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TO A QUESTION ABOUT READINESS OF EDUCATIONAL ORGANIZATIONS TEACHERS TO WORK IN THE E-LEARNING ENVIRONMENT

(analysis of monitoring studies)

UDC: 37.018.43:004.738.5]:371.213.3
Review Scientific Paper

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Abstract - The article deals with the current problem of professional readiness of teachers to implement e-learning technologies to improve the efficiency and quality of teaching and learning processes. It is shown the necessity and importance of conducting monitoring studies for the regular information updating about the teachers' readiness to implement e-learning. Received results of studies have brought and analyzed.

Keywords: E -learning technologies, e-learning environment, ICT - competence, monitoring.

The preparation of future generation to effective work and orientation in digital space is a priority goal in many countries. The main responsibility for solving this task lies on teachers at schools who should form a system of students' competencies related to the concept "information and media literacy".

For the first time (in a professional environment) the term "e-learning" was used in October 1999 in Los Angeles at the *SBT Systems* seminar.

In 2001, Dr. Allison Rossett defined e-learning as courses which are hosted on a server that is connected to the Internet. According to UNESCO experts, e-learning is learning through the Internet and multimedia. Other definitions focus on different aspects of e-learning. Here are some of them:

- e-learning – a wide range of applications and processes, providing training, built on the use of a personal computer, virtual classrooms, and means of users' interaction in the network. E-learning involves delivering educational content via the Internet, intranet, audio- and video recording, CD ROM.
- e-learning – learning, built on the use of information and communication technologies. It covers the entire range of actions such as support for the learning process and the delivery of learning content to students.

Although there are many approaches to the definition, we can clearly distinguish two main components of e-learning: technology factor (software, hardware, internet access, etc.) and the human factor (administrators, teachers, teachers' trainers, students and etc.)

In international educational master's program of UNESCO "Information and Communication Technologies in the professional development for teachers" says, that a key factor of global implementation of e-learning technologies into the modern education system is still teachers who possess high level of professional competence, continuously raise it and provide the efficiency and quality of education [1]. However, according to UNESCO, a major international and regularly occurring problem is to provide the required quantity and quality of professionally trained teachers. UNESCO sees the solution of this problem in holistic and systematic approach to improving the system of teachers' education and their professional development through access to high-tech digital educational resources.

In our opinion, the main problem of the modern teacher, working at any educational level: both secondary and vocational education in any country

in the world is the optimal combination and constant update of:

- Competence in the subject area;
- Competence in the field of information and communication technologies;
- Competence in appropriate use of a wide range of tools and e-learning technologies for improving the effectiveness of teaching and learning , as well as for performing pedagogical and subject- professional tasks.

We see the solution of the designated problem in the systematic approach to modernization of Russian education for reaching the goals and objectives of informatization in education, as providing educational process with only computer technologies does not create sufficient conditions for effective implementation of e-learning technologies. Implementation of national priority project "Education", the efforts of the UNESCO Institute of Information Technologies in Education, methodical elaborations in Institute of Informatization of Education, a partnership of state and regional education departments with various companies (Microsoft, DELL, Kaspersky, C-Systems, MS Surface , etc.) allow the system to carry out the process of modernization of Russian education:

- Equipping schools with computers and necessary network system (for example, in educational institutions of the Rostov region indicator of the number of computers per student reached 7,5;
- Implementing a variety of projects (" electronic textbook", "Online class", "ProstoKlass", etc.);
- Creating own electronic educational resources , implementing a Learning Management System (LMS) and providing access to open world's resources with teaching and learning materials for all levels of the educational process;
- Developing distance education technologies for people with disabilities;
- Monitoring the teachers' level of competence in the field of e-learning technologies and their willingness to effectively implement these technologies;
- Using the monitoring data to generate a high level of preparation of teachers to work in the e-learning environment;
- Updating professional competence of teachers through refresher courses;
- Adjusting the program of study based on the data of monitoring.

One of the priorities in the Laboratory of problems of education informatization in Taganrog Institute is the participation in the development and implementation of programs for training and retraining of teachers in the use of e-learning technologies.

To solve this problem effectively, the staff developed a comprehensive monitoring program, which includes the study of readiness for the implementation of e-learning technologies in educational process of three groups of respondents:

Group 1 – teachers in schools (Taganrog, Rostov region, Russia)

Group 2 – teachers in Chekhov Taganrog Institute (branch of RSUE)

Group 3 – students in Chekhov Taganrog Institute studying the program “Teacher’s Education”.

The Laboratory of Problems of Education Informatization in Chekhov Taganrog Institute (branch of RSUE), carries monitoring studies (acquisition of data, analysis and preparation of a report [3]) of teachers’ readiness in educational organizations of Taganrog city to implement e-learning technologies in their professional activities, as well as students and teachers of pedagogical institute. Research is determined by the rapid implementation of e-learning tools and technologies at all stages of secondary and vocational education: electronic teacher's portfolio; virtual educational community ; electronic diaries; electronic multimedia learning tools ; LMS; open educational resources etc. A modern teacher must not only possess a sound knowledge of information and communication technologies which are the basis of the learning process in the e-learning environment, but also actively, constantly, efficiently and effectively apply them in their professional activities [2].

The objective of the study was not to determine the levels of teachers’ readiness (low, medium, high) to work in the environment of e-learning. The main emphasis in composing questionnaires was aimed at identifying the necessary thematic areas for the development of training programs, as well as the most significant gaps in the development of modern technologies and the extent of the need for their elimination.

The technology of monitoring studies included the following steps:

- developing tasks for monitoring;
- creating tools (questionnaires);
- processing and analyzing the results;

- forming the report for making management decisions according to the standard procedure of conducting monitoring [3,4].

We present the results of monitoring stages of teachers' readiness in educational organizations in Taganrog, Rostov region to work with e-learning technologies. Teachers were asked to answer the following set of questions:

- Experience and frequency of use of ICT in the classroom;
- The level of Internet access for students and teachers;
- Experience of developing their own educational products for the digital environment;
- The need for additional training to work in e-learning environment;
- Preferred form of trainings or refresher courses.

The analysis of the first group of respondents (teachers of schools in Taganrog) showed that 90 % of teachers need additional training for effective implementation of e-learning, 55 % prefer face-to-face format of education, 25% - part-time education and 20 % - the format of thematic webinars.

Here is the analysis of the most significant results obtained from the monitoring study (Fig. 1 - 4).

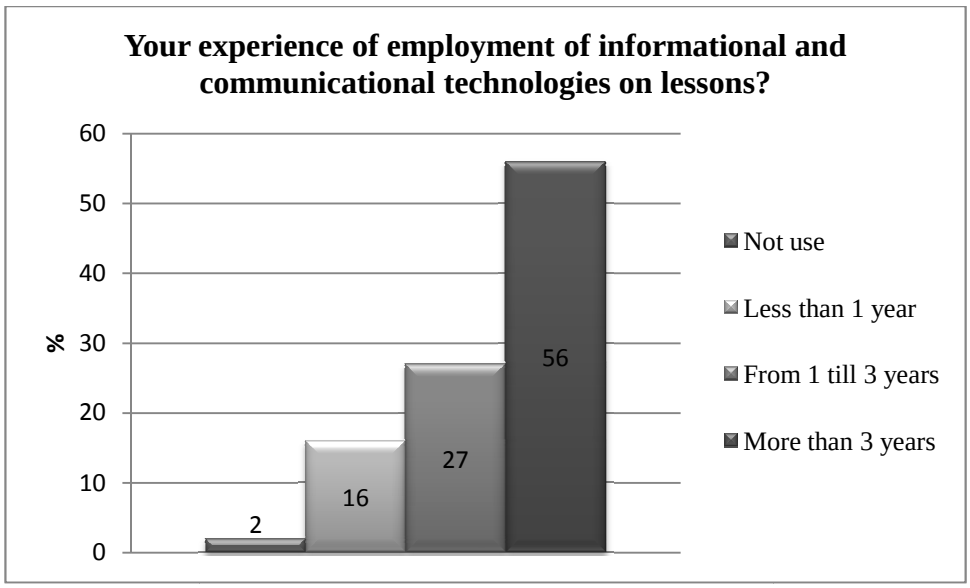

Figure 1. The experience of using ICT in the classroom

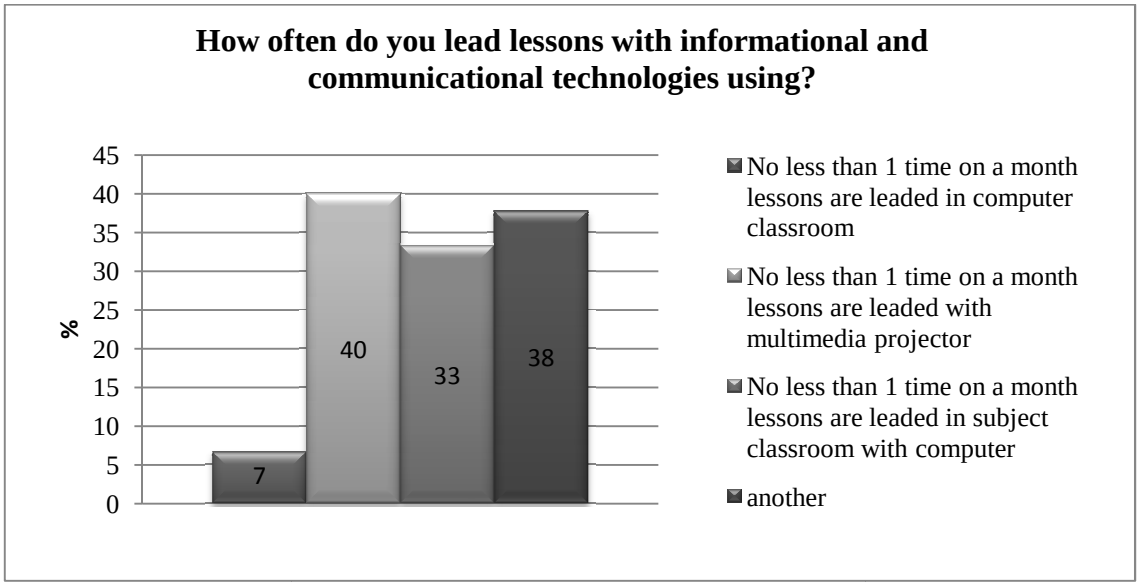

Figure 2. The frequency of using ICT on lessons

As it is seen from the analysis of the experience of applying ICT in the classroom (see Figure 1), 56 % of teachers have used ICT more than 3 years and 27 % - from 1 year to 3 years. Only 7 % of

teachers have 1 lesson a month in the computer lab (see Figure 2). The main options for the use of ICT in the classroom are: the use of a multimedia projector (405) and giving lessons in the subject class with a computer - 33%.

In our opinion, this question about giving lessons with the use of ICT requires the expansion, as teachers (33%) did not indicate what specific technologies they use.

Analysis of the results allows to note that 93 % of teachers conduct classes using ICT at least once a month and 75 % (2/3) actively use multimedia projector and a computer in their work.

In the matter of preference of professional developing courses, votes were distributed as follows (the survey participants were able to select several courses- Fig.3):

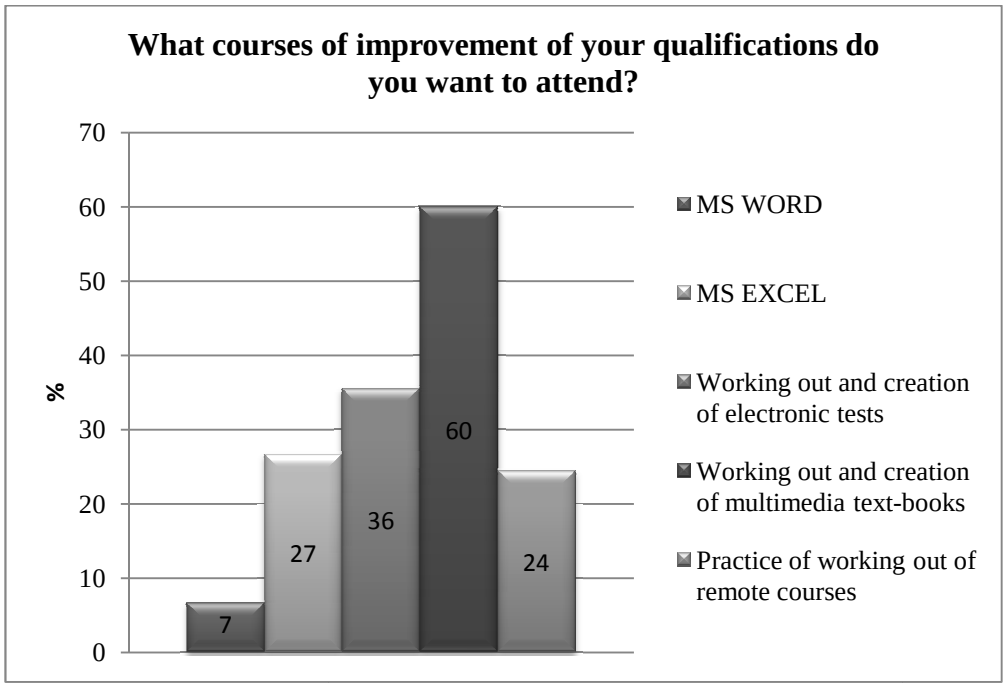

Figure 3. The choice of topics of training and professional development courses

The data, shown in Figure 3, demonstrates that approximately 30 % of teachers still expressed the need for the development through courses of elementary computer skills (work with text documents (MS Word) - 7% and spreadsheets (MS Excel) - 27%).

About 40 % of teachers do not have or think that they have not mastered the technique of designing and creating the assessment tools for electronic testing. There is an interesting fact that teachers need the creative implementation of their professional knowledge and skills, which is reflected in the desire to acquire the necessary competence for the development of multimedia training tools (60%) and distance courses (24%).

The analysis of developing own educational products (Figure 4) shows that about 20 % of teachers have experience in the development of electronic textbooks, thematic Internet - resources, copyright training programs. 80 % of respondents chose the answer "other", 30 % indicated the development of presentations and tests, 70% - lack of necessary experience.

