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Modern Educational Technologies in Professional Training of Student in Technical Institutes of Higher Education

Diana Izvorska[1*], and Stefan Kartunov[2*]
[1] Technical University/DESO, Gabrovo, Bulgaria
[2] Technical University/Emeritus Professor, Gabrovo, Bulgaria
[*] dizvorska@gmail.com

„Tell me a story about something and I will forget it.
Show me something and I will recollect it.
Let me do it and I will remember it."
Confucius

Abstract: *A new stage in the development of presentday society is evidenced in which modern technologies are an inseparable part in social experience hence the need of their application in instruction and training. New forms of providing education involve interactivity and collaboration in the process of learning. This work aims to demonstrate the authors' attitude toward contemporary educational technologies and their application in the professional training of students following engineering degree courses. Here we make a review of some modern educational technologies employed in professional training, which are separated into three groups: situational or problem-oriented situational, discussion-based and experimental-empirical methods. Here the application of one concrete method from each of the three groups is also demonstrated in the context of active training of students following degree courses in technical institutes of higher learning.*

Keywords: *modern educational technologies, professional training, students in technical degree courses*

1. INTRODUCTION

Some substantial changes in economy, science, culture and education took place over the last decade as a result of the progress made in technologies. A new stage in the development of present day society is evidenced in which new technologies have become an inseparable part of social experience hence the need of their application in instruction and training.

"Educational technologies" as a term refers not only to technical equipment which aid the process of teaching and learning, but also include pedagogically grounded decisions of choice; formation and application of a series of methods, techniques, forms and means of training, which provide achievement of assigned educational goals in accordance with the concrete educational medium and the specifics of trainees. The objective to be attained is to enhance effectiveness of both teaching and learning by means of educational technologies.

New forms of education are characterized by interactivity and collaboration in the process of training. Various approaches to defining educational technologies can be formulated as an agglomeration of methods for implementing syllabuses and curricula, which present a system of forms, methods and means of training that are instrumental in reaching educational goals. Variances in educational technologies are normally determined by the differences in applied educational means.

Variety in educational systems allows the strong aspects of education to be adapted to the formation of a renovated model, which will fully correspond to

modern conditions and the ever increasing competition in all aspects of life.

The aim of this work is to demonstrate the authors' attitude toward modern educational technologies and their application in the professional training of students in technical institutes of higher learning.

2. EXPOSTION

There are a number of opinions and concepts concerning the necessity of applying technologies in education with regard to both theoretical and practical aspects of pedagogy. According to one of them, the emphasis is laid on technology components in both processes of teaching and learning. Technologies, in this particular aspect, are regarded mostly as didactic and pedagogical means and aids. In this way some "technology-based" methodological systems are created such as audio-visual, computer-aided, communication, integrated, etc. Another view in this line is that technologies are related, most of all, with techniques, methods and forms of teaching: discussion-based, group work, teamwork, situational, role-play and some other.

Achieving higher efficiency in learning does not imply that mere application of technologies will guarantee increased interest in the input on behalf of students and trainees. Knowing the styles of learning is a firsthand necessity. In order to increase the variety of teaching strategies it is important for teachers to be not confined to their personal preferences, but also take into account those of their students. A large number of teaching styles are available, which reflect individual preferences to the ways of grasping and processing information, and structuring the learning environment; therefore, approaches to and methods of teaching should be of good variety. In this way dissatisfaction with learning, which oftentimes is motivated by the objective necessity for the individual student to conform to the style of perception and learning, will be overcome and prove favorable for the enhancement of his\her personal motivation.

Motivation is many-sided and variable; it is not a characteristic feature of personality rather it could be defined as the enabling force which shapes people's conduct over a certain period of time. In the context of education, it is one of the most widely used notions that underlies the structure and meaning of qualitative learning in modern educational institutions. The phenomenon of motivation can be defined as the inner impulse, drive or urge to act and make a personal commitment in the process of learning. Generally, it is described as internal state which stimulates, directs and sustains behavior by taking a prominent place in the structure of personality.

