenting measurement data is accomplished using a computer,

1.1 Data acquisition systems

Data acquisition is the process by which physical phenomena in the real world are transformed into electrical signals that are measured and converted into a digital format for the purpose of processing, analyzing, and storing of the computer [2].

Figure 1 shows the general scheme of the system for data acquisition.

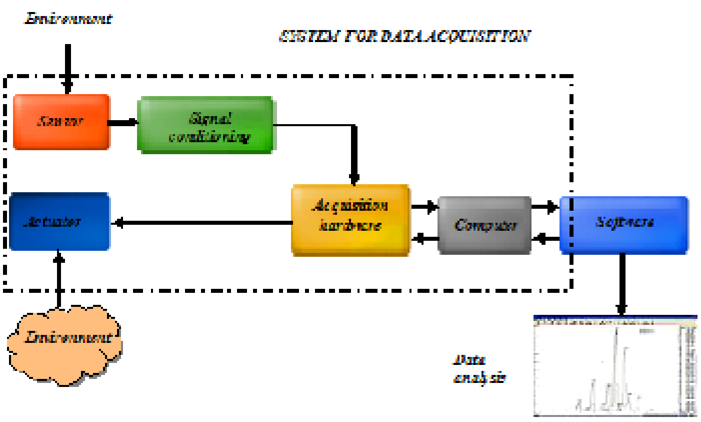

Figure 1. *General scheme of data acquisition system[1]*

Acquisition systems consist of measuring devices that accept signals from a large number of sensors and transducers, process them, transmit and remember, including the software for acquisition control, analysis and display of the data. They are known in literature as DAS (Data Acquisition System). The primary purpose of these systems is to collect data. Usually these are the data of some physical processes. After collecting it, the data is then correlated with other data, filtered, reduced, etc., in order to extract the wanted information. The data can be further analyzed, visually displayed on various types of displays, or can be used as the basis for other render diagrams. For most of the applications DAS is designed not only to collect data but also to take appropriate management actions. Therefore, the definition of DAS should include not only the aspects of obtaining data, but also the managing of the way the systems function.

The system for data acquisition and management is defined as:

Electronic instrument, or a group of interconnected electronic hardware components, intended to measure and quantization of analog signals and digital acceptance, in order to digitally analyze and process, and take feedback-control actions. [1].

The basic components of the system for data acquisition are:

- Hardware data acquisition. The main function is A/D (analog-digital) and D/A (digital-to-analog) conversion. It is installed via slots inside the computer or externally via a cable connected to a computer. It consists of subsystems, each of which performs a specific task. The subsystems include analog inputs, analog outputs, digital I/O, counter/timer.
- Sensors and actuators (Executive). Transducers are the devices that transform input energy from one form to another form of energy output. They convert the physical phenomena into signals representing hardware input for data acquisition. There are

two types of sensors based on the character of the output signal: analog and digital. Digital sensors produce an output signal that is a digital representation of the input signal and has an amplitude signal at discrete points in time. The standards of digital sensors include TTL or ECL (emitter-coupled) logic. Digital input sizes are mostly confined to the reception of voltage signal +24 VDC, analogue to the standard current signals (4-20mA) or voltage signals (0-10V), and the output relay or transistor of relatively low power. Analog input values are received directly from the measuring transducer (transducer - sensor), or from a set made from measuring sensor and an element for adjusting (conditioning) of the signal (transmitter) or from a set which prepares the signal from the transducer for direct reception by the PC via some of the standard communication links (transceiver). Return effect on the measuring and control system is realized through the executive mechanism, actuators, preceded by executive converter. As with data collection, the activation of managing mechanism is achieved through the standard current (4-20 mA) or voltage signal (0-10V, 24V). The most common actuators are: vent pipes, valves, couplings, etc. The actuator consists of a mechanical device which changes the executable size (vent pipes, switch, contactor, valve, ..) and drive (solenoid, servo-electric, pneumatic or hydraulic).

- Hardware for signal conditioning. The signals generated by the sensors are often incompatible with hardware for signal conditioning. Signal conditioning implies filtering (removing unwanted noise from the useful signal), amplification, linearization, buffering, sampling / holding (sample / hold), attenuation etc. signal from the measuring encoder.
- Computer. It includes the processor, the system clock, data bus, memory and space to store data. The computer provides the processor, system clock bus for data transfer, memory and disk space to store data. The processor controls how quickly data can be accepted from the converter. The system clock enables obtaining weather information on the data collected. Knowledge of the information gathered by the sensors is not enough. It is necessary to know when the measurements were taken. Data from the hardware are transferred to system memory via DMA (Dynamic Memory Access) or interruption. DMA is a controlled hardware and works extremely high speeds. Maximum speed of data acquisition is also designated by the computer architecture bus.
- Software. It enables the exchange of information between a computer and hardware. Typical software allows configuring the time of sampling and collecting a predefined amount of data. Receiving information from the hardware and sending information to the hardware. There are two types of software: computer hardware and application. Hardware software allows you to access and manage the hardware. [3].

