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.
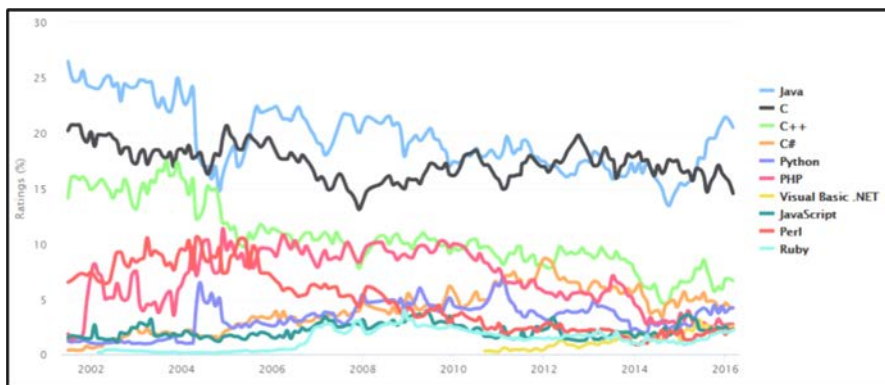

Figure 1. *The most commonly used programming language in the 21st century [7]*

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.
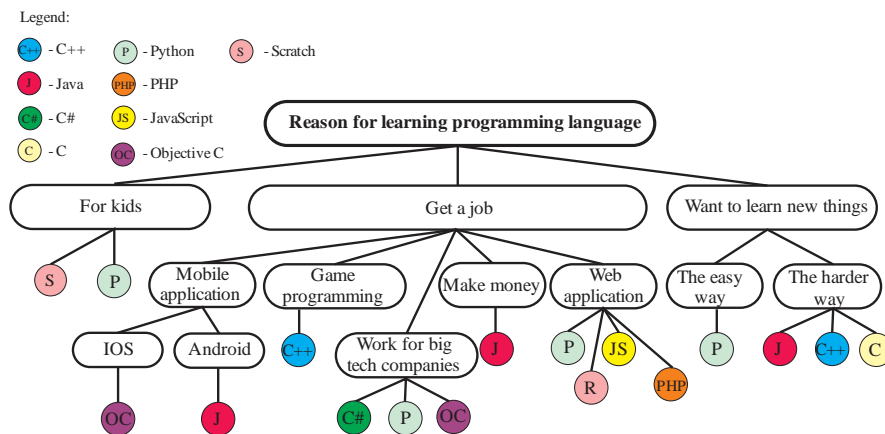

Figure 2. *Algoritm for choosing programming languages [8]*

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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