Interactive methods and interactivity, in general, as an approach in the course of learning, have their part of ever increasing importance in the process of study at all levels of education. The notion *interactivity* is a compound of *inter* (between, jointly) and *activity* (action, pro-activeness), which in the pedagogical context is interpreted as the interaction between instructor and trainee or the interaction between trainees for the purpose of achieving specific educational objective. According to Ivanov, interactivity could be regarded in two aspects: as a process and as a product. Interactivity regarded as a process implies interaction with another person in verbal or some other physical way whereas, if regarded as a product, it could be defined as "characteristics of the consumer – system or consumer – document, which in some instances is referred to as 'quasi interaction"(Bretz). Very often "interactivity" designates interaction with computer or some other technical system. [1, pp. 209). Interactivity occurs in the so called "interactive system of learning" which is a combination of numerous study situations, whereby various types of knowledge and information are exchanged between participants in the learning process. There are two such systems: one of them is "people oriented" and is based on the interaction between the subjects in the process of learning; the other is known as "technology-based system of learning" and comprises the interaction taking place between learners and technical aids [2, pp. 39-40]. In the age of high tech structures and resources, the interaction type "learner – information technologies" appears to be a major prerequisite for quality knowledge and skills.

Within the context of the process of learning and taking into account the specifics of professional training, we can note several types of highly effective interactive methods which may be divided into **three major groups**. [3]

3. METHOD

One of the groups includes the so called ***situational or problem-situational methods.*** Their special feature in the course of learning is the remake of situations, which are close to real life, for the purpose of using the experience of the trainees| learners| in solving a certain problem. Problem-situational methods create favorable environment for development of analytical capabilities and finding adequate solutions to real practical problems. The group of situational methods includes a solution to a case study, or course project in particular. Said case study presents concrete information which is connected with various aspects of reality such as social environment, social problems, interpersonal relations and so on. Normally, it is about some conflicts, controversies or challenges. Participants

are assigned the task to analyze the information by drawing upon the experience and knowledge they have gained so far, then make assessment of and find out a solution to the concrete problem. Case studies can be on decision making, evaluation, investigation or others. A good example of finding case study solution is the course project in the subject of "Technology oriented design" which is part of a Master's degree course program. Here the task is to review a draft design of a switch, find out its errors and weak points with regard to design workability and make workability assessment. Fig.2 illustrates the so called mixed type design of switch breaker (featuring 6 contacts in 2 parts and secured position of switching for the actuating cam). In addition to plastic made parts (a, b), the washers cut out from hard cardboard (c,d) plus the large quantity of metal parts, increase the production cost and make the unit assembly cumbersome. Weak points of this design are the many spots for setting which reduces accuracy; three-positional bearing around the axis of parts in the securing bolts 2; expensive tools for the plastic parts, large amount of work needed for adjustment and tightening, a good number of parts and unreliable switching-on. The task is to make proper changes in design. Three alternatives for change have been proposed concerning the submitted design.

Alternative I: Replacement of free bearing support with two point bearing support; centering stopper on the lid for the purpose of easier assembly, simplification of contact springs fixation; simplified parts made by means of pressing; cheaper tools for manufacturing; greater strength of the body design which eliminates the need of fixation elements; enhanced possibility for more precise assembly.

Alternative II: Excessive use of plastic made parts; cleaning of cam; adjustment of intermediate plot B ; replacement of assembly screws with tubes made of hard card to envelop the body, which will provide greater stability; rolls are replaced with simplified small steel balls. Still remaining weak points: too many threads in the plastic parts (18 screws and 18 thread holes), free bearing support in the nested metal bearing socket, which is made by automatic turning; the cam disc is moved toward the axis for no particular reason; assembly takes too long time.

Alternative III: Axial bearing in the cover and body wrapping; plastic parts tied together in the slot opening with the bottom part, which supports the contacts by means of fixation bolts and nuts. The axle is situated on the switching cam. Threads for fixation of contacts are eliminated by making use of molded sockets to counter unscrewing of nuts 'b' which lie in the direction of molding. Easier assembly with no use of threads and free access for the tool securing fixation bolts. Molded centering core for enabling simultaneous switch-on of all six contacts.

Conclusion: Alternative III is the most appropriate.

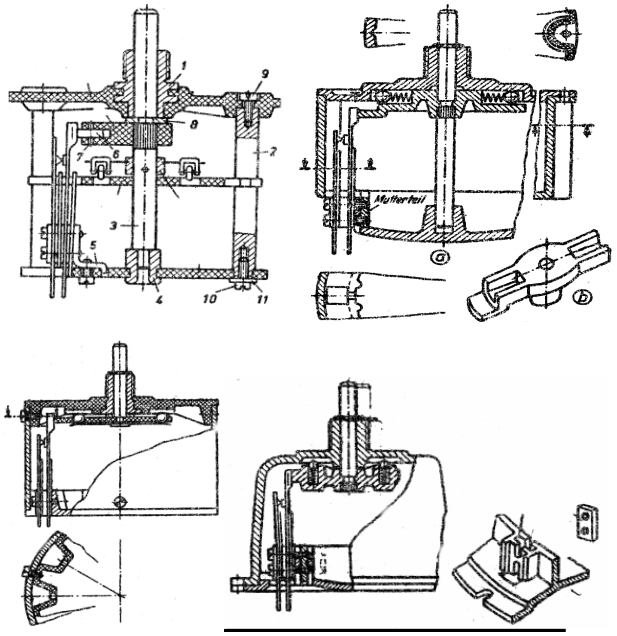

Figure 2. *Design of mixed type:*

Alternatives I, II, III [4]