2. MOTOR VEHICLE NOISE MEASUREMENT METHOD

While the vehicle is in motion, on each side of the vehicle two to three measurements are carried out and largest value obtained is taken. Test measurements are not taken into account. The technique of measuring the noise of vehicles in motion: a microphone is set at 1.2 ± 0.1 m above the surface with a distance of 7.5 ± 0.2 m from the centerline of the vehicle in comparison to normal PP to this axis (Figure 2). [4].

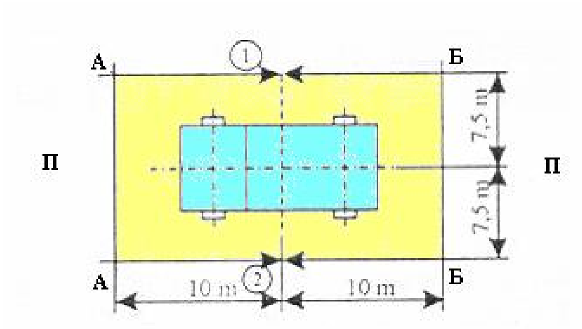

Figure 2.*Measuring points when the vehicle is in motion* [4].

Figure 2 shows that the part of the track where testing is done parallel with the PP at a distance of 10 meters, in front and behind, the two lines AA and BB are drawn. The vehicle is moving unvaryingly at a given speed, and on arrival at the position AA, where full gas is given and maintained until the rear of the vehicle passes through the line BB when gas is reduced.

2.1. The method of measuring engine noise in standby mode

For this measurement it is necessary to meet the requirements and then access the technique of measuring the noise of vehicles in standby mode.

Every open space is suitable for measuring noise emission of the vehicle while in standby mode if it is flat, made of concrete, asphalt or other hard surfaces, except trodden clay surface, where it can pull a rectangle whose sides are 3 m (Fig. 3) far from end points of the vehicle to which there are no visible obstacles. [4].

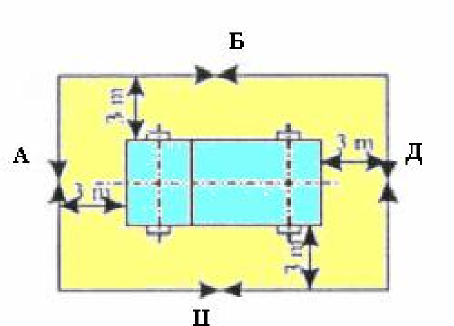

Figure 3. *Positions of noise measurements while the vehicle is stationary* [4].

Number of measurements per measuring point is a minimum of three the one that has the highest noise level is taken as the valid one. The measurement is considered valid if the difference is not greater than 2 dB (A) in between three consecutive measurements.

The vehicle should be placed on a flat surface so that the shift lever is in neutral, and the engine is running at the appropriate speed level for this operating mode. In addition, it should be noted that the vehicle must be technically correct, and to avoid measurements if the engine cooling system is on.

3. VIRTUAL INSTRUMENTATION

The basic idea of virtual instrumentation is that the personal computer, as a powerful and affordable development platform, with the help of a dedicated specialized hardware and software modules, is used in order to collect data from measuring devices for further processing and display of measured values. This represented the beginning of a new concept called virtual instrumentation.

Virtual instruments represent visualization and centralization of complex measurement systems on a standard personal computer in the form of a virtual user interface. [3]

The main advantages of this concept are the following(Figure 4). :

- The virtual instrument may have any combination of industry-standard hardware for collecting or issuing data: GPIB (IEEE 488), RS232 - devices, VXI - systems, field bus (CAN, Interbus-S, Profibus, etc.), multifunctional - connecting cards, DAQ - instruments, components for image processing and so on.
- Possibilities of analysis of measurement data and their presentation go beyond the traditional measurement techniques.
- Along with powerful software developmental environment and a set of hardware components, numerous virtual instruments can be implemented and cover a broad range of tests and applications.

Figure 4. *Traditional and virtual instrument*[3]

In centralized acquisition systems all transducers are connected on central computer interfaces, and it provides a complete digital signal processing: digital filtering, linearization, process monitoring, alarm, control, etc. For a computer to work in real time, i.e. in control of all the signals necessary for multiplexing and conversion, to end this process between the two conversions, it needs to have great processing power. However, computers with a specific construction are often used. The issue that is highly pronounced with these systems is the reliability due to failure of the central computer. Furthermore, the realization itself contains many wires leading to the central computer, and if the measuring points are spatially distant, there is also the problem of the transmission of analog signals in terms of industrial interference. The centralized system usually does not allow the separation of the control from the acquisitions. The main advantage is that the system design does not include communication between components, but all acquisition cards simply read by a direct memory access, using the existing driver instruments, as well as in case of any other virtual measurement system.

In centralized measurement systems all the devices for data collection are connected directly to the computer. The connection is realized either via the system bus (PCI, ISA, VXI, etc.) or via standard communication interface of the computer. (Figure 5). [3].
The standard interfaces include:
• Parallel port
• Serial interface RS-232
• Universal Serial Bus USB
• Firewire (IEEE-1394)
• IEEE-488 (via adapter)
Modern measurement devices have infrared, Bluetooth or WLAN interface

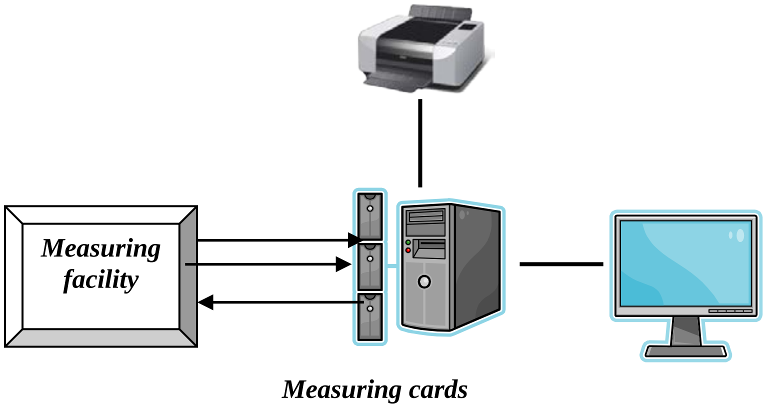

Figure 5. *Centralized measurement systems*

4. CONCLUSION

An important moment in the technology of measuring noise, whether on a motor vehicle or other technical systems, is to choose a proper methodology and comply with the applicable standards and laws of the territory in which the research is conducted. If the state does not have its own standards and regulations, some of the other national standards shall be taken as valid; in most cases here, the German standard RLS 90 for analyzing the traffic noise on the basis of which traffic noise emissions are measured and forecasted, is taken as the valid one.
In addition to this, it is necessary to use the measuring technique which also meets the prescribed requirements, so the measurements are accurate and valid. Specifically, this study was conducted using measuring equipment that meets all the standards for mapping noise pollution, such as RLS 90, RLM 2, Schall 03, ISO 9613.

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Determination of velocity and acceleration of the object in motion moving down along vertical cylindrical rails

Stojan Savković[1], Vojislav Vujičić[1], Ivan Milićević[1], Milan Marjanović[1], Radomir Slavković[1] and Nedeljko Dučić[1]
[1] Faculty of Technical Sciences Čačak, University of Kragujevac, Serbia
e-mail ivan.milicevic@ftn.kg.ac.rs

Abstract: *In this paper is presented the methodology for measuring the velocity and acceleration of the object in motion moving down along vertical cylindrical rails of laboratory device for pipe impact testing. For this purpose are used magnetic sensors and digital oscilloscope. An overview has been given of all relevant parameters, measurement procedure and measurement results. Since the measurement of velocity and acceleration was done indirectly, by measuring the time of movement of the object along a specified path, an overview has been given of all the necessary conversion formulas required to calculate the desired physical values.*

Keywords: *measurement; time; speed; acceleration; sensor*

1. INTRODUCTION

Measurement of velocity and acceleration at a relatively short distance usually is based on the measurement of displacement with respect to a reference point [1-3]. This paper describes laboratory exercise experimental determination of the speed and acceleration durng the free fall of the object. The method consists of measuring the time required for the object to overpass a certain path. To detect the position of the object electromagnetic sensors were used [4-7] whose operating principle is based on Hall-effect (*Hall efect*), fig. 1, placed in extreme positions at a distance equal to the length of path that the body should overpass.

Figure 1. *Hall effect electromagnetic sensor*

Sensors based on Hall-effect belong to the special electromagnetic sensors. Hall effect occurs when a semiconductor through which current flows is introduced into a magnetic field. If the semiconductor plate is in a fixed position perpendicular to the magnetic field of induction $\vec{B}$

and if through the plate flows current I (*fig. 2*), then on the holders of electricity effects principle of Lorentz force $\vec{F}$ perpendicular to the direction of current and induction:

$$\vec{F} = e\vec{v}_s \times \vec{B} \tag{1}$$

Where are:

$\vec{v}_s$ - mean velocity of charge carriers due to longitudinal electric field $\vec{E}$ that creates current I in the plate;

e - the amount of the charge, which is under the influence of a magnetic field.

Typical Hall-voltage value of the current is expressed in about few mV, and the value of the output resistance is from few ohms to several hundred ohms.

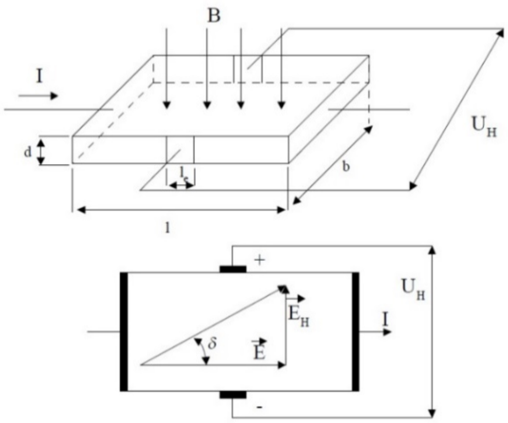

Figure 2. *Hall plate* [8]

Hall sensors are used to measure displacement affecting the change in the strength or direction of magnetic induction. Hall sensors are used to measure other quantities by the elastic elements which converted value into a proportional shift (force, preasure, acceleration, etc.). On figure 3 is shown use of Hall sensor for measurement and detection of displacement.

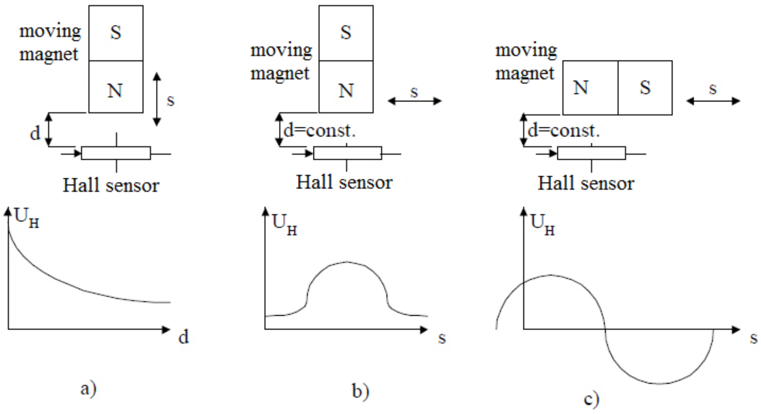

Figure 3. *Measurement of displacement by Hall sensors: a) magnet is moving perpendicular to the plate, b) i c) magnet is moving parallel to the plate* [8]

2. METHODOLOGY OF MEASUREMENT

In practical exercises of technical mechanics described in this paper, for measuring the velocity and acceleration during free fall, the laboratory device is used for testing pipes by impact (*fig. 4*). It is necessary to determine the velocity and acceleration of linear bearings when falling down along vertical cylindrical rails.

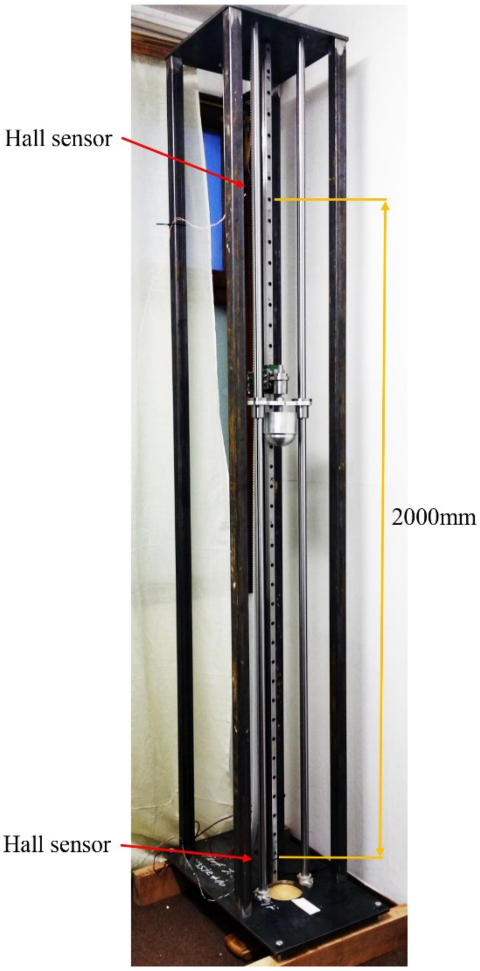

Figure 4. *Laboratory device for pipe impact testing*

The method consists of measuring the time taken for the object to exceed a predefined path - in this case the path of the 2 m. The sensor system consists of a permanent magnet attached to the moving object and fixed Hall sensor. Detecting the position of the object is done by using two electromagnetic sensors based on Hall-effect, set up in the end positions at a distance equal to the length of 2 m, ie. the lenght of the path that the object needs to overpass. The primary output parameter is the time of free falling object. Sensors detect the inflience of permanent magnets mounted on the object that is moving down along cylindrical rail. Time is measured by the digital oscilloscope (*fig. 5*).

Figure 5. *Digital oscilloscope*

The measurement is done when the object is lifted into the upper level position shown in figure 4 and released into free fall without initial velocity. The upper sensor registers the influence of permanent magnets mounted on the object. That signal on the oscilloscope is registred as an initial moment of movement of the object. In the moment of passing the object near the second mounted sensor in the lower end position, sensor receives the signal that the oscilloscope registers as a time at which the body took time equal to the distance between the two sensors - in our case the distance from 2 m. Then, on oscilloscope is shown the time divergence (t) between the two received signals, (*fig. 6*), which represents the time it takes the object to overpass the path of 2 m during free fall via cylindrical rails, with no initial velocity. All measurements were performed at a constant room temperature of 22 °C.

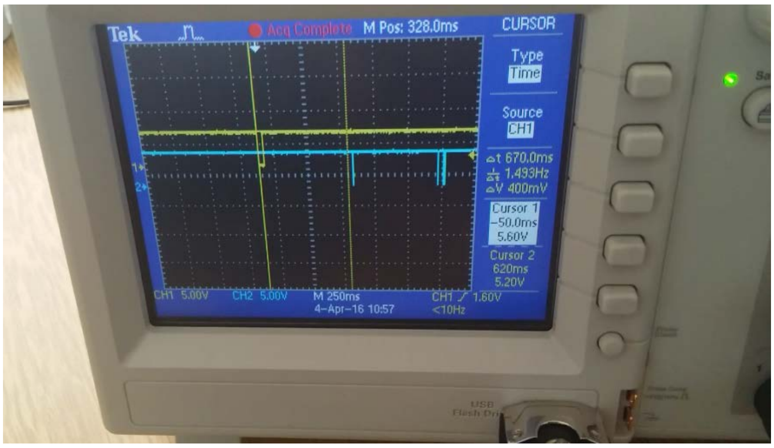

Figure 6. *Review of measurement on a digital oscilloscope*

3. RESULTS OF MEASUREMENTS AND DISCUSSION

Calculating the acceleration of the object

The acceleration of object during free fall without a initial velocity can be determined from the equation 2: [9-12]

$$a = \frac{2h}{t^2} \tag{2}$$

Where are:
h = 2 m – distance traveled during a free fall down along cylindrical rails;
t [ms] – measured time of free fall.
The measurement results and calculated values of acceleration of the object at a moment when it overpasses the path of h, are given in table 1.

Calculating the velocity of the object

At the initial moment, before relecing, at the height h, the object has the potential energy E_p, that transforms into the kinetic energy of E_k when the object starts free fall. Velocity of the object at a time when it overpasses the path of h, can be determined using the following expression:

$$E_p = E_k$$

$$mgh = \frac{mv^2}{2}$$

$$v = \sqrt{2gh} \tag{3}$$

Therefore, acceleration calculated on the basis of the measured time, using relations (2):

$$v = \sqrt{2ah} \tag{4}$$

The calculated velocity values for all measurements are given in the table 1.

Table 1. *Measurement results*

Measurements	Free fall time t $[ms]$	Acceleration a $\left[\frac{m}{s^2}\right]$	Velocity v $\left[\frac{m}{s}\right]$
1	650	9.4675	6.1538
2	650	9.4675	6.1538
3	640	9.7656	6.2500
4	660	9.1827	6.0606
5	640	9.7656	6.2500
6	650	9.4675	6.1538
7	640	9.7656	6.2500
8	640	9.7656	6.2500

Theoretical time during the free fall of the object can be calculated on the basis of the expression:

$$t = \sqrt{\frac{2h}{g}} \tag{5}$$

Given the fact that the gravitational acceleration in the central Serbia amounts $g = 9.804\frac{m}{s^2}$, for height of h = 2 m, from expression (5) theoretical time during free fall of the object can be calculated and it values: t = 638.75 ms.

The theoretical velocity calculated using the expression (3) values: $v = 6.262\frac{m}{s}$.

The analysis of the results and their comparing with the theoretical values, it can be concluded that the deviation is caused by the existence of friction between the bearing balls and beads, air resistance, etc. Consequently, the obtained values of time of movement of the object are greater, and the values of the acceleration and velocity of the object at the end of path are lower by a few percent compared to the theoretical value. In this case, the maximum difference between the values of the individual measurements are about 3%, due to minimum deviations of initial position of the object, from which the measurement starts.

4. CONCLUSION

The presented methodology can be used to precisely determine the velocity and acceleration of objects during free fall along cylindrical rods by described laboratory device, where time is measured of the moving object along a provided path. Also, based on the deviation of the measured values from reference (theoretical) values, time, velocity and acceleration, it can be determined the forces of friction between the bearing ball and cylindrical rods. Described exercise can be used in carrying out practical training in mechanics and physics, as well as other technical disciplines.

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UDK: 620.97+621.31]:37 Scientific review paper

Energy efficiency of electrical drives: between energy engineering, energy policy and energy education[1]

Miroslav Bjekić[2] and Dragana Bjekić[2]
[2]Faculty of Technical Sciences in Čačak – University of Kragujevac, Čačak, Serbia
e-mail mbjekic@gmail.com, dragana.bjekic@ftn.kg.ac.rs

Abstract: *For implementation of the concept of energy efficiency of electrical drives (EEED) it is necessary to accomplish some prerequists: to train engineers for of (energy efficient) electrical drives construction, to design and realize ED, to define principles and create procedures of energy efficient implementation of ED, to choose energy efficient use of ED, to accept energy efficient behaviour in this field and to train to use it. According to the multidisciplinarity of the concept of energy efficiency, three basic dimensions of energy efficiency are considered: (electrical) engineering, policy and education in this field. Necessity of the connection of three dimensions to meet energy efficient criteria, is presented with the practical examples – activities and results of scientific research focused on the energy efficiency of ED.*

Keywords: *energy engineering, energy policy, energy education, energy efficiency of electric drives, multidisciplinary.*

1. INTRODUCTION

General concept of energy efficiency refers the quality of energy consumption.

Realization of energy efficiency in different domains of human dealing demands positive attitudes to the energy efficiency as a style of individual life, and life of the community (policy of energy efficiency), construction of the energy efficient equipment and technology (engineering), development capacities for energy efficient behaviour (education). Looking from the industrial companies position, it is necessary to develop integrated approach to energy efficiency and to overcoming the gap between theory and theoretical research, and industrial practice [1].

The main concepts on the topic of this paper – energy engineering, energy education and energy policy – are considered in the field of energy efficiency, and they are three dimensions of the project „Research, development and implementation of the programmes and measures of energy efficiency of electrical drives“. Complexity of the field of energy

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efficiency of eletrical drives (EEED), team multidisciplinarity [2], multidisciplinary and interdisciplinary competence of team members individaully and as a team, are illustrated by the activities of the project team. Based on description of activities and results of the project, the relationship between engineering, education and policy is considered. Their interdependance for realization of expected results and energy efficient behaviour, and availability of the energy efficient technology system are considered, too.

2. ENGINEERING, POLICY AND EDUCATION IN THE FIELD OF ENERGY EFFICIENCY

Today, engineering-technological aspects of energy efficiency or *energy (efficiency) engineering* means an approach of development of technological equipment, machines, industrial systems etc., because, the concept of energy efficiency is generally accepted concept and request of modern society. Therefore, all of engineers' constructions, products and all of developed processes, are necessary to fulfil minimum of the energy efficiency standards.

Engineering-technological aspect of EEED or energy engineering of ED is focused on energy efficient electrical motors and energy efficient electrical drives. It means the next [2], [3]:

- correct selection of motor type and elements of electric drive system,
- correct selection (choice) of nominal values of electrical drives system, electric motors in these systems, because overdimensioning is very often case in the practice (overdimensioning is a problem because it increases the coast of equipment, removes the work point of it without nominal designing value for these etc.)

Policy of the energy efficiency or *energy policy* includes activities and measures in the field of legislative regulations, law documents and the other regulations and standards based on the political decisions, agreement of different institutions in the system, and of a wider community which is important to accept and implement these regulations, and to develop positive attitudes and readiness for energy efficient dealing in a specific field. Adoption of the international criteria is crucial aspect of creation of the policy of energy efficiency [3], and definition of indicators of energy efficiency is one of the operationalized activities of the policy [4].

Energy policy of ED or policy of EEED [5] should to obtain commitment for EEED implementation, defined by standards (IEC60034-1, IEC60034-2-1, IEC60034-30, on Serbian: SRPS60034-2-1 and SRPS60034-30), and legislative framework for measures and regulatives implementation. Specific topic of EEED policy are: laws, regulatives, standards, directives, nominal values of the electrical motor with high performance, financial iniciatives for supporting to implement more efficient electrical drives, energy control [3].

Policy of EEED is more realistic as an element of the general policy of energy efficiency. By using adequate technology it is possible to realize significance energy conservation and energy saving, but, most conversation and most quality using of electrical energy are possible by changing of human behavior. Than, energy efficient behaviour becomes a part of the national and international strategy of energy efficiency and scenarious of sustainable energy policy.

Creation of the culture of energy efficiency is educational process. Education for energy efficient dealing or energy education has goals which are depended from the purpose of educational activities and strategies. Different goals are defined – from the goal to develop energy awareness on indivudual level, to develop awareness of social groups, and to the goal to master of the knowledge and skills (general and professional). All of these are the base to acquire energy efficient behaviourand responsibility of users, decision makes, or engineers(from the constructor to the system maintainer).

Energy education or education for energy efficient behavior in domain of using electrical drives should to provide development of theenergy awareness and energy efficient behavioru of all actors – designer of ED, mainainer, user, creator of social context of energy efficiency. The focus of the energy education is not on designers–constructors of electrical motor and drive because they are the small professional specialized groups which acquire professional knowledge and skills in the stage of formal education. The focus of the enregy education is on the educaiton of the users of ED (managers of energy efficiency, operators on ED, users of ED in industrial context, users of small ED in nonindustrial context, etc.). The expansion of energy efficient behaviour of ED users is based on development of the positive energy awareness by education, by techological innovations, by timely information for the actors, by actors inclusion in the communication network of EEED policy.

The first step of education for energy efficient using of energy is development of the energy awareness and energy efficient using of everydays equipment in early education, in the family, and in the school. Training students of electrical engineering for construction, design, using and maintain electrical motors and drives on energy efficient manner is the crucial for EEED. But, this education is realized at the Serbian universities partially, not as integral concept.

3. REVIEW OF THE PROJECT ACTIVITIES AND RESULTS

These three dimensions of energy efficiency are the basis of development and realization of the project „Research, development and implementation of programmes and measures of energy efficiency of electrical drives“. The project started in 2011 as a project in the field of technological development (the research field according to Serbian Ministry of education and science), and it realizes in 2016, too.

3.1. Project phases and activities

The subject of the research in the project is: regulation and promotion of the energy efficiency of electrical drives (EEED), most often present in modern industry [3]. The successivelly realization of the project goals is presented in the next review of the research phases (realized from 2011 to 2016):

Phase 1. Research of programmes and procedures of EEED:

- analysis of the program of EEED in EU and the world (measures, organization, control, sanctions);
- legislative regulations of EEED – review of the standards, regulations, measurements, and recommendation in the world, EU and Serbia;
- analysis of realized effects and possible savings by implementation of the energy efficient electrical drives in EU and world;

- defining of the conditions of EEED policy implementation: analysis of needs of target groups, readiness and posibilites to implement regulations, possibilities to inform target public.

Phase 2.1. Development of the programmes and measures of EEED:

- Harmonization of the standards in the field of energy efficiency of electrical machines and electrical drives: IEC60034-1, IEC60034-2-1, IEC60034-30 i rečnika 60050-411;
- Defining of recommendations for selection of the energy efficient electrical motor.

Phase 2.2: Analysis of energy efficiency of realized practical sollutions in the field of electrical drives:

- Analysis of possible technical solutions for reconstruction of the electrical drives of dredge from the aspects of energy efficiency;
- Reset of the higher harmonics in regulated multi–motor drives.

Phase 3.1: Implementation of the programmes and measures of EEED – methodology development:

- development of the standard method of measurement of magnetic properties of ferromagnetic plates, and development of the optimal method and dimension of measured samples;
- development of the new method of regulation of induction motor drives.

Phase 3.2: Implementation of the programmes and procedures/measures of EEED – development of technical solutions and training:

- teasting magnet losses of the materials which are used in the construction of the motors, from the aspect of the energy efficiency;
- design of the laboratory (space and equipment) for EEED control;
- construction and analysis of measurement equipment for testing classes of EEED, according to the proscribed standards;
- realization of the software for determination of the class of EEED;
- solutions of EEED realized in the practice;
- team for implementation of the policy of EEED – structure, competence and development of the team;
- organization of the symposium of EEED.

Phase 3.3. Implementation of the programmes and measures/procedures of EEED – realization of the solutions and education programmes:

- development of the new magnetization model of the materials which are used in the construction of electrical motors;
- realization of the complet measurement set – testing station for electrical motors testing;
- modification and improvement of the algorithm of the induction motor machines regulations;
- preparation of the manual for design and construction of EEED;

- analysis of energy efficiency of the practical realized solution ED;
- development of the team to the policy implementation and measures of EEED;
- preparation of the handbook for the managers of EEED.

Phase 3.4. Implementation of the programmes and measures/procedures of EEED – realization of the solutions and evaluation of the activities:

- realization of the laboratory set for testing of three phases induction motor;
- preparation of the Laboratory for electrical machines, drives and regulation at FTN Čačak for realization of remote laboratory testing;
- continuiation of the activities in the Commission of the Institute for standardization – Commission N02: Rotating electrical machines;
- evaluation of the programme of engineers education for implementation of the policy and measures of EEED;
- defining of energy efficiency of the multimotor drive in work regime;
- experimental testing of the results obtained with the new magnetisation model of ferromagnetic plates;

Phase 3.5.Implementation of the programmes and measures/procedures of EEED – evaluation of the activities:

- Practical implementation of the mathematical models of hysteresis of ferromagnetic plates (engineering practice example);
- improvement of DTC algorithm of regulation of induction motors, with the goal to minimizing torque ripple and losses on motors;
- experimental evaluation of the standard of belt conveyor under the conditions of implementation of the current regulated electrical drives;
- research/evaluation of effects of specialized initial training of electrical engineering students – future engineers in the field of EEED and development of the methodology of training evaluation.

3.2. Structure of the project results in domains of energy engineering, policy and education

The research had wide goals and gave contributions in all three energy efficiency domains (dimensions). But, the basic contributions are in the field of testing, improvement and construction of EEED and development of the measurement methodology of EEED. Research results are published in 62 units (14 papers in the international journals – M20 scientific categories in Serbia, 27 papers in the internatnional conference - M33 scientific categories in Serbia), including scientific monography [3] and two technical solutions [6, 7]. Focus on the research in all three domains of energy efficiency is illustrated with the problems and selected works/papers which present solutions of the problems, and research results representative for three dimensions (table 1).

Table 1. Contributions/Results of the project TR33016 in 3 dimensions of EEED

	Energy engineering	Energy policy	Energy education
Phase 1. Research of programmes and measures / procedures of EEED	Overcoming barriers of introducing EEEM/EEED [8]	Legislative regulations of EEED –standards, propisi, mere and recommendations in the world, EU and Serbia [9]	Energy efficiency behaviour in industry [10]
Phase 2.1. Development of programmes and procedures of EEED	Potential electricity sving by using EEED [11]	Public relations as method of EEED policy promotion [12]	
Phase 2.2. Analysis of practical solutions	Energy efficiency of Pumps electrical drives [13]	Standards in the field of EEED [14]	
Phase 3.1. Implementation of EEED programmes and measures / procedures – development of methodology	Reduction of torque ripple in DTC induction motor drive [15] Software for testing the level of exploitation and class of EE motors [6] Application of Standard and Modified Eh-Star Test Method for Ind. Motor Stray Load Losses [16]	Introducing of energy management system in Serbia [17]	
Phase 3.2. Implementation of EEED programmes and procedures – dev. of technical solutions and training	Efficiency classes of three-phase, cage-induction motors software ([18] Design, construction, calibration and use of electromagnetic brake [19]		Team competence of the specialized team for EEED [2] E-course: Designing of EEED [20]
Phase 3.3. Impl. of EEED programmes and procedures – realization of solutions and ed. programmes	Development of the platform for testing algorithm of regulation AC motors [21]	Vocabulary SRPS IEC 60050-411: Obrtne mašine [22] Vocabulary on the IEC web page [23]	E-course: EEED: implementation of policies and procedures/ measures [24]
Phase 3.4. Implementation of EEED programmes and procedures – realization of solutions and evaluation of activities	Electrical motor testing station with electromagnetic load emulator [25] EE of belt conveyor at constant speed operation [26] Electromagnetic brake with one rotating disk for laboratory testing of EM [7]		Communication competence of engineers in EEED teams – education and evaluation [27]
Phase 3.5. Impl. of EEED programmes and procedures – evaluation	Remote control of electromagnetic load emulator for electric motors [28]		Professional develop-ment of EEED el. engineers [29]

4. CONCLUSION

Researchers’ step toward energy efficiency gives social framework and social significance for their researshes. According to the social importance of EEED (electrical drives are the holders/basis of industrial systems), it is necessary to consider not only technological dimensions of researches, but also policy dimensions of energy efficiency and energy education. It provides a multidisciplinary context, researchers collaboration, multidisciplinarity of the results/contributions, and leads to integrated approaches to energy efficiency of electrical drives.

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Day of computing at TIO 2016

Day of Computing is an event that is held with the aim to connect former and current students of the Computer Science at Faculty of Technical Sciences. Also, it's an opportunity to show the results achieved at the Laboratory for Computer Science, together with the results that have been achieved in the field of Computer Science at the Faculty of Technical Sciences. Day of Computing will be an opportunity to get feedback from former students of computing regarding the importance of the knowledge acquired at the Faculty on practicing the profession.

It is expected that during this year's Day of Computing the association of former students of Computer Science at the Faculty of Technical Sciences will be formed.

NeReLa at TIO 2016

The activities of the TEMPUS project NeReLa (Building a network of remote laboratories for strengthening the cooperation between universities and vocational secondary schools, http://www.nerela.kg.ac.rs/) will be presented within the 6th international conference TIO2016. The coordinator of the project is Prof. Radojka Krneta, Faculty of Technical Sciences in Čačak. The aim of the project is to improve engineering studies in Serbia by introducing innovative teaching methods concerning remote experiments, as well as strengthening the cooperation between universities and vocational schools through training vocational school teachers in using remote experiments in the classroom.

Serbian project partners: University of Kragujevac, University of Belgrade, University of Novi Sad, University of Nis, Network of Reg. centres for voc. schools teacher prof. development, Association of Electrotechical Vocational Secondary Schools, Association of Mechanical Vocational Secondary Schools and Balkan Distance Education Network (BADEN).

EU project partners: University of Maribor, Slovenia; University of Deusto, Bilbao, Spain; University of Porto, Portugal; European University Cyprus; Best Cybernetics, Patra, Greece.

During the last two project years a huge number of project activities have been performed from which we can choose the following:

- Four largest state universities in Serbia signed the contract of founding the NeReLa network that will enable joined use of remote experiments which are set in laboratories of these universities,
- LiReX web library of remote experiments was created,
- NeReLa Winter and Summer school were conducted and more than 100 teachers of secondary schools from whole Serbia were trained there to work with remote laboratory experiments,
- Catalogue of remote laboratory experiments and exercises with user manuals was printed for NeReLa Winter and Summer school participants,
- Teaching modules with remote experiments within professional courses in Electronics, Computers and Mechatronics were realized at partner universities and several secondary vocational schools.
- NeReLA team has published a lot of papers in numerous conferences dedicated to remote experimentations and laboratories such are following: REV2014, TIO2014, TAEE 2014, New Technologies in Education 2015, YU INFO 2015, EXP.AT'15, ETRAN 2015, TREND 2016, REV2016.

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Network of Remote Labs

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