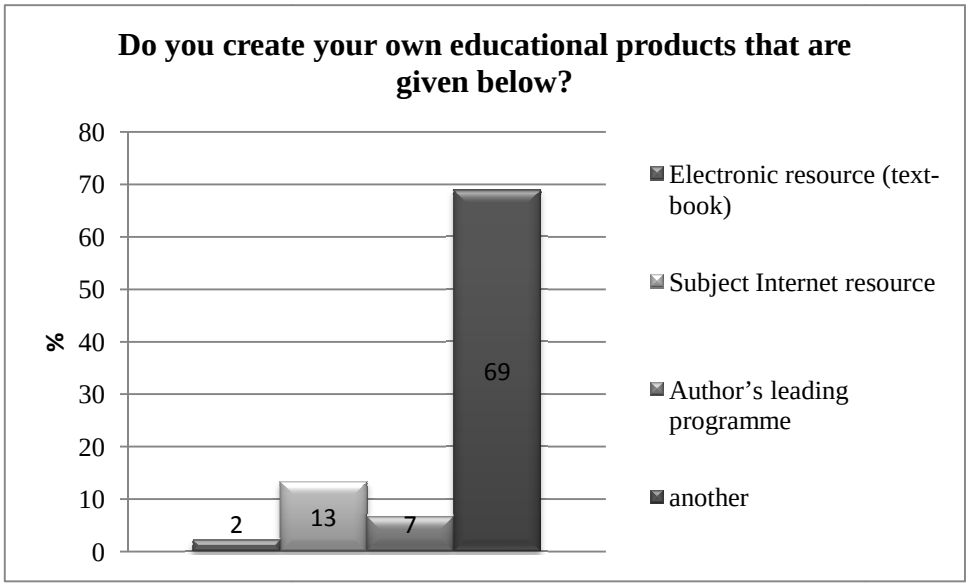

Figure 4. Creating own educational resources

Analysis of the summarized results demonstrates insufficient teachers' preparation in educational organizations to work effectively to implement e-learning technologies. In this connection the Laboratory of Problems of Informatization of Education in Chekhov Taganrog Institute (branch of RSUE) set the following objectives:

1. Carry out ongoing monitoring studies aimed at determining the degree of readiness of graduate students of "Pedagogical education " program, teachers in educational organizations and educators to work in the e-learning environment;
2. Prepare traning courses with consideration of possibility of their carrying out different formats (full-time, distance and mixed);
3. Constantly update teaching and learning materials for full-time and distance training courses.

Dealing with the problems associated with the effective use of e-learning tools and technologies by teachers, the Laboratory of Problems of Informatization of Education in Chekhov Taganrog Institute (branch of RSUE) was the initiator of the development of teaching and learning materials for the course «Teacher in e-learning environment» and the inclusion of this course in the curriculum of «Pedagogical Education» program.

E- Learning environment - is an innovative technology of organization of educational process that is constantly evolving and improving. E-learning tools and technologies are based on innovations in the field of information and communication technologies that are embedded not only in education. The ICT industry is constantly and rapidly evolving and aims at computerizing the whole society. In connection with this, education system must respond adequately to meet all the modern advances in these areas.

A modern teacher must maintain a consistently high level of professional competences in the subject area, as well as in the improvement of teaching and learning processes, which is impossible without e-learning technology. Constant monitoring of teachers' readiness to work with e-learning technologies allows of monitoring the level and development of ICT competence according to the latest achievements in the field of ICT application in education. Analysis of the obtained data should serve as a basis for making management decisions (development of methodological and training materials, organization of training courses etc) to correct the discrepancies between available and required levels of competence.

REFERENCES

[1] International Master's Programme of UNESCO IITE "ICT for professional development of teachers": educational training program for master degree specialization 050100 "Pedagogical Education" (qualification (degree) "Master" / UNESCO Institute for Information Technologies in Education. - M.: Publishing Center "Statistics of Russia." - 2013. p.80.

[2] Zankova E.Yu., Yashchuk E.V. Formation of information culture of a modern high school teacher. Bulletin of Taganrog State Pedagogical Institute. Humanities, № 1, 2012, pp. 24-28.

[3] Mayorov A.N. Monitoring in Education: Univ. 3rd, rev. and add. Mayorov, A.N. -M.: Intelligence Center, 2005 - 424c.

[4] Guidelines on organizing the monitoring of educators' professional development // http://www.hiiamvvv.narod.ru/VVV/mprro.html

MULTICAMPUS DISTANCE EDUCATION BASED ON VIDEO-CONFERENCIG SYSTEM

UDC: 37.018.43:004.773.5
Professional Paper

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Abstract – This paper aims at evaluating the potentials of videoconferencing education as well as to understand students' perceptions and satisfaction with this kind of distance education compared to the traditional classroom environment, but also to understand the main challenges in this kind of setting. An experimental research conducted showed that this form of distance education could be equally good as traditional methods of teaching. It also leaded to several important conclusions that may help in creation of efficient teaching methodology.

Keywords: Videoconferencing, distance education, teaching methodology

I. INTRODUCTION

Up to several years, go two state universities were providing the higher education services overall territory of Republic of Macedonia. These universities, Ss. Cyril and Methodius and St. Kliment Ohridski, were located respectively in the cities of Skopje and Bitola. Considering their location as well as strong economy demands at one hand, and the economic circumstances preventing people from moving freely from rural areas to cities for studying, have risen important questions regarding the ease of access to academic institutions for people living in not developed regions, notably the east of the country.

Therefore, in order to offer equal possibilities for high education studies, state University "Goce Delcev" – Stip was established in 2007. Organized as an integrated university, according to contemporary standards, it perfectly fits the global worldwide trends in higher education. Namely, the University is located in Stip and has four campuses, integrating 13 faculties - covering almost all scientific disciplines, 10 university centers and three institutes. The studies at this university are performed in 12 units, dispersed in 12 different cities (mainly in the eastern part of the country).

"Goce Delcev" University is permanently growing both in number of students and staff members. This is constraining the university to enlarge its infrastructure as well. These growing trends are challenging the university itself to organize and support the education process with attention for communication and collaboration between the various campuses.

Although, this process is still mainly conducted through physical mobility of academic staff between different locations, the university is progressively supporting initiatives that replace or enhance physical with virtual mobility.

Considering the new challenges in higher education and understanding the importance of innovation in education through implementation of contemporary ICT technologies, the institution is doing permanent efforts to integrate various forms of distance learning with the traditional education.

Distance education has been defined as "a separation in time and/or space between the learner and the instructor. More than a geographic separation of learners and teachers, it is a distance of understanding and perceptions that must be overcome by teachers and learners" [1]. There are many types of distance-education models including online courses, interactive videoconferencing, videotaped lectures, and audiotaped lectures.

According to our preliminary evaluation, among other distance learning methodologies, videoconferencing is considered the most relevant and proven to stimulate collaboration between the various sites, to support and enhance student and/or staff communication, to enable flexible quality learning and accessibility, as well as to rationalize various costs.

Various research studies have been conducted in order to investigate the challenges of establishing a establishing a video – conferencing

based distance education. Moreover, many studies have been conducted in order to understand the real benefits of video – conferencing as a form of synchronous form of education not only in higher education but also, also in other segments of the society.

For e.g. a pilot project aimed to deliver video-conferencing diabetes lessons to healthcare and allied healthcare professionals who provide basic level care for, and management of, people with diabetes in the Scottish Highlands region [2]. Feedback from participants indicated that the educational content was relevant and that the use of videoconferencing could provide accessibility to training where distance, cost and other issues may make access difficult. Student performance on the assessment instruments did not differ between those who received the training through video conferencing and those who received the training through face-to-face delivery.

Another, qualitative research study has been conducted in order to determine how students who are taking synchronous distance education classes via video conferencing perceive distance learning courses [3]. The results of the study have shown that the most important problems in synchronous distance education were the disconnection and sound problems, mainly due to hardware issues. Other very important issue evidenced in this study was that students became bored after some time because of limited camera angles and cameras. Besides these technical problems, the researchers observed, and the students expressed that the factors of teacher, environment, distance, course type and duration also caused the students' perceptions to change.

In [4] researchers focus on the issues how two separate classrooms that are connected to one instructional process can be handled simultaneously by one teacher.

The purpose of this study is to evaluate the potentials of videoconferencing distance education compared to the traditional classroom environment as well as students' perceptions and satisfaction in both settings.

II. RESEARCH METHODOLOGY

In order to compare the traditional face-to-face classroom course delivery to synchronous videoconferencing way of distance teaching an experimental research has been conducted. This research also aimed at evaluating the students' perception and satisfaction with this method of teaching using contemporary ICT technologies.

This research was conducted for an elective 6-credit hour Object – Oriented Software Engineering (OOSE) course delivered during the winter semester of 2012. This course was delivered to two separate groups of students, all of them regular students at the Faculty of Computer Science, University "Goce Delcev". To the first group counting 60 students, the lectures were taught face to face in a traditional classroom setting. These students were physically located in the city of Stip.

Second group, counting 42 students was attending the same course in asynchronous sessions via interactive videoconferencing. Students from the second group were enrolled at one of the dispersed campuses of the Faculty of Computer Science, University "Goce Delcev" located in the city of Strumica situated in the far southeast part of the country, and approximately 70 kilometers away in the city of Stip. In the latter course, the instructor was physically located in the city of Stip (Figure 1).

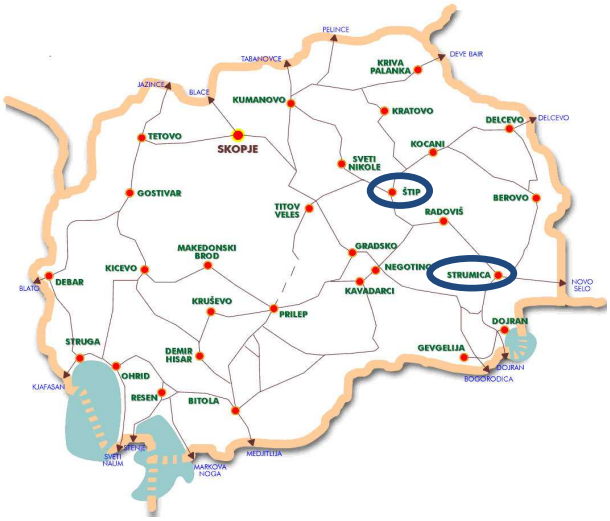

Figure 1. Campuses locations

Both courses covered the same topics and were given by the same instructor except for two lecture hours to the students in Stip, and two lecture hours presented in the classroom to students in Strumica campus given by external experts.

The distance-education lectures were delivered from a classroom equipped with Polycom HDX 8000 end-point (Figure 2), 36 computers, document camera, interactive whiteboard, two LCD projectors and monitor.

Figure 2. Polycom HDX 8000 end-point, with table microfon, multiview camera and remote controller

The lecturer had the ability to combine and to switch among three views delivered to the distant classroom: video image (e.g., the lecturer); computer screen (e.g., PowerPoint presentations); and the document camera (e.g., used to show hardcopies of figures and demonstrate working out calculations by hand). One LCD projector projected the image being transmitted to the distant classroom, and at the monitor, the image of the students in the distant classroom was presented. The distant classroom was equipped with Polycom HDX 7000 end-point, document camera, two LCD projectors and whiteboard. They were projecting picture big enough to be perceived clearly by all students. During transmission, the distant site also had a faculty facilitator present at least for the beginning of each class, and two technicians monitored the entire transmission.

The videoconferencing system used, allows setting up the camera in a number of different positions (e.g., wide shot of an entire class, close up shot of students in on the lower right quadrant) and store them as 'camera presets'. The presets are usually assigned to a button on the remote control. This allows the lecturer to easily focus in on a group of participants during the interactive portion of a session or just get a good overview of the level of engagement of varying groups at the remote site.

The traditional classroom lectures were delivered in a classroom equipped with a computer, a document camera, two video projectors and one interactive whiteboard. The synchronous distance education environment is summarized in Figure 3.

In this setting, the instructor may incorporate an alternative video source (e.g., a document camera, a VCR) for sending to remote locations, or may receive video from an alternative video source at the remote site. New feature “people on content” for example uses chroma key technology to allow lecturer(s) in a video call to become one with their content. Therefore, the potential for combining video inputs and outputs can seem endless.

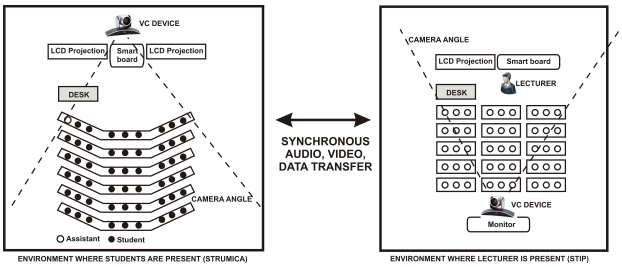

Figure 3. Synchronous distance education environment

However, with the introduction of more technologically advanced resources during classes, there is the increased danger of losing focus on the most important aspect of teaching - learning. Planning curricular objectives and concentrating on students as the major stakeholders, leads to a continuum in the life cycle of a technology based course. Evaluation at a personal level throughout the course but also at a curricular level can lead to improvements to better suit the needs of the students.

Course and instructor evaluations were administered to each group at the conclusion of the courses. The questions rated students' perceptions of the course and instructor using a 5-point Likert scale anchored at 5 = strongly agree and 1 = strongly disagree. The variances of the results were first analyzed using Levene's test for equality of variances. The evaluations were then analyzed using independent sample t tests based on the assumption of the equal variances or unequal variances where appropriate in SPSS v19.0. The final course grades were analyzed by the same method.

III. RESULTS

Students' demographic data are presented in Table1. The traditional classroom students had a higher computer science grade point average (GPA) (P = 0.012) at the onset of the 2 courses, and the distance-education students had a higher mean grade in the prerequisite Software Engineering Basics (SEB) and Software Analysis and Modeling (SAM) courses (P = 0.321 and P = 0.222 respectively) that preceded the OOSE course. No other significant differences were found.

TABLE I. STUDENT DEMOGRAPHICS

	Traditional classroom settings [Mean value]	***Videoconferencing distance education settings [Mean value]***
Age(years)	16.40	17.56
Overall CS GPA (on the scale 5-10)	8.67	7.44
Grade in SEB	8.80	8.15
Grade in SAM	7.90	8.83

Students who completed the course in the traditional classroom setting had an average final course grade of 8.92 compared to an average final course grade of 8.45 among students in the interactive videoconferencing group (P = 0.031).

The response rate for the course and instructor evaluation was 95.24% (40 out of 42 students) for the distance-education students and 95.00% (57 out of 60 students) for the traditional classroom students. The mean evaluation score (Table 2) for the distance-education students was higher than for the live students (4.7 ± 0.6 and 4.4 ± 0.7, respectively; P < 0.001).

TABLE II. DOMAIN ANALYSIS OF STUDENT RESPONSES

	Traditional classroom settings [Mean(SD)]	***Videoconferencing distance education settings [Mean(SD)]***
General	4.4 (0.7)	4.7 (0.6)
Lecture content	4.4 (0.5)	4.6 (0.8)
Presentation/style	4.6 (0.5)	4.8 (0.4)
Student contact	4.3 (0.8)	4.7 (0.6)

During the videoconferencing lecture, the number of interactions between students, as well as between students and teacher were counted. The number of interactions is presented in Figure 4. As it may be observed from the figure the number of interactions is growing, which means improved synchronous communication.

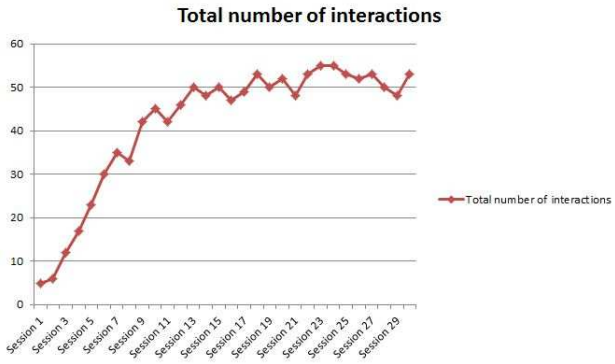

Figure 4. Total number of interactions during the synchronous videoconferencing lectures

IV. CONCLUSION

In videoconferencing distance education, it is often common for the distance students to feel a sense of alienation. In our case, students completing the OOSE course in a traditional classroom setting or by videoconferencing performed well and had a high overall perception of the instructor and courses. The distance-education course was rated higher by students than the same course delivered in a standard classroom. Several techniques were used by the instructor to facilitate the instruction via videoconferencing that may have influenced the distant students' perceptions of the course. Based on the results of the interview with the distance students the use of recitations was highly valued by the distant students. Therefore, the incorporation of regularly scheduled recitation-type sessions should be considered when developing a distance-education course. Moreover, encouraging interactivity with discussions between sites and group works were also highly appreciated.

So, we can say, as a general finding from this research is the need for instructors to understand and acknowledge that using videoconferencing, as a delivery mode will have an impact on teaching styles and methods. Even though the term "interactive video-conferencing" is often used when discussing this type of technology-based, teaching, successful interaction does not take place unless lecturers plan and understand how the medium will alter their teaching approaches. Other findings also indicate that whether the course delivery mode is a traditional one or a technology-based mode, effective lecturers establish and maintain a highly interactive classroom community. Therefore, for efficient delivery of educational content through distance videoconferencing mainly depends on how much teachers are knowledgeable about their subject, about their learners, and about pedagogy.

REFERENCES

[1] T.S. Hunter, E. Deziel, W.A. Marsh, Assuring excellence in distance pharmaceutical education. Am J Pharm Educ. 2003;67.

[2] W. Maltinsky, S. Hall, L. Grant, K. Simpson, S. MacRury, "Pilot project and evaluation of delivering diabetes work-based education using video conferencing." Rural & Remote Health 13, no. 1 (2013).

[3] H. Karal, C. Ayca, E.T. Yiğit, "Perceptions of Students Who Take Synchronous Courses through Video Conferencing about Distance Education." Turkish Online Journal of Educational Technology 10, no. 4 (2011).

[4] J. Hussa, "Distance education in the school environment: integrating remote classrooms by video conferencing." Journal of Open, Flexible and Distance Learning 2, no. 1 (2012): 34-44.

TEACHING OF NOVICE PROGRAMMERS: STRATEGIES, PROGRAMMING LANGUAGES AND PREDICTORS

UDC: 371.3:004.42
Professional Paper

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Abstract - Research on the challenges of teaching novice programmers has long been a subject of interest of all the factors involved in the study of introductory programming objects. Novice programmers often try to understand too soon what really programming means. Such approach is usually superficial and can lead to frustration and withdrawal. The problem is reflected in the low passing grades and high dropout rates in subject of introductory programming at various universities. The aim of this study was to review the relevant literature and research on strategies for teaching novice programmers that have proven to be successful. The factors that can significantly influence the success in learning programming are identified as well as experiences about the impact of the first programming language election to the overall success of students in introductory programming subject.

Keywords*:* predictors, novices, programming, programming languages, teaching strategies

I. INTRODUCTION

In the traditional teaching of computer science students have great difficulty in acquiring new concepts [1]. Over the last two decades there have been profound changes in the way we perceive and implement learning within the education system. Teaching places students in the center of the learning process rather than a teacher who dominates in the traditional approach to teaching. Teachers must adapt their approach to teaching novices to facilitate the adoption of intensive programming concepts and encourage them to greater involvement in the introductory programming. Computer science has an important task to identify what students are really interested in while programming, to discover the context in which students do it and how they do it. Today, students rather create real applications such as games and stories as part of a larger learning community instead of programming only to program [2]. New teaching methods influenced by development of constructivism advocate active construction of knowledge by students rather than passive absorbing from textbooks and lectures. In computational science emphasis is on building an efficient computer model.

In the field of programming the construction of knowledge is associated with predicting and understanding what is going on during execution of a computer program [3].

II. NOVICE PROGRAMMERS TEACHING STRATEGIES

Experts and novices in a particular area have different approaches to building their knowledge. Experts prefer the emergence of generalization while beginners favor superficial observation [4]. Concepts of programming that are acquired, are ranging from simple, such as variables, branching, looping, through manipulation with input and output data and errors towards demanding concepts such as structured data types, recursion, pointers and references [5]. Previous studies have shown that teachers know little about what students actually learn in the introductory programming and poor knowledge of students' problems they face while learning to program [6]. Researchers are interested in how novices adopt difficult concepts of introductory programming, which problem-solving strategies they apply while doing it and if teacher can master a positive impact on students to develop a quality approach to learning. During seventies early phenomenographers found two different approaches to learning that students use: deep approach, in which students tend to develop a real understanding of what they learn and surface approach to learning in which students just want to do a task that they get from teachers without real

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understanding. Teachers and learning content strongly influence the choice of deep or surface approach to learning among students [7, 8].

Interactive approaches to teaching programming such as: syntax-free, computational literacy, problem-solving and computing as interaction have been analyzed [4]. All these approaches share the common view that students should learn coding and from that experience learn complex, transferable skills such as analysis, design and problem solving. These approaches stress the importance of supporting students in achieving this goal. Most universities in the introductory programming still work in the traditional way of teaching, which consists of lectures, assignments and perhaps a demonstration of individual tasks. For students it is not such a problem to learn the syntax and semantics of programming languages individually but to combine these components into a meaningful whole. Many of them gave up their classes because they were not able to solve the tasks, they felt inadequate and unfit for it. In order to break the practice of "being taught to" introductory programming courses sometimes emphasize student engagement rather than passive learning. One strategy that fosters such an approach is **cognitive apprenticeship** strategy that emphasizes the adoption of cognitive skills. Cognitive apprenticeship starts by showing the conceptual model of the process most often through working examples and constantly explaining each stage of the process by the teacher. Students gradually solve the tasks, first with minimal teacher's assistance until the time when the teacher's help is no longer needed. Previous studies have shown that cognitive apprenticeship brings a higher retention rate of students in the introductory programming subjects [9]. A special form of cognitive apprenticeship strategy represents a strategy of **extreme apprenticeship** [10, 11], which emphasizes communication between teachers and students during the student's problem-solving process. This strategy emphasizes learning by doing and the importance of ongoing feedback from teachers. Students are introduced early in solving problems that are always divided into smaller parts. Such fractional tasks students find solvable and understandable. Extreme apprenticeship method in teaching programming can be integrated as part of the **pair programming** where students program in pairs while constantly revising written code. This software development technique, in which two programmers work together at one keyboard, showed significant positive results, particularly in the field of student's feelings of satisfaction and self-esteem [12, 13]. There is a long tradition of using students and undergraduate students as teaching assistants in general.

The method of **peer teaching** showed success in improving the pass rates of introductory programming subjects and retention in the same subjects.. Peer teaching is a pedagogical practice designed to support student engagement in teaching and improve learning outcomes. This teaching practice begins with a certain number of questions that correspond to individual students. After individual responses smaller group discussions followed, and the process of teaching concludes with a discussion led by the teacher with the whole class. Studies applying these strategies in teaching computer science showed high satisfaction and higher rates of exam results in introductory programming subjects [14].

Many universities promote teamwork and cooperation among students, through the use of **collaborative learning**. Collaborative learning combines students into groups according to various criteria and characteristics of the students. Precisely, the model that connects students to their programming knowledge and involvement in the group, proved to be successful in improving students' knowledge, regardless of some of their characteristics and their habits of learning [12].

For teacher is extremely important to know the way in which novice programmers adopt difficult concepts to be able to select his teaching strategies. Experienced programmer applies strategies that are derived from solving the past problems, which is not the case for novice programmers [15, 16]. They can understand the syntax rules of the programming language very well and write simple programs, in the same time it is very difficult for them to find solutions to problems not having the experience of one expert. Knowing the difference between beginners and experts in analyzing and solving problems will emphasize concepts that beginners focus on. Teachers are often in a dilemma on how to organize the content of learning programming. Studies have shown that changes of teaching sequences will not affect what beginners really learn. However, the change to the sequence of the learning content influences the cognitive load and effort that students recognize while learning these sequences [15]. Students will recognize the difficult concepts regardless of the order in which they were present. Learning from the concrete to the abstract gives the lowest score of weight and maximum efficiency. Teachers should thoroughly work on basic skills and simple problem solutions before entering the complex planning. In this way, newcomers have the opportunity to acquire the necessary background for understanding and implementation of plans.

A potential cause of failure of students in introductory programming lies in the creation of non-viable mental models of programming concepts [3]. According to Craik the brain creates "small-scale models of reality" that can be used to predict and understand the events and supporting explanations of these events. Mental models are incomplete, changeable, have blurred boundaries, they are unscientific and prejudiced, while accepting new information they still retain the old one what can often create additional problems in understanding. Exploring the mental models of students is very important, especially for the preparation of teachers and designing instructional materials. Although there are many studies that deal with the human mental models of natural surrounding phenomena, there are very few studies that have explored exactly the mental models of novice programmers. Learning to program involves the creation of viable mental models of basic programming concepts. Students with viable mental models solve programming tasks significantly better than those with non-viable mental models [17, 18]. It is assumed that many students, before turning to the subject of the introductory programming have deeply entrenched the ideas about some computer concepts such as assigning command.

Constructivism advocates actively constructing knowledge of students combining experiential world with existing cognitive structures. Teaching strategy that particularly provokes existing ideas is just Festinger's cognitive conflict strategy. Applying this strategy causes students to recognize errors in their understanding by bringing them into a state of cognitive conflict. Then the student perceives the discrepancy between his cognitive structure and external conditions, or between parts of his cognitive structure. Model of teaching strategy that integrates cognitive conflict and visualization software tool through Jeliot gave good results in improving the non-viable model of programming concepts [17, 19].

For students with no previous experience with programming **Kick-start activation** strategy is recommended [20]. In this approach student starts with deep structure of programming before introducing the structure of programming language. The strategy is based on a real computer program and is easily introduced while students participate in solving tasks to eliminate the errors that were intentionally made by teachers. The concept of the algorithm is introduced through pseudo-code and flow charts at the same time allowing students to enter solving problem phase, programming phase and understanding the differences between human and computers way of thinking.

III. PROGRAMMING LANGUAGES AND TEACHING ENVIROMENTS FOR NOVICES

Understanding the learning process of the first programming language can create effective learning environments. Some systems accommodate programming in an accessible and entertaining context like storytelling, games and robots [21], others simplify programming languages by keeping a few simple commands, reducing the syntax elements or maintaining the highest possible similarities with general-purpose languages without changing the structure of commands (QBasic, SP/J, Turing, Blue, JJ). The main purpose of MacGnome and Gnome is the prevention of syntax errors. Systems like Play, Show and Tell, My Make Believe Castle, Logo Blocks Alice 2, Karel J Robot and Kodu are examples of systems developed for using objects and graphical representations of actions and events, all in order to totally circumvent syntax errors. Programming languages like Pascal, SmallTalk, Playground LiveWorld, Blue Environment are examples of languages which aim to boost the availability of programming. AlgoBlocks promotes collective learning. The best examples of programs that introduce programs through some content are programs that include micro-worlds, robots, gaming and media computing. Early examples of the use of micro-worlds in programming are designed in Logo. Micro-worlds are useful for teaching, but there is a risk that students will not be able to convey the importance of content in the real world. The use of robots in the initial programming has proven successful and motivating in many institutions [22]. Media computing, which involves manipulating the media such as images and sound files, encourages creative expression while dealing with programming features such as loops and data management. Applying the approach of media computing resulted in increasing memory, enthusiasm among students and encouragement of women to participate [23].

Among the various environments that attempt to facilitate the introduction of the special programming highlights Alice, Greenfoot and Scratch. Although designed in different times and contexts, all three environments are visual, encourage direct participation in attractive activities and introduce students to programming. These environments have strong support in user community, either individually or in face to face groups in the form of a gallery, a Web site where students publish and share their materials. The absence of syntax errors in these environments has increased the security of novices, but these problems occur again at the turn to the textual programming languages [24] such as Java or C++.

Figure 1: Transferring Alice3 project into Java code

Graphical environment Alice3 successfully solved the problem of transition to Java with methods that directly convert Alice3 objects in Java code (Fig.1) [25]. The connection was made between problem solving strategies in Alice environment and supporting teaching techniques of indirect transfers known as bridging and hugging. With this technique, the teacher helps the student create a link from the content of which the concept taught to some other possible content in which the concept could be applied but also teacher creates learning situations that are very similar to situations in which the transfer is expected. A similar approach is used in BlueJ environment which is intended for initial teaching of object-oriented programming. BlueJ offers a graphical presentation of the class in the form of UML diagrams [26]. Good results in working with novices showed the Kodu programming language showing the increased involvement of students and students' projects containing even demanding programming concepts [27].

The main goal of any introductory programming subject and learning the first programming language is learning basic programming concepts that can be applied equally well in any programming language. Also, first programming language must be intuitive enough for beginners so they do not give up at the very beginning [28]. More than 8,000 well-known programming languages are documented on the World Wide Web [29]. Which of these languages are the most suitable for beginners? Today, thinking about the programming languages focuses more on the educational aspect of learning. Among the programming languages like C, C++, Python, Java, Eiffel, Haskell, JavaScript, Logo, Pascal, VB most appropriate for teaching were evaluated as Python and Eiffel. Although Java fills most of the required criteria, its major drawback is that it is not designed for teaching.

Many novice programmers when writing the first computer program follow the feeling of failure because they have to deal with unexpected syntax errors, errors of program or some output value that is not expected. All of the above may be included in the forms of program feedback. Program feedback is essential in assisting students to understand the computer program and the way in which computer interprets the program. One approach in solving these problems involves the use of problem-oriented programming and testing POPT [9] supported by the TestBoot tool. It allows novice to define simple input-output table of cases without the need of learning a new environment or changing the structure of the program. The results are better quality of generated code, smaller number of corrections of first program solutions and longer time to create the first solution. Another approach involving testing in introductory programming subject uses some personalized programming environment like Gidget. Gidget is a game where beginner helps the robot to repair his faulty code. They go through several levels of the game while learning basic design and analysis of algorithms in a simple imperative language (Fig. 2). This approach has caused an increase in motivation and engagement of students in correcting faulty code [30].

Figure 2: Gidget – performance error with and appropriate robot message

Good results can also provide tools that help students in the form of teaching assistant. Tool Petcha is an example of such a tool that acts as an automated assistant in matters of programming [31]. It complements existing tools, it is easily removed at the time when is no longer needed and promotes the use of existing development environments such as Eclipse and Visual Studio.

IV. PREDICTORS OF NOVICE PROGRAMMERS PERFORMANCE

Studies of factors that can significantly influence the performance of programming are very interesting subjects for teachers of introductory programming. These factors can point out what should be highlighted or should represent the foundation of teachers work but also can

recommend what to avoid in working with novices. The best indicators of success in all disciplines are considered students' self-esteemed success, their attitude, enthusiasm and general academic motivation. These factors have a strong impact on the performance of students, but do not separate programming from other disciplines. Earlier extensive research emphasized as the strongest predictors the degree of comfort, mathematical knowledge and attribution of success dependent on luck. Several studies have confirmed the existence of a positive correlation of deep approach to learning with the initial programming grade, but also a negative correlation of surface approach to learning with the same grade. Significant positive correlation was also found between the assessment of programming and sketching the spatial maps. We can say that various navigation strategies can have a positive impact on the programming code [32]. A strong positive correlation was shown between success in the programming and problem solving in mathematics and the natural sciences. Research of students' comments and observations collected during programming tasks showed that the positive previous programming experience strengthened positive self-assessment of student work [33]. Using viable mental models of programming concepts positively affects the success in initial programming [34]. Among the negative predictors were highlighted the frequent frustration with the tendency of rapid withdrawal, an aversion to programming, a sense of failure during programming, use of different programming models to solve the problem, believing that the best solution is to learn by heart, that real programmers immediately see the solution to the problem and that it takes a great knowledge of programming to achieve success [35]. Students who had a high percentage of successful continuous translation of programs achieved good success in programming, while students with lower achievement in programming had a high percentage of continuous errors in programming exercises and a greater number of hours spent on debugging the program. Previous programming experience showed to be useful for students, while gender, number of years of programming and programming languages that the student knows didn't significantly affect their performance [36]. There is a significant positive correlation between learning style abstract/random according to Gregorc, while learning styles according to Kolb does not demonstrate the power of predictors. Results related to learning styles vary through researches and it is possible that some meta-study could help produce valid conclusions about their impact. Teachers can hardly affect most of these factors significantly, but it is extremely important to know well their students in order to adjust teaching strategies and select the appropriate system for teaching as well as appropriate initial programming language.

V. CONCLUSION

In this debate about teaching novice programmers some teaching strategies that have shown the potential to facilitate students the adoption of demanding concepts of programming have been addressed. These strategies require more student engagement in the work and pay special attention to any form of mutual interaction and collaborative engagement between students and teachers. None of these strategies has proved to be successful in every learning situation which leads to the conclusion that it is necessary to adjust the chosen strategy with the context of learning, learning environment and the student himself. Learning environments and first programming language both, must introduce students into programming in a way that is interesting and engaging enough to keep them working while adopting demanding programming concepts. Knowing the factors that significantly influence the performance of programming teacher can improve students programming and avoid bad influences on their performance.

REFERENCES

[1] Sheard, J.; Carbone, A., "ICT teaching and learning in a new educational paradigm: Lecturers' perceptions versus students' experiences," in *Proc. of the Seventh Baltic Sea Conference on Computing Education Research*, Koli National Park, Finland, 2007.

[2] Kafai, Y. B.; Burke, Q., "The Social Turn in K-12 Programming: Moving from Computational Thinking to Computational Participation," in *SIGCSE'13, March 6–9*, Denver, Colorado, USA, 2013.

[3] Ben-Ari, M., "Constructivism in Computer Science Education," in *SIGSCE 98*, Atlanta, GA, USA, 1998.

[4] Fincher, S., "What are We Doing When We Teach Programming?," in *29th ASEE/IEEE Frontiers in Education Conference*, San Juan, Puerto Rico, 1999.

[5] Piteira, M.;Costa, C., "Computer Programming and Novice Programmers," in *ISDOC'12*, Lisbon, Portugal, June 11, 2012.

[6] McCracken, M.; Almstrum, V.; Diaz, D.; Guzdial, M.; Hagan, D.; Kolikant, Y. B.; Laxer, C.; Thomas, L.; Utting, I; Wilusz, T, "A multi-national, multi-institutional study of assessment of programming skills of first-year CS students," in *SIGCSE Bull, 33, 4*, 2001

[7] Biggs, J.B., "Teaching for quality learning at university," in *Open University Press/Society for Research into Higher Education, second edition*, Buckingham, 2003.

[8] Raadt, M.; Hamilton, M.; Lister, R.; Tutty, J.; Baker, B.; Box, I.; Cutts, Q.; Fincher, S.; Hamer, J.; Haden, P.; Petre, M.; Robins, A.; Simon; Sutton, K.; Tolhurst, D., "Approaches to learning in computer programming students and their effect on success," in *28th HERDSA Annual Conference*, Sydney, Australia, 2005.

[9] V. L. Neto, R. Coelho; Leite, L.; Guerrero, D. S.; Mendonça, A. P., "POPT: A Problem-Oriented Programming and Testing Approach for Novice Students," in *ICSE 2013:Software Engineering in Education*, San Francisco, CA, USA, 2013.

[10] Vihavainen, A.; Paksula, M.; Luuklainen, P., "Extreme Apprenticeship method in Teaching Programming for

Beginners," in *Proceedings of the 42nd ACM technical symposium on Computer science*, 2011.

[11] Black, T. R., "Helping Novice Programming Students Succeed," in *JCSC 22, 2*, 2006.

[12] Phuong, D. T. D.; Shimakawa, H., "Collaborative cLearning Environment to Improve Novice Programmer with Convincing Opinions," *WSEAS TRANSACTIONS on Advances in Engineering Education, Issue 9, volume 5*, pp. 635-644, September 2008.

[13] Corney, M.; Teague, D.; Thomas, R. N., "Engaging Students in Programming," in *12th Australian Computing Education Conference (ACE2010)*, Brisbane, Australia, 2010.

[14] Porter, L.; Garcia, S.; Glick, J.; Matusiewicz, A.; Taylor, C., "Peer Instruction in Computer Science at," *ITiCSE'13,*, 1-3 July 2013.

[15] Kranch, D. A., "Teaching the novice programmer: A study of instructional sequences and percetion," *Educ Inf Technol*, pp. 291.-313., 2012, vol:17.

[16] Raadt, M.; Toleman, M.; Watson, R., "Training Strategic Problem Solvers," *SIGSCE*, pp. volume 36, number 2 , pages: 48-51, June 2004.

[17] Ma, L., Investigating and Improving Novice Programmers' Mental Models of Programming Concepts, University of Strathclyde, Department of Computer & Information Science, 2007.

[18] Ma, L.; Ferguson, J.; Roper, M.; Wood, M., "Investigating the viability of mental models held by novice programmers," *SIGCSE '07: Proceedings of the 38th SIGCSE technical symposium on Computer science education*, vol. 1, no. ISBN: 1-59593-361-1, pp. 499-503 , 2007.

[19] Ma, L.; Ferguson, J.; Roper, M.; Ross, I.; Wood, M., "Improving the Mental Models Held by Novice Programmers Using Cognitive Conflict and Jeliot Visualisations," in *ITiCSE'09*, Paris, France, 2009.

[20] Lathinen, E.; Ahoniemi, T., "Kick-Start Activation to Novice Programming - A Visualization - Based Approach," *Electronic Notes in Theoretical Computer Science*, no. 224, pp. 125-132, 2009.

[21] Pauch, R.; Kelleher, C., "Lowering the barriers to programming: A taxonomy of programming environments and languages for novice," *ACM Computing Survey 37, 2*, June 2005.

[22] McGill, M. M., "Learning to Program with Personal Robots: Influences on Student Motivation," *ACM Transactions on Computing Education,Vol. 12, No. 1*, p. 32 pages, March 2012.

[23] Guzdial, M., "A media computation course for non-majors," in *Proceedings of the 8th annual conference on Innovation and technology in computer science education*, Thessaloniki, Greece, 2003.

[24] Powers, K.; Ecott, S.; Hirshfield, L. M., "Through the Looking Glass: Teaching CS0 with Alice," in *SIGCSE '07*, Convington, Kentucky, USA, 2007.

[25] Dann, W.; Cosgrove, D.; Slater, D.; Culyba, D.; Cooper, S., "Mediated Transfer: Alice 3 to Java," in *SIGCSE'12*, Raleigh, North Carolina, USA, 2012, March.

[26] Bennedsen, J.; Schulte, C., "BlueJ Visual Debugger for Learning the Execution of Object-Oriented Programs?," *ACM Transactions on Computing Education, Vol. 10, No. 2, Article 8*, June 2010.

[27] Stolee, K. T.; Fristoe, T., "Expressing Computer Science Concepts Through Kodu Game Lab," in *SIGCSE'11*, Dallas, Texas, USA, 2011, March 9–12.

[28] Gupta, D., "What is a Good First Programming Langugage?," *Crossroads - The ACM Student Magazine, Volume 10 Issue 4*, August 2004.

[29] "Ministry of Truth," 10th November 2008. [Online]. Available: http://theministryoftruth.tumblr.com/post/58975997/the-encyclopedia-of-computer-languages. [Accessed 2 may 2014].

[30] Lee, M. J.; Ko, A.J., "Personifying Programming Tool Feedback Improves Novice Programmers' Learning," in *ICER'11*, Providence, RI, USA, 2011.

[31] Queirós, R.; Leal, J. P., "PETCHA - A Programming Exercises Teaching Assistant," in *ITiCSE'12*, Haifa, Israel., July 3–5, 2012.

[32] Simon; Fincher, S.; Robins, A.; Baker, B.; Box, I.; Cutts, Q.; Raadt, M.; Haden, P.; Hamer, J.; Hamilton, M.; Lister, R.; Petre, M.; Sutton, K.; Tolhurst, D.; Tutty, J., "Predictors of Success in a First Programming Course," *Australian Computing Education Conference (ACE)*, vol. 52, pp. 189-196, 2006.

[33] Kinnunen, P.; Simon, B., "Ma program is OK - am I? Computing freshman's experience of doing programming assignements," *Computer Science education*, vol. vol. 22, no. No. 1, pp. 1-28, March, 2014.

[34] Bornat, R.; Dehnadi, S.; Simon, "Mental models, Consistency and Programming Aptitude," in *ACE2008*, Wollongong, Australia, 2008.

[35] D. A. Kranch, Writer, *Teaching STEM to Novices: Maximize Your Effectiveness and Minimize Your Losses.* [Performance]. 2011 STEMtech conference, 2011.

[36] Watson, C.; Li, F. W. B.; Godwin, Jamie L., "No Tests Required: Comparing Tradicional and Dynamic Predictors of Programming Success," in *Sigcse 2014*, Atlanta, GA, USA, 2014.

WEB 2.0 TOOLS IN EDUCATION, THE GAP BETWEEN THE CURRICULUM AND SCHOOL PRACTICE

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Review Scientific Paper

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Abstract – Modern pedagogical efforts, the information society and changed mental structure of new generations require the implementation of web 2.0 tools in education. Web 2.0 services and sites allow users to interact and collaborate with each other. Web 2.0 tools, such as online documents, social networks, wikis, blogs, social bookmarking and online presentations are interesting possibilities with interactive and multimedia support, which motivate students and fit their mentality and everyday lives (Namestovski & Arsovic, 2013). This research project investigates the level of web 2.0 tools application in Serbia, and also explores the barriers and offer possible solution. On the other hand the curriculum and the textbooks were also analyzed.

Keywords: education, implementation, web 2.0 tools

I. INTRODUCTION

Web 1.0 was characteristic to the Internet until the middle of the first decade of the new millennium, mostly meaning passive content servicing and one-way communication. The following Web 2.0 environment – beside "content consumption" – also means creating and sharing of contents, emergence of online applications, as well as of interactive and collaborative activities. On the other hands the communities in this environment are formed around the field of users' interests. The document editing and storing tools, e-mail sending/receiving softwares were also moved to the online space. These processes facilitated the mobility of users and the rapid and easily access to the documents.

The most popular Web 2.0 tools are social networking sites (Facebook), where all Web 2.0 features are appearing, first of all immediate and interactive communication.

Besides the social networking sites, there is the image and video hosting, sharing websites (YouTube, Flickr, Picasa), collaboratively edited free online encyclopaedia (Wikipedia), online auction websites (eBay), blogs and microblogging services (Twitter) and online document editing applications (Google Docs and SkyDrive)

II. EDUCATIONAL STRUCTURE OF REPUBLIC SERBIA

The educational structure of Republic Serbia is divided into elementary schools, high schools and higher education. Elementary schools consist of 4+4 classes. In first 4 classes (lower classes) class teaching is realized, in other 4 classes (higher classes) subject teaching is realized.

The high schools, ended with Matura (Graduation) are 4 years long, and besides these high schools, there are high schools with three years duration, in most of the cases with vocational type of education. All public educational institutions in Republic of Serbia are under direction of Ministry of Education, Science and Technological Development and the curriculums were created by this organisation.

The faculties of universities are independent, the curriculums of these institutes can be customizable and adaptable for programs and needs.

III. WEB 2.0 TOOLS IN LOWER CLASSES OF ELEMENTARY SCHOOL

In republic of Serbia the teaching of IT contents began in lower classes of elementary school within the framework of subject: From toys to computers. The subject is optional (1 lesson per week) from 1 to 4 classes. The curriculum was created in 2008. In the framework of this course, the students are meeting with concepts of materials

and different toys, and after that with basics concepts, security risk and rules of conducts related to IT. The units of course are repeated and expanded in the form of concentric circles and usually lectured by teacher.

The aims of the course at first grade are the development of motor skills, logical thinking and creativity. Besides of these contents, the course includes the basic components of computer, the safe using of computer, basic text inputs and editing, drawing and printing in the first class (Ministarstvo prosvete, nauke i tehnološkog razvoja, 2008a).

Following the principle of concentric circles, in the second year the contents from the first class are extended. In the introduced software (Paint) the numerous possibilities and tools are extended. The text and picture editing is expanded with scanner and digital camera application (Ministarstvo prosvete, nauke i tehnološkog razvoja, 2008a).

At the third grade the teaching contents are also expanded. For creating picture and textual contents used Paint software. In the curriculum and in workbook appeared the calculator and the concepts of hardware and software was presented using practical examples. At the end of school year the operation of sending and receiving e-mail is appearing (Ministarstvo prosvete, nauke i tehnološkog razvoja, 2008b).

At the fourth grade for the topic of text and picture editing (Microsoft Word, Microsoft Publisher) and for the topic of presentation (Microsoft PowerPoint) new softwares appeared. Activities on the Internet were expanded with applying web camera and multimedia message (Ministarstvo prosvete, nauke i tehnološkog razvoja, 2008c).

In conclusion can be highlighted that Internet and activities related to Internet are underrepresented in curriculum and is workbooks. The services of Internet appeared only in topic of E-mail. Web 2.0 tools, are not represented in the curriculum of lower classes of elementary schools in Republic of Serbia, in the framework of the curses From toys to computers.

IV. WEB 2.0 TOOLS IN HIGHER CLASSES OF ELEMENTARY SCHOOL

At higher grades of elementary school, there is IT and computer technology (facultative subject - one lesson per week) and Technical education and IT (compulsory subject – two lessons per week) at seventh and eighth grades. The curriculum of Technical education and IT contain 14 lessons (from total 72 lessons) related to IT contents in seventh grade and 18 in eighth grade (Ministarstvo prosvete, nauke i tehnološkog razvoja, 2010a).

At the seventh grade, the acquiring of using IT tools appeared as the goal of the year. Besides of programming, video and audio editing, the curriculum contains the Internet unit as separate part of curriculum with six lessons. This unit contains learning contents such as rules of communication using Internet or mobile devices. Although the curriculum places the emphasis on the process of sending and receiving e-mail and this unit is presented in workbooks in the form of dial up Internet and Outlook Express, and there is the requirement of registration online and free e-mail address, where again there are the possibilities of implementation of web 2.0 tools, such as Google Drive in Gmail environment. On the other hands the curriculum mentioned the blogs, comments and forums on Internet, where there are also possibilities for effective implementation of web 2.0 tools (Ministarstvo prosvete, nauke i tehnološkog razvoja, 2010b).

In the eighth grade one of the main aims of the school year is development of digital literacy and implementation IT tools. Besides of spreadsheet calculation and programming, there is also creating web sites. In the framework of web design, there are possibilities for implementation web 2.0 tools, even though the workbooks based on HTML encodes websites and Microsoft FrontPage as web editor, the curriculum refer for JOOMLA and Dreaweaver as optional solution. In addition, there is also a favourable fact that 14 lessons (from total 34) are freely chosen project. Here the modern web 2.0 tools can appear in framework of communication between students, during the realisation of project or even in presenting the project.

The greatest disadvantage of education and learning IT contest in elementary schools of Republic of Serbia is the facultative subject and the fact that contents cannot effectively build on each other's during the process. On the other hand the teachers of Technical education and IT in most of the cases don't have IT qualification, even though the pairing of technical education and IT specialisation on the universities of Serbia is becoming increasingly popular.

The curriculum of IT contents in elementary school is not inter-correlated or related to other subjects. Workbooks don't have annexed CD and online support is also limited.

V. WEB 2.0 TOOLS IN SECONDARY SCHOOLS

The teaching of IT contents in secondary schools in Republic of Serbia depends on major of education institute. Secondary school with arts

profile have IT subject in first year, with two lessons weekly. On the other hand, in the general grammar school there are two lessons per week, during four year or in few grammar schools, mainly with natural science or IT profile, where number can reach even 12 lessons per week related to IT.

The one of significant disadvantage of curriculums in secondary schools is that contents and requirement are not unified and not compatible with ECDL curriculums. Just in a few secondary schools ECDL (European Computer Driving Licence) exam is realized, which guarantees unified level, using standardized theoretical and practical questions. ECDL certificate prove IT skills and it is acknowledged in whole world.

We analyzed the general grammar school curriculum in this paper from diverse secondary schools, and we recognized the possibilities of implementation web 2.0 tools in entire educational process and especially in framework of IT subjects. The curriculum for grammar schools was written in 2011, so it is the latest document among the analyzed curriculums.

The subject of IT teaches two lessons per weeks in general grammar schools. The curriculum prescribes web 2.0 teaching materials in first and in second years. In the third year the curriculum prescribes programming and in fourth year activities related to date bases.

Among the main aim of education, besides the development of linguistic, mathematical, scientific, artistic and cultural competencies, there is the formatting and development of technical and digital literacy. Although in framework of IT competencies the competent and critical usage of devices of information society is especially highlighted, in different situations there is focusing on the interest of person and community. Among the goals are still the understanding of principle of the Internet and local networks, exploitation of resources of network and using of services of internet for e-learning purposes. In this part the sharing of computing resources is emphatic, instead of interactive and collaborative communication and content sharing. Web design and preparing other online (web based) applications are also prescribed by curriculum. On the other hand the curriculum emphasize the appropriate activities on the social networks, first of all the sharing of useful information and the importance of assistance.

Although this educational aims are not up to date and is not adapted to the changed structure of educational system in informational society, with few addition and innovation it can effectively support the implementation of web 2.0 tools.

At the teaching of several softwares (such as operating systems, text editors, presentation editors and image editors) the curriculum and workbooks based on curriculum present the offline application (for example Microsoft Office: Word, PowerPoint) and there are no connection toward online contents or solutions. The existing educational structure doesn't have motivational effects for collaborative work forms and for sharing finished projects and artifacts. On the other hand, the applications are not named, so the application based on web 2.0 services is not excluded.

In first year of grammar schools web 2.0 tools are appearing in the framework of the Internet unit. In this unit, learning contents such as searching on Internet, processing and using the information from Internet, online maps, the using of social networking sites, e-commerce and e-government, e-learning, rules on Internet (netiquette) and ethics are included.

In second year of grammar schools appearing web 2.0 tools framework Multimedia unit, where curriculum prescribe the sharing (uploading) created video materials on the Internet. Besides this unit there is advanced using of Internet, where the web 2.0 tools are clearly prescribed, such as Online document editors (operations in "cloud") – sharing documents on Internet, Blog, Wiki tools and Electronic portfolio.

In accordance with those objectives the application of web 2.0 tools in grammar schools in Republic of Serbia is possible.

VI. Empirical Research About Using Web 2.0 Tools in Education in Republic of Serbia

To investigate the real situation in schools of Republic of Serbia about using web 2.0 tools, we created a theoretical model and the schedule of scientific research.

The schedule of research:

Phase 1: Analysis of related literature

Phase 2: Organising research teams

Phase 3: Preparing online and offline questionnaires

Phase 4: Publishing and filling the questionnaires

Phase 5: Processing the received results

Phase 6: Comparison of results of Republic of Hungary and Republic of Serbia

Phase 7: Comparison of results with international results

Phase 8: Formulation of conclusions and recommendations

The theoretical model is based on the following scientific literature

International:

ITL Research (2011): Innovative Teaching and Learning Research, 2011 Findings and Implications, SRI International, Microsoft Partner in Learning.

EU:

European Resource Centre for Web 2.0 Education (2011): Analysis of Training Courses (Deliverable 23)

Hungary:

Fehér P. (2008): Internet és számítógéppel segített tanulás a kistelepülések iskoláiban (A pedagógusok módszertani kultúrája fejlesztésének és megújításának lehetőségei IKT-eszközök alkalmazásával) - Internet and computer supported learning in rural schools (Improving teachers' classroom techniques with ICT technology integration)

Serbia:

Namestovski, Ž. (2013): Analiza efekata primene obrazovnih softvera na motivisanost nastavnika i učenika u nižim razredima osnovne škole - Analysis of the Effects of Applying Educational Software Tools on Pupils' and Teachers' Motivation Level in Primary Schools

The references and the scientific literature promote the comparison of results from different countries and with results of similar investigation from world and EU.

The research team formulated followed researchers: Dr. Buda András (Hungary), Fehér Péter PhD (Hungary), Dr. Námesztovszki Zsolt (Serbia), Bagány Ágnes (Serbia), Major Lenke (Serbia), Szálas Tímea (Serbia), Vinkó Attila (Serbia).

The questions are categorised in four groups, as follows: 1. Basic information (14 questions) 2. Attitudes (12 questions) 3. The implemention level of web 2.0 tools in education and in leisure (5 questions) 4. Barriers and possibilities of motivational factors for using web 2.0 tools (7 questions) 5. Other remarks and perception.

The research is currently in phase 4: Publishing and filling the questionnaires. The online questionnaire is available on following address: http://bit.ly/1dOKBww.

VII. CONCLUSIONS

Although the research is in progress, the preparatory section is finished, the base for successful research is established and the preliminary results of survey outlines the significant gap between curriculum and school practice.

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REFERENCES

[1] European Resource Centre for Web 2.0 Education (2011): Analysis of Training Courses (Deliverable 23). http://bit.ly/1fA2NIP

[2] Fehér Péter (2008): Internet és számítógéppel segített tanulás a kistelepülések iskoláiban (A pedagógusok módszertani kultúrája fejlesztésének és megújításának lehetőségei IKT-eszközök alkalmazásával). http://bit.ly/1dQiT2E

[3] ITL Research (2011): Innovative Teaching and Learning Research, 2011 Findings and Implications, SRI International, Microsoft Partner in Learning. http://bit.ly/1gqGIst

[4] Ministarstvo prosvete, nauke i tehnološkog razvoja (2008a): Nastavni program za predmet Od igračke do računara za prvi i drugi razred osnovnog obrazovanja i vaspitanja. http://bit.ly/1scrO2j

[5] Ministarstvo prosvete, nauke i tehnološkog razvoja (2008b): Nastavni program obrazovanja i vaspitanja za treći razred osnovnog obrazovanja i vaspitanja. http://bit.ly/Ke3tHx

[6] Ministarstvo prosvete, nauke i tehnološkog razvoja (2008c): Nastavni program obrazovanja i vaspitanja za četvrti razred osnovnog obrazovanja i vaspitanja. http://bit.ly/1k3iDQq

[7] Ministarstvo prosvete, nauke i tehnološkog razvoja (2010a): Pravilnik o nastavnom programu za osmi razred osnovnog obrazovanja i vaspitanja. http://bit.ly/1hExFsr

[8] Ministarstvo prosvete, nauke i tehnološkog razvoja (2010b): Pravilnik o nastavnom programu za sedmi razred osnovnog obrazovanja i vaspitanja. http://bit.ly/1pVlHLN

EXPERIMENTAL EXAMINATION OF STRUCTURED-MODULAR INSTRUCTION

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Professional Paper

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Abstract - The experimental examination of the efficiency of constructivism based structured-modular approach was done on the example of Anemometer module at Electro-technical school. The starting hypotheses were confirmed, i.e. the level of factual knowledge doesn't depend on the treatment of the group but their size, namely, the ability of using the knowledge is significantly better with structured-modular teaching. The transfer of cognitive skills gained by this approach is expected, but didn't happen. The students consider that the structured-modular teaching is better and more interesting. It enables them to problem solving independently and the knowledge is better related to the needs of practice. From the taxonomy of educational contents is easy to designate modules of the lowest hierarchical level. These modules become relevant to students by gradual grouping from the simplest to more complex intentional modules. They are constructed by experts and skilled teachers, on the basis of student's interests and affinity. The development of abilities to apply knowledge, independent learning and employing sophisticated resources is more important than accumulation of factual knowledge. This demand sees a role of teacher as coordinator, teaching materials as guide through the modules and assessment as confrontation of student with problem situation.

Keywords: structured-modular instruction, teaching method, constructivism, cognitive skill, transfer

I. INTRODUCTION

Despite all the criticisms, lecture followed by exercises that further explain the learned concepts is the predominant form of teaching. It provides well-structured knowledge, it is very time efficient and it provides an opportunity for students to quickly get an overview of some scientific discipline and gives a sense of control of the whole process to the teacher [1]. Transmission character of teaching suffers from serious deficiencies: it is mostly focused on factual knowledge, understanding and easier application; poor motivation and passivity of students do not stimulate creativity; it is unadjusted to real interests of students; excessive influence curriculum creator leaves teachers a little room for adaptation to local conditions.

Possible answer to this situation is modular teaching [2]. The idea of thematically rounded modules that starts from the real life and verification of the entire set of modules instead of individual one have yielded significant results [3], [4], [5]. Structured-modular model of the teaching process is characterized by a specific clustering module procedure and their hierarchical structure. Prevail teaching models that are grounded in a constructivist paradigm are seminars, project teaching, learning through research, teaching questioning [6], [7], [8]. Of course, there is also room for variety of methods used in the ERR (evocation, understanding, reflection) framework for teaching [9], [10].

By its nature, structured - modular model is praxeological and covers the entire educational process, such as didactical theories. Experts in specific scientific areas conduct collecting, sorting and selecting of goals, defining educational content and its taxonomical schemes and modules of the lowest hierarchical level. Teams consisting of experts and teacher-practitioner will make integration and placement of modules in real contexts, based on students' interests. Optimization module shall be set on the basis of transparent criteria. Teachers are more familiar with their school environment and student abilities, they have a major role in defining the teaching methods and forms of work, in making the choice of the teaching social organization, teaching aids and equipment that will be used as well as method of evaluation results. They cease to be a transmitter and a primary source of knowledge. Teachers become guide to students - their co-workers in a team. In collaboration with other teachers they also define common points with their courses and possibilities of teamwork. Verification of student achievement takes place through the entire process of carefully selected problem situations. Instead of measuring the accumulated factual knowledge, the test is more oriented towards recognizing the wealth of ideas, their argumentative purification,

towards the quality of implementation, testing and documentation of solutions [11]. Test instruments and analysis of the results besides the revised Bloom's taxonomy [12] should be based on the SOLO taxonomy [13] which measures the perspective of knowledge on the local - holistic scale. Structured-modular teaching particularly comes to the fore at higher levels of implementation and creation, i.e. a multiple and holistic perspective. Empirical research conducted among third grade students of Electro-technical school through the course of Digital electronics had an important role in the development of models for content programming, selection and design of the module and the organization and management of the teaching process with structured modular approach.

We set four hypotheses:

H_1: There is no significant difference in knowledge of the facts, which are the result of learning, between the standard and structured-modular way.

H_2: There is a significant difference in the ability to apply knowledge as learning outcomes between standard and structured-modular way.

H_3: There will be a transfer of cognitive skills acquired in the structured-modular teaching assignments in more complex applications and synthesis.

H_4: There is a greater student affinity toward modular-structured teaching than for classical.

II. EMPIRICAL RESEARCH

A. Research draft

The central empirical method in this paper is a didactical quasi-experiment from the group of operational and applied researches. It is supplemented by surveys which tested students' attitudes in experimental group and qualitative snapshot of the teaching process. Experimental model that Campbell and Stanley called “right” and Kerlinger “good”, with streamlined parallel group [14] was applied. Working of groups took place on the following scheme:

- C-2, control group consisted of 39 students, classical work, common lectures, exercises divided in three subgroups
- C-1, control group consisted of 14 students, classical work, separate exercises and lectures
- E, experimental group consisted of 24 students, modular-structured classes divided into two groups of 12 students

It is well-known by Glass and Smiths’ extensive meta-analysis that smaller classes achieve significantly better results [14]. C-1 group was formed for that reason, in order to control the impact of group size, by which we avoided attributing the impact of other factors.

In order to retain the naturalness, each group was composed of students from the same classes and groups as it was before the research and the instruction was performed by the same teacher. There was no equalizing by couples as it was already established that there where no significant differences between the groups according to the overall success, the general ability test, grades of group of courses in electrical engineering and initial test of knowledge. Including teaching materials and test instruments were the same for all groups.

B. Sample

In the study that lasted for six weeks, 77 students participated in two parallel classes of third grade Electrotechnical school with identical programs.

Digital electronics course was taught by a teacher with five year experience as a designer in electronic industry and three year experience in teaching. He was a leading teacher, teacher who was ready to change his role and status in the structured - modular teaching. He gained his authority with a rather unconventional than rigor relationship with students. According to Bennett typology [14] teachers closest to him belong to first and third categories: he prefers intrinsic motivation and integration of content, students choose what and how they will work, mostly in teams.

Module Anemometer/Rev counter gave the possibility of a direct connection with the subject of electronic assemblies and sub-modules via computing encoder and processing by computers. It was necessary to provide sufficient signal generator, oscilloscope, rectifier, test circuit boards electronic components and catalog with specifications of digital circuits.

C. Methods, procedures and measuring instruments

The study applied the Problem test capability, initial and final knowledge test and the questionnaire for a survey of students in the experimental group. Several students did not participate in all stages because of the inability.

Bujas’s Problem test of the ability for the profession of electrics/electronics/automation had 70 tasks, and was handled for 45 minutes. The mean value was M = 38.58 and standard deviation

σ = 10.39. Respondents achieved 46.22 points (equivalent to z - value is 0.735).

The initial knowledge test consisted of two parts and it was addressed to all three groups for 60 minutes. Tasks could be classified into six types: multiple choices, replenishment, comparing, multiple joining, analytical reasoning and synthesis. Winning points were all fully or partially correct answers. Negative points were included to discourage guessing, depending on the severity of the error. Scoring system was previously agreed for each task with all possible variations for correct and incorrect responses. The tests were corrected independently twice as in the final test.

The first part of the initial test (14 tasks, 55 points) checked the knowledge of digital technique and electronics circuits, which was prerequisite for mastering of module. There were no significant differences between groups [Table I].

TABLE I. COMPARISON OF INITIAL CONDITIONS BY GROUPS

	E – group	C-1 group	C-2 group	ANOVA / Kruskal-Wallis
1. Bujas's Problem test (z-score)	0.78	0.55	0.77	F=0.492, sig.= 0.613
2. Overall success mark	3.24	3.19	3.28	F=0.032, sig.=0,969
3. Electronic courses mark	2.73	2.58	2.85	X^2 =0.36, DF=2, sig= 0.835
4. Pre-test – (known topics, prerequisites)	41.35	42.71	41.71	F=0.156, sig.=0.856
5. Pre- test – (new topic + use of catalog)	10.55	9.86	11.21	F=0.611, sig.=0.546
6. All previous elements (1-5) together (quick cluster - 3 group – percentage of students in best group)	36.8	33.3	33.3	

The second part (8 assignments, 31 points) explored the possible knowledge of the material that was about to be processed by the module. Also, there were no significant differences between groups.

The constructive validity of the test, determined by factor analysis, emphasized the importance of three factors that explain over 50% of the variance: the knowledge of the signal, cascading circuits and knowledge of logic gates. Reliability of the tests according to the Spearman-Brown formula was a modest 0.69 because of the inhomogeneous structure of the test, a small number of tasks and the effect of guessing. The discriminative value of most tasks, expressed by ϕ coefficient, was very high. The exceptions were two tasks in which no one knew the answer because it was about material yet to be processed as well as tasks of the knowledge of the EX-OR gate and periodic signals. Table (table1) shows that there is no significant difference between groups by any criterion.

The final knowledge test included topics: flip-flop, the delay signal, register, shift register, counter, display, divider, decoder, driver, A/D and D/A converters.

The first section (11 tasks, 47 points) assessed the level of factual knowledge, understanding, application and analysis. Solving time was 30 minutes. Typical tasks included the situation of the various table of stabiles, differences of asynchronous and synchronous counters, definition and principle of shift register operation. There were no significant differences between groups.

The second part (task 3, 44 points) related to the complex application and synthesis. Resolution time was 25 minutes. An example application was the tachometer. On the block-scheme students should have marked the names of the assemblies, the number of lines, the type and position of the control signals. Synthesis was assessed with task that was supposed to explain the schematic work of echo sounder (transmitting part, the receiving component, display and managing of time counting). Students of the experimental group achieved a significantly better result.

The third part of the test (3 tasks, 22 points) attempted to examine whether there was a transfer of cognitive skills in the field of A/D and D/A converters, which was not included in the modular-structured classes. Time was limited to 25 minutes. There were no significant differences between groups.

Likert scale of attitudes was used for students of experimental group to test interesting aspects, usability of knowledge in realistic problem situations, the necessary level of independence and demands of students, the role of teachers and their qualifications, possible applications throughout the school year and in other courses and preferences in relation to the standard teaching. The views were presented in the form of a statement by the Likert scale, ranging from 1 to 7.

D. Preparation of the experiment

First step in the preparation of the experiment after defining the objectives, tasks and research hypothesis included a choice of schools, grades and classes in which was possible to conduct an experiment. The choice fell on the School of Electrical Engineering for the sake of several reasons: established curriculum, opportunities to connect content from a large number of cases with one teaching module, having lecturers with enough experience in design and teaching ready to accept an experimental mode that is full of uncertainty, good laboratory material equipment, existence of well-developed laboratory exercises in the area covered by the module and existence of two parallel classes of third grade in the same profession that were mature enough for realization of more complex modules.

It was necessary to find interesting relevant problem for students who were able to realize the anticipated 12 hours of instruction, compatible with the existing curriculum and the pace of their implementation. It was preferred that the components (sub modules) could be incorporated in the other main modules as a complete solution, that the knowledge of the related courses that were thought at the same time could be used but also that it could provide the preparation of individual assembly for the module in those courses.

We assumed that the acceptable module was anemometer, a device that measures wind speed. Anemometer is inevitable in the collection of data necessary for the design of wind turbines that are the leading source of renewable energy today. Regardless of the enormous importance of energy issues, an attempt to exploit energy background to animate students remained fruitless, because they didn't see immediate benefits or usability in their daily lives. For them it was others' problem – government's, companies' etc. However, the simple possibility of using the same device caused a great deal of interest. A few of them were sailors, and they knew the meaning of the unit in preparation tactics for the race. During the implementation of the modules students noticed that the main module, after changing encoder, could be used for device that was even more attractive - the car or motorcycle tachometer.

Synopsis that defined the key points and the time required to reach them was designed before the realization of the module. In everything else the teacher had full freedom, but he was expected to achieve the highest possible quality and thoughtful students' engagement.

E. A recording of the teaching process for the experimental group

The focus of this recording is directed towards the aspect of establishing problem dialogue, with emphasis on the stage of decomposition of the main problems in several smaller ones. Therefore, despite the existence of a large number of teaching process recording protocols such as Flanders, there were used only some of their elements. With the help of their teacher, students were mostly able to follow the development of the project from concept to concrete specifications. Appointed tasks were in the zone of proximal development, still slightly above the current capabilities of students.

The teacher skillfully guided the process by constant creating of problem situations, at first verbally and later confronting students with unexpected and seemingly contradictory situations that led to cognitive dissonance. It was obvious from the footage that half of the students were active during the theoretical problem solving, and during the independent practical work almost all of the students were involved, much more than in the traditional teaching. It is reasonable to presume that other students tried to find a solution, but that was not recorded because of slower labor or smaller capacity or they didn't manage to make it on time.

The module offered the possibility of extending so the encoder pulses were shaped and driven to the I/O port of the PC, counted in time and directly presented as the speed of wind speed in the digital and analog form on a computer screen, along with the graphics display of speed change in time. Students really liked that option, and one of them, very suspicious of anything new, said that he had "the best two hours since going to school".

F. Realization of the teaching process with control groups

In conventional work teaching is delivered in a form in which frontal lessons for the whole class follow the material from textbooks. Laboratory exercises follow the lectures and are held in groups up to five students with pre-prepared manuals for students. Manuals provide description of laboratory exercises, a scheme by which the assembly will be measured, a description of measurements and instruments, and often the appearance of the table in which to enter the results. A common mistake with this approach is the aspiration towards mechanical performance of a large number of exercises that precisely follow the manual. It typically serves as a source of prepared information and teachers and students both don't participate in its production. For student everything is served. He doesn't encounter even

one real problem in the design and manufacture of assembly because someone else, usually a teacher, made it for him. The students were expected to carry out the scheme to connect circuits and devices, measurement, data processing and display. The interpretation of the results is usually paternal.

The effect of exercise is reflected in the fact that the student is "convinced" that the theoretical elaboration of certain circuits is correct and that the results obtained in individual measuring points were predicted by the teacher or textbook. No self-disclosure or greater intellectual effort of student was included. This result is useful in the beginning of professional student education when it is necessary to master the technique of measurement and data processing, but it is difficult to expect that the student, accustomed to such work, will be able to independently design a complex device. Laboratory work has the potential in developing methods that are similar to scientifically ones or in the process of provoking curiosity and motivation of students, but working with the constructed model students do not recognize its benefits in their private and professional life, so their motivation is low.

Why has this way of teaching managed to maintain in technical courses of many technical schools and colleges? This approach certainly has a number of technical advantages: the timing of exercise realization can be accurately predicted, students can study them in advance, and the necessary theory for understanding is included in the exercise description. This approach is economical because large number of students can use small number of models. This approach allows teachers casual work, without the possibility of unpleasant trip into the unknown, failure model is simply replaced by backup.

The main problem of this approach is the tendency to perform more and more exercise, even purely mechanically, without understanding. The problem is not that such teaching model exists, but that it is often dominant or the only one in professional schools.

III. ANALISYS OF THE RESULT OF THE EMPIRICAL RESEARCH

Reliability of the final test, expressed by Spearman-Brown coefficient of internal consistency was 0.78. The discriminative value of all tasks, except two, was very high. Percentage of correct answers was in the range of 3% to 86%. Constructive validity of the final test was determined by the factor analysis (Principal Component Analysis, Varimax rotation). The most important factors were registers, then understanding of the device block schemes, A/D converters, counters and their application and circuit delay.

In the overall factual knowledge there was no significant difference between the standard and structured-modular way, although the experimental group (E) was significantly better than the large classical groups (C-2) [Table II]. Group size had greater impact (η^2 = 0.032) than treatment (η^2=0.002). This confirmed the hypothesis H_1.

In the synthesis and application of acquired knowledge in more complex tasks, the experimental group was significantly better than both control groups. Treatment (η^2 = 0.065) had more significant contribution than the group size (η^2=0.044). In this way, the hypothesis H_2 was confirmed.

TABLE II. TWO-WAY ANALYSIS OF VARIANCE AND QUICK-CLUSTER BY GROUP ON FINAL TEST

	E- group	C-1 group	C-2 group	F-test (sig.)	TREATMENT		GROUP SIZE	
					F-test (sig)	η^2	F-test (sig)	η^2
Facts	23.04*	21.93	18.27**	0.064	0.681	0.002	0.133	0.032
Application, synthesis	11.17*	6.93**	3.89**	0.000	0.031	0.065	0.078	0.044
Transfer to A/D & D/A	6.61	4.86**	8.14*	0.040	0.212	0.022	0.019	0.077
% students in best group	66%	29%	29%					

Comment: * - significantly better group ($p<0.05$), ** significantly worse group ($p<0.05$)

In knowledge of the A/D and D/A converters the best result achieved large group of classical C-2, which was significantly better than the group C-1. It is important to note that all groups started to adopt this material in the same conditions and in the same, standard way. Certain degree of transfer of cognitive skills was expected to be acquired in modular teaching in the experimental group, but it did not happen. Hypothesis H_3 was not confirmed. Another analysis confirmed the superiority of the experimental group. Quick cluster analysis showed that 66% of students in the experimental group and 29% of students in control group belonged to a best group.

Multiple regression analysis showed that the score of electrical courses was influential predictive factor for all three components of the test. Contrary to expectations, problem test had three times weaker influence, even in the tasks of synthesis and complex applications.

Attitudes about their experience with the modular classes were presented in the form of statements, and students of the experimental group expressed their agreement or disagreement with Likert scale ranging from 1 to 7 at the end of the realization of the module.

Students strongly emphasized that the work had been interesting (average score 6.42), that acquired knowledge had been associated to real problems (6.0) and their greater ability to solving problems by themselves (5.92).

Also, students slightly agree that such approach is possible in other courses (5.11) and that other teachers are trained for such work (5.11). They completely noticed teachers' changed role (6.53).

They consider that students need to be more independent (5.74) and that this approach requires more of their work (4.32). This problem-based modular teaching students find better than the classic one (5.26), suggesting that it should be introduced gradually from the beginning of the school year (6.68).

The survey analysis confirmed the hypothesis H_4 that students were more prone to modular-structured teaching than the classic one.

IV. CONCLUSION

Instead of a one-way flow of information typical for frontal teaching, constructivist-oriented teaching techniques are collaborative and two-way and turn teachers into "travel guide for info sphere." Successful dealing with the challenges of the real world, typical for industrial training, becomes more represented in school education through emphasizing competencies rather than factual knowledge. For the sake of students preferences to learn in real context and easier integration of new concepts in students' concepts network it is justified to use initial introduction of thematic units. Specialy suitable framework for such approach is modular-structured teaching.

Empirical research on the module Anemometer / Rev counter in the Digital Electronics course has confirmed the effectiveness of structured-modular approach. For the acquisition of factual knowledge size of the group showed significantly greater effect than adopted structured-modular treatment compared to standard lecture followed by laboratory exercises. Significant difference was shown in dealing with demanding situations such as application in new context or synthesis (creation) in favor of structured-modular approach that was applied to students of experimental group. It showed significantly greater effect of treatment than the effect of group size. The transfer of complex cognitive skills in new material that was cultivated in a standard way didn't occur although it was expected.

Students questionnaire of the experimental group showed that students in structured-modular approach strongly emphasized interesting work, expressed greater interest in the problems that emerged from real-life context and felt that they had raised their own level of proficiency in problem solving. They observed the changing role of teachers toward more advisory role, also they noticed that they were striving to more independence and would like to use this approach in other courses. Students are careful in assessing how much it is really feasible.

Isolated or overlapping materials are frequent consequences of teachers' closure in narrow boundaries of your profession. Structured-modular approach is interdisciplinary and it naturally integrates content from various scientific disciplines. This requires adequate training of teachers and the tendency to work in a team. This needs to be nurtured during prospective teacher studies rather than focusing exclusively on autonomous action.

REFERENCES

[1] Powers, K.D., Powers, D. T., Making sense of teaching methods in computing education, 29th ASEE/IEEE Frontiers in Education Conference, 1999, San Juan, Puerto Rico, p. 11b3.30 – 11b3.35, 1999.

[2] Batstone, R., Teachers and Course Design: The case for a modular approach, *ELT – Journal,* 42 (3), p. 185-195., 1988.

[3] Mack,D., Modulation, An international meeting "Modular training systems and strategies", Washington, p.182-189., 1992.

[4] Spours,K., Modularization and progression: Issues in the 14-19 Curiculum, An international meeting „Modular training Systems and Strategies", Washington, p. 65-90., 1992.

[5] Decker,J. A.,Valk, A.E. van der, Pre-university physics presented in a thematic and systematic way: Experiences with a dutch physics curriculum development project, *Eur. J. Sci. Educ*, 8(2), p. 145-153., 1986.

[6] Matthews, M.R.)., Constructivism in science and mathematics education , D.C. Phillips (ed.), *National Society for the Study of Education, 99th Yearbook*, Chicago, University of Chicago Press, p. 161-192. , 2000.

[7] Kirschner, P. A., Sweller, J., and Clark, R. E. (2006.) Why minimal guidance during instruction does not work: an analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching (2006), *Educational Psychologist* 41 (2), p. 75-86.

[8] Petrina,S., Advanced teaching methods for the technology classroom, London, Information Science Publishing, 2007.

[9] Instructional Strategies Online http://olc.spsd.sk.ca/DE/PD/instr/alpha.html, 2013.

[10] Wondimu, S., Skalicka,P., Kostalova,H. i dr (2010.), A modern teaching methods manual for primary and secondary schools, People in Need, Addis Ababa, 2010.

(http://www.czda.cz/editor/filestore/File/MTM_MANUAL_priloha%20dotace%20vyucovacimetody.pdf), 2013.

[11] Boljat, I., Luketin, I, Structured-modular model of instruction (cro.. Strukturirano – modularni model nastavnog procesa (unpublished), 2014.

[12] Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Raths, R. and Wittrock, M. C. Eds. A taxonomy for learning, teaching and assessing. A revision of Bloom's taxonomy of educational objectives, Addison-Wesley Longman., 2001.

[13] Biggs, J. B.,Collis, K. F., Evaluating the quality of learning: the SOLO taxonomy (Structure of the observed learning outcome), Academic Press., 1982.

[14] Cohen, L., Manion, L., Morrison, K. (2007.) Teaching methods in education, Routledge, 2011.

MONITORING ICT COMPETENCIES OF STUDENTS: FACULTY OF TRANSPORT AND TRAFFIC ENGINEERING

UDC: 378.6:656]:007
Original Research

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Abstract - The aim of this study was to observation the level of ICT knowledge and skills among the student population at the Faculty of Transport and Traffic Engineering. How would we have contributed to raising ICT skills of students. The main task is to establish a methodology improvement and harmonization of curricula with European standards and the needs the Faculty of Transport and Traffic Engineering.

Keywords: - ICT competencies- Information and Communication Technologies competencies, IT knowledge, IT skills.

I. INTRODUCTION

The students at the Traffic science Universities are expanding their knowledge of the Information and Communicaiton knowledges (ICT [1]) through the subject of Computer science, at the first year of the study. The students are achieving their basic knowledge in this field during the primary and secondary school education. The goal of this research is to monitoring the ICT knowledge of students, which have been achieved during the primary, secondary school and university education, to increase the level of ICT student competence at the higher level.

The ICT student competence needs to be synchronized with the European standards (FCDL-Finnish Computer Driving Licence and ECDL-European Computer Driving Licence) and the courses of professional computer science education, in the field of traffic science.

The appliance of ICT technologies in the system of education could be divided in two groups:

1. Individual teaching and instructions

- Practice and repetition at the knowledge and skills acquire;
- assistance in the search of information and data-bases;
- the communication with the expert in the given field;
- text processing and work with the tables;

The function model of complex system simulation, with the goal of understanding the system operation.

2. Group teaching and instructions;

- e-mail communication (student, teacher, parent)
- program support for the presentation of the work results within the group work
- video presentations
- program support for the video conferences for the distant groups;
- Communication within the unapproachable locations.

Which ICT competences should the students at the universities for traffic sciences acquire, during the Computer science courses? Should the emphasis lay upon the improvement of their general IT competence, or, should the pedagogic work basis lay on the specific computer science competence?

One of the most significant pre-conditions, enable students to achieve specific IT knowledges in the field of traffic science, is that the students should hold the previously achieved knowledges in the field of computer science. The informatic literacy, which the students acquire during primary and secondary education, as well as during the individual education. The equipment at the computer labs, usage of adequate study books, software legalization and the teaching personnel in the primary and secondary school education are the key factors which have the influence on

[1] ICT- *Information and communication technologies*

achievement in basic ICT student competencies. European Commision started the initiative for improvement of informatic literacy in Europe in 1995. The document, titled "European frame for the key-competencies" has been created a result of this initiative. It has an important role in raising the informatic competencies in European countries. This document also helped to achieve a standard of the informatic competencies and knowledges (ECDL-European Computer Driving Licence) as well as to adjust the education systems in the EU countries. As a part of the reform of primary and secondary education, Ministry of education of Republic of Srpska had earmarked a significant funds for equipping the computer cabinets, teaching personnel education and forming of school information systems. The investment had an objective to enable the creation of better conditions for achieving the basic ICT competencies for the students of primary and secondary schools. That represents important imput level to raise the ICT knowledge among the students at the traffic science universities.

II. ACHIEVING THE ICT KNOWLEDGE AT THE FACULTY OF TRANSPORT AND TRAFFIC ENGINEERING

Due to the long interval of teaching "Informatic" through the primary, secondary and individual education, the questions for the need of realized lessons in IT at the traffic science universities, have been imposed? The assumption is that the students have achieved necessary ICT knowledge to be able to attend the lessons at the traffic science universities, and that there is no need to raise the student ICT competencies at the higher level of knowledge.

Upon organization of informatic classes at the the Faculty of Transport and Traffic Engineering, the question is imposed, if the general educational model for realization of informatic classes should be used, or traffic science universities should make the education models, which are adapted for their personal needs.

The process of adoption of IT knowledges, from the point of view of beforehand developed methodologies, could have larger significance in the matter of value, than the effects by itself, presented through the number of (ESPB- European Credit Transfer and Accumulation System) points, results of learning, or, quantity and quality of achieved knowledge, respectively. We must take the fact in consideration that the student achieves a part of the IT knowledge through the individual activity (Internet, social networks).

Some IT contents need a longer time to learn, as they need the time to revolve and discover the knowledge through engagement of various cognitive abilities and creative-critical approach to learning. In such manner, the students are achieving the high-level knowledge which would not be easily forgotten, which is easy to structure into the existing cognitive schemes, and which is easy to use, transform, and apply in the different professional subjects which are requiring IT knowledge.

We could conclude that the informatical literacy, with reference to the raising of ICT competences of students, represents one system on the whole.

III. RESEARCH

The research is based upon the monitoring of ICT knowledge among the students, which the students achieved during the primary, secondary and university education.

The research was divided into three parts:

- The first part of the research or primary research [2]. Analysis of the ICT competencies of students at the "beginning" of the semester. ICT competences of students acquired through secondary education.
- The second part of the research. Analysis of the ICT competencies of students at the "end" of the semester. ICT competences of students acquired through university education (extended part of research).
- The third part of the research. Comparative analysis of the ICT competencies of students at the "beginning" and "end" of semester. Monitoring of the ICT competencies of students within one semester.

To determine the ICT knowledge of students, it is necessary to analyze the student achievement during the secondary and university education, with the insight in the IT subjects and grades. These grades should serve as a diagnostic parameter. Due to the data transparency, the input and output test of skills and knowledges of students has been done, in accordance to the educational informatical modules and rules following the logic of knowledge tests.

The students have been tested through two tests of same structure. At the beginning and end of the study of „Informatics" at the Faculty of Transport and Traffic Engineering. Tested by multiple-choice questions, which were used in order to check the informatical knowledge and skills. The test-questions have been formed out of the

European standard data base (ECDL-European Computer Driving Licence). Students are tested at the beginning and end of the semester.

- First test (Test of Knowledge) has been realized in the classic maner. The task was to determine the informatical knowledge among the students, in accordance to the European standard.
- The second test (Test of Skills) has been realized as an online test. The task was to determine the informatical skills among the students, in accordance to the European standards.

One of the basic parameters, which were used to evaluate the informatical knowledge and skills is a system of measurement of the achievemnt of students, where the concept of „measure“ represents a certain standard, which has been used to examine the level of ICT knowledge and skills of students attending the Faculty of Transport and Traffic Engineering.

To evaluate the variable informatical parameters, we have used a different measure instruments. One of the measure instruments used to make a poll among the students concerned their final grades achieved in the secondary school and the type of the school they attended

IV. METHODS

The target group is consisted of 219 students, which are attending the first year at the Faculty of Transport and Traffic Engineering in Doboj, as a part of the University from East Sarajevo. The students are registered for the 2013/2014, and which are attending the „Informatics“ course for the first time. The target group falls under the category of intentional sample, and is consisted of the group of 127 first-year students at the Faculty of Transport and Traffic Engineering in Doboj.

The target group represented in percentages, represents 57.99% of total population. Therefore, we can use the sample in the further researches as a valid one.

The variables in this analysis are represented in the data acquired from two Tests of Knowledge and two Tests of Skills. Finally, four tests of knowledge and skills the beginning and end of the semester. The third variable represents the achievement of the high school students in the field of informatic, as part of final grades (Average grade in high school). The fourth variable represents the achievement of the university students, as part of final grades (Average grade in faculty).

The goal of these tests was to present the knowledge and skills as an aggregate (informatical competence [2]) achieved from students in their previous and university education.

We have acquired the following data through this research: demographic information about the student gender, the information about the structure of high schools, the information about the achievement of students, in a form of final grades on high school and university, the information about the results of tests of skills and knowledges. All information, acquired through the research, has been presented in the following diagrams.

According to the demographic information related to the student gender, 127 students took part in this research. Out of this 64% were male and 36% female students. The larger number of male population is also noticeable at the Figure 1. The reason is that the research took place at the Faculty of Transport and Traffic Engineering, where we have a significantly higher level of registered male population among students. Therefore, such gender ratio is expected.

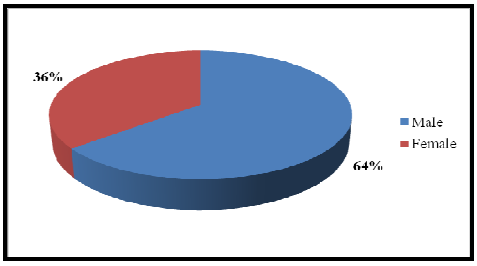

Figure1. Demographic structure of students.

Using poll-techniques, we have polled the students at the Faculty of Transport and Traffic Engineering and gathered the information about the structure of obtained high school level, as shown in the Figure 2.

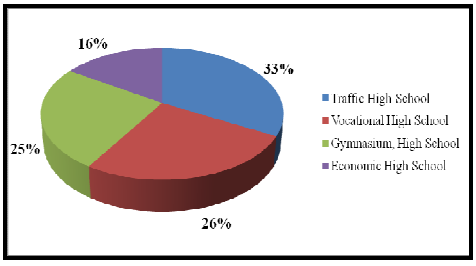

Figure 2. The percentage of obtained high schools by the polled students.

As an indicator of the student achievement in the field of „Informatic“ throughout the high school has been taken the average final grade from the informatical subjects.

[2] ICT- competencies

As an indicator of the student achievement in the field of „Informatic“ throughout the Faculty of Transport and Traffic Engineering has been taken the average final grade from the course of „Informatics“.

The data collected through the tests (Test of Knowledge and Test of Skills of the beginning of the semester) have been displayed percentual, as it is shown in the Figure 3 and Figure 4.

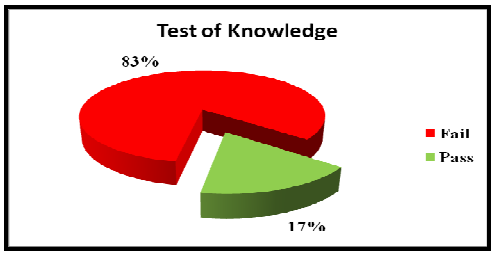

Figure 3.The percentage of students success at the IT knowledge test of the beginning of the semester.

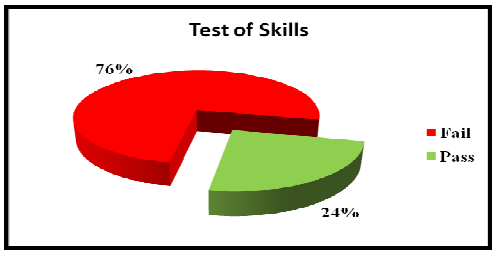

Figure 4. The percentage of students success at the test of IT skills of the beginning of the semester.

The data collected through the tests (Test of Knowledge and Test of Skills of the end of the semester) have been displayed percentual, as it is shown in the Figure 5. and Figure 6.

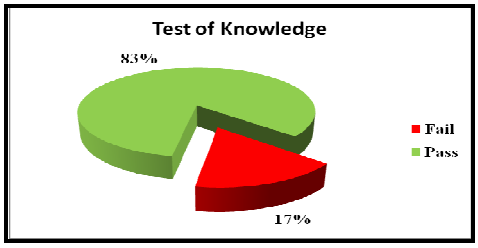

Figure 5.The percentage of students success at the IT knowledge test of the end of the semester.

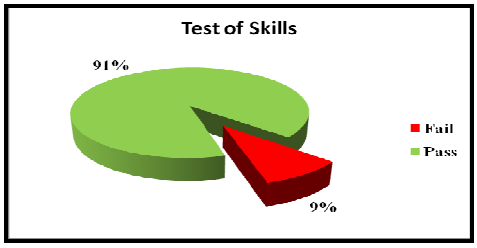

Figure 6. The percentage of students success at the test of IT skills of the end of the semester.

Total result of the tests (IT knowledge and IT skills) at the beginning and end of the semester is shown in the Figure 7. and Figure 8.

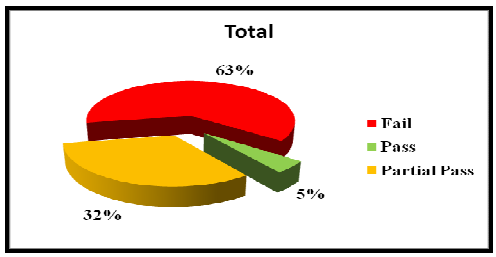

Figure 7. Total percentual succesful pass grade at the beginning of the semester.

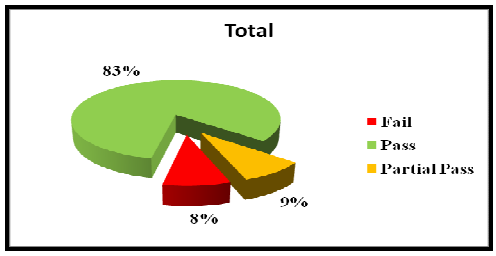

Figure 8. Total percentual succesful pass grade at the end of the semester.

The information obtained through the research have been processed, using standard software tools and they have been analysed using statistical methods.

V. RESEARCH RESULTS

A primary research [2] is described the analysis of the ICT competencies of students at the beginning of the semester.

The first part of the research

Analysis of the ICT competencies of students at the “beginning” of the semester. ICT competences of students acquired through high education.

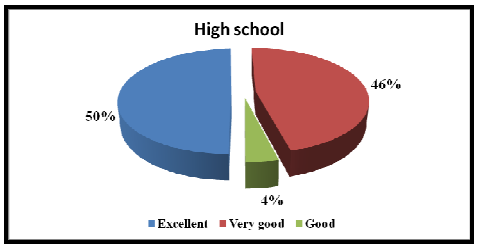

Figure 9. Graphical view of students IT knowledge and skills at the beginning of the semester.

The descriptive analysis has been made over the collected data and the results are shown at the Table I.

TABLE I. DESCRIPTVE STATISTIC

		Test of Knowledge	Test of Skills	Average grade in high school
N	Valid	128	127	128
	Missing	0	0	0
Mean		24,898	20,457	4,388
Std. Error of Mean		0,3159	0,381	0,049
Median		25,000	21,000	4,330
Std. Deviation		3,573	4,294	0,553
Minimum		16,000	8,000	3,000
Maximum		35,000	27,000	5,000

TABLE II. K-S TEST RESULTS

		Test of Knowledge	Test of Skills	Average grade in high school
N		128	127	128
Normal Parameters[a,b]	Mean	24,898	20,457	4,388
	Std. Deviation	3,573	4,294	0,553
Most Extreme Differences	Absolute	0,074	0,121	0,209
	Positive	0,074	0,064	0,204
	Negative	-0,074	-0,121	-0,209
Kolmogorov-Smirnov Z		0,840	1,360	2,370
Asymp. Sig. (2-tailed)		0,481	0,050	0,000

a. Test distribution is Normal.

b. Calculated from data.

The distribution normality has been done using Kolmogorov-Smirnov (K-S) test.

Based upon the results shown in Table II, where the KS tests results for variables are larger as largest empirical distribution discrepency from normal curve, we surely can conclude that the distribution for all three variables is normal.

We have examined the link between the variables, using the correlation method (Test of Knowledge , Test of Skills and Average grade in high school). To be able to examine the normal division of research results, wehave used the Pearsons correlation coefficient.

Since the standard deviation and covariance between variables are apparent, than we can use the Pearsons correlation coefficient in accordance to the Equation 1,

$$r = \frac{\sigma_{xy}}{\sigma_x \sigma_y} \qquad (1)$$

where the values are:

ΣXY - covariance between variables (*Test of Knowledge -Average grade in high school and Test of Skills - Average grade in high school*)

ΣX – standard variable deviation (*Test of Knowledge and Test of Skills*)

ΣY - standard variable deviation (*Average grade in high school*)

The results obtained through the Pearsons correlation test for variables are:

Test of Knowledge - Average grade in high school

$-1 < -0,040 < 0$

Test of Skills - Average grade in high school

$-1 < -0,099 < 0$

To be able to determiune if the correlation coefficient is statistically significant (different as Zero), we need to make further tests, using student or t-test. The hypothesis for correlation coefficient test are:

$H0 : r = 0$

$H1 : r \neq 0$

The t-function calculation is performed in accordance to the Equation 2:

$$t = r\frac{\sqrt{(N-2)}}{\sqrt{1-r^2}} \qquad (2)$$

Since t_1= -0,4456 is a value for a correlation variable coefficient (Test of Knowledge - Average grade in high school), and t_2= -1,1141 is a value for correlation variable coefficient (Test of Skills - Average grade in high school).

We are taking the coefficient of a theory of t-test out of the table of students' distribution. The level of freedom is calculated, using the Equation 3.

t_t=1,96 for the 95% confidence

$$DF = N - 2 \qquad (3)$$

Since the values t_1 and t_2 are lower than tabellar values (t_t) we can accept the H0 hypothesis in both cases, and consider that r = 0.

Based on the correlation test as well as significance test, we can say that the dependence between the input tests and the average high-school grades is negligible.

The input knowledge and skills tests (at the beginning of the semester), as well as the average grade in the informatical subjects in high school

could be used as a valuable evidence of informatical competence of students, before they start their lessons at The Faculty of Transport and Traffic Engineering in Doboj.

Based on the input tests results and the high-school pass grades, we have obtained the following conclusions.

We can confirm the H0 hypothesis, that the student informatical competences at the first year of studies at The Faculty of Transport and Traffic Engineering in Doboj are not satisfying the competences defined by European standards, whcich we have demonstrated through a number of statistical analysis. The insight in the previous statistical analysis could help us to make a conclusion that there are no statistically significant correlations between the average grades from the high school and input tests.

The second part of the research

A secondary research is described the analysis of the ICT competencies of students at the end of the semester. ICT competences of students acquired through university education (extended part of research).

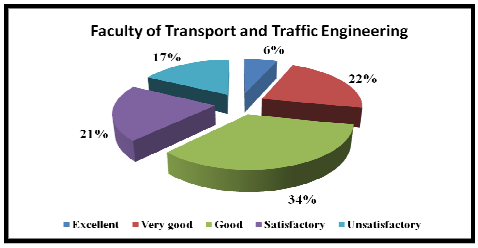

Figure 10. Graphical view of students IT knowledge and skills at the end of the semester.

ICT competencies are shown over the final score of the students achieved at the end of the semester. The achievements of students we have shown using a six-point scale: Excellent, Very good, Good, Satisfactory, and Unsatisfactory. Because of easier presentation of the results of the achievements of students at the beginning and end of the semester is done equalizing scale. In Figure 10. we can observe that the greatest number of students on faculty has a very good 22% achievement and good 35%. What shows us that the ICT competencies of students at the end of the semester uniform compared to the beginning of the semester. ICT competencies of students we raised to a higher level at the univesity education.

The third part of the research

Comparative analysis of the ICT competencies of students at the “beginning” and “end” of semester. Monitoring of the ICT competencies of students within one semester.

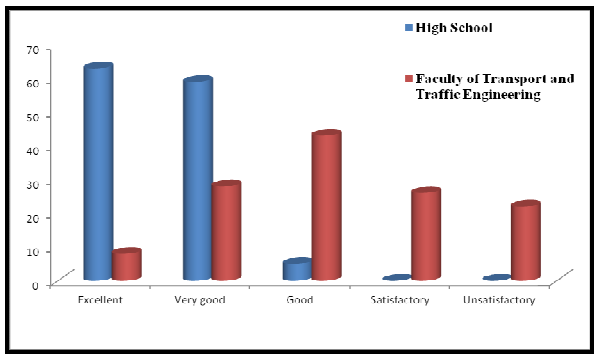

Figure 11. Comparative analysis of the ICT competencies of students at the “beginning” and “end” semester.

ICT competencies of students are displayed in the form of student achievement on tests of knowledge and skills at the beginning and the end of the semester. The achievements of students we have shown using a five-point scale (Excellent, Very good, Good, Satisfactory and Unsatisfactory).

The achievements of students described on the basis of their score in high school. Ranged in the interval score excellent, very good and good. While, achievements in the faculty are not dispersed and presented the Gaussian curve (Figures 12.). Rating scale at the university ranges from excellent to unsatisfactory.

Figure 12. and Figure 13. compared the results of tests of knowledge and skills at the beginning (before) and end (after) of the semester.

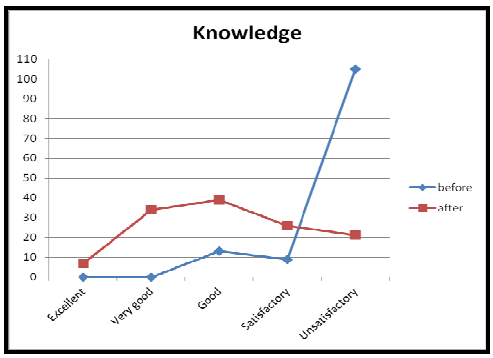

Figure 12. Comparison of the results of knowledge tests at the beginning and end of the semester.

From the graph Figure 12. shows that most students are not learnig basic IT knowledge