Tests also pertain to this group. An example of such a test, containing 55 questions and 21 tasks plus another 30 questions for the purpose of self-preparation in the subject of "Micro and nanotechnology, has been developed and presented in [5].

The second group of interactive methods are the so called ***discussion-based methods.*** They, too, are based on the interaction between participants in the process of learning and most often are reduced to discussing different issues and problems. Opinions are shared for the purpose of making proposals, decisions and expression of points based on mutual consent between participants in the discussion. Another example of developing different solutions and their subsequent incorporation into learning is presented in [6]. Discussions held are presented in [7, 8].

Another popular discussion-based method is the so called ***brain storming*** which was initially created in the 1940ies and further developed in 1953 by Alex Osborne in his book 'Applied Imagination'. It is a method for stimulating individual creative thinking in learners whereby a collective solution to a problem related to creativity is found by means of mutual consent on behalf of participants. Brainstorming and its varieties (straight and reverse brainstorming plus combination of the two) appear to be a very useful way of stimulating learners for more creativity, generating of genuine ideas and their blending into effective solutions [9]. Reverse brainstorming aims specifically at finding out flaws in products and their ensuing elimination. Outcomes are forwarded to experts or managers for assessment and selection of promising, functional proposals. This in turn develops in

students skills for teamwork, critical analysis and builds self-confidence and capacity for financial management. Learners opt on real technical tasks or those belonging to everyday life and participate in didactic games. Examples of such training, in which the author of this paper participated, are the classes in Methodology of practical development included in the program of "Precision Engineering Technology" that is taught at the Technical University of Darmstadt, Germany. Assigned tasks in which direct brainstorming is applied are on developing domestic products such as nutcrackers, robots for didactic games in football, basketball, climbing as well as assignments on industrial introduction: self-adjusting driver's seat in conformity with the size of the driver and many other. Example of reverse brainstorming is the preparation of expert assessment of machinability in the subject "Technology-oriented design" taught in the Master degree courses of "Mechanical Engineering' and "Mechatronics".

The third group includes the so called ***empirical methods.*** One of the most widely applied among them is known as ***project work***. |Implementation of research projects helps students to work out their individual intellectual and formal autonomy and build their practical background as well. In doing this they are supposed to go through the following three stages:

- *Cognitive* – constructing the content of educational activity, the process of realization and awareness of the tendencies in the development of the educational/academic degree "Insights into future".
- *Managerial* – orientation toward the set target, planning and control over the process of achieving the goal.
- *Developing* – forecasting processes, formation of personal skills of social importance and support of individuality; qualitative change in both subjects and objects; arising of new forms, innovations and novelties; transformation of their internal and external relations.
- *Sustaining culture* – planning of ways for reproduction and development of culture; selection of culture-oriented content and remake of cultural samples and norms, aiming at education of young people.
- *Motivational* – development of inner and outer motivation for active participation in the process of learning based on important and interesting information on culture, tradition, history and language of the country whose language is being learnt.
- *Informative-educational* – realization of such methods of instruction as demonstration, explanation, investigation of facts, events and processes.
- *Heuristic* – orientation toward individual discovery of what is new, based on the previous experience of learners and directing them to active cognitive activity. Development of control programs and tuning of CNC machines.
- *Control* – implements current and stage by stage monitoring.
- *Reflex and assessing* – determining the level of acquisition of knowledge, skills and habits in the process of project realization and in accordance with program requirements.
- *Communicative* – the project aims at developing communicative competence of learners. Communicative competence implies the ability of future specialist to live among other people plus the ability to interact, be part of a team, and collaborate in achieving mutual understanding. In essence communicative function and its major point is in getting ready to be involved in an optimal interactive system, which operates bet-ween individual units and participants and also interacts with external structures [3].

The project-based method is an approach to learning which adds further dimension to traditional methods and, in addition, allows to be used at all levels, ages and capabilities of the learners. Instruction in the subjects "Mechanical and precision engineering technology" and Technology of mechatronic systems" requires that students in the degree courses of "Mechatronics", "Mechanical and precision engineering" and "Environmental protection engineering" should develop a project on "Design of technology processes in manufacturing parts; assembly technology, adjusting and tests of devices and machines". This course project includes two work-pieces which are machined with and without chip removal plus developing a device for the first machined part and a tool for the second one. Here is provided and example of machining of a part belonging to the group "Axles and shafts". The manufacturing technology process for machining of a shaft is as follows:

1. Positioning to contact.
2. Outer planning.
3. Drilling of hole with bit φ 7, 8 position 2 of revolving head.
4. Core-drilling of φ 8, 8 at position 3 of revolving head.
5. Finishing external turning at position 4 of φ27,5.

6. Finishing external turning at position 5 of φ 23.

7. Chamfering and face turning of the step at position 6 plus profile machining with reach over carriage 2.

8. Making chute and chamfer with tools fixed on reach over carriage 3 and 4.

9. Cutting with tool 5 on reach over transition 4.

Work technology process for machining of exemplary part for serial production is presented on Fig.3 [7]. Methodological instructions on the project are given in [8].

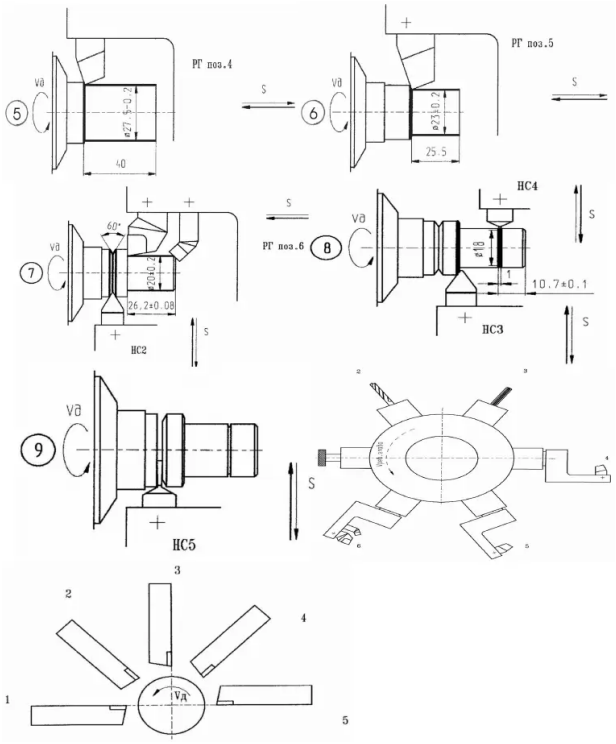

Figure 3. *Work technology process for machining of shaft*

Multimedia presentations are of particular importance in the system of modern methods and forms of instruction. Using them during instruction in professional subjects has gradually turned their application into a method of organizing active, creative teamwork of students, which facilitates acquisition of knowledge by making the entire process more interesting. Presentations allow for the teaching input to be perceived as a system of memorable images that contain exhaustive and well-structured information. This method is close to electronic instruction and is applied in distant learning. Unique in their resources, multimedia presentations make up a genuine model of activeness and pro-activeness in individuals thus enabling them to form skills for collecting, processing and presenting information by novel interactive methods. Students' individual performance in presenting a new product before an audience consisting of their colleagues will have a serious effect. Similarly, it can change their motivation for work; something which is valid especially for students who do not seem quite interested in the taught subject. A proper example of that is the project for multimedia instruction in the subject of "Technology of mechanical and precision engineering" Technical University of Gabrovo, Bulgaria [10, 11, 12]. The European Dual Research and Education – EUDURO project was developed over the period 2015-17 in joint partnership with participants from the University of Wismar, Germany. A model of instruction in engineering subjects taught in technical degree courses at TU-Gabrovo is presented in [13]. A summary of the applied modern educational technologies in professional training of students, following degree courses included in the professional trend of "Mechanical engineering technology" in Technical Institutes of Higher Learning, is given in [14].

4. CONCLUSION

In closing it can be said that:

1. Interactive methods set the participants in a mode of continuous discussion thereby allowing for expression of personal opinion, and suppose available usage of constant feedback.
2. Interactive methods enable participants to construct behavioral strategies. They also are a natural form of work due to the necessity of alternative interaction between teacher and student; of conducting dialogues, and developing interactions based upon group activities.
3. By applying these methods along with the rules of group work, we establish a model of dialogue that is different in terms of quality, and of interaction between teacher and student that contributes to the personality development in young people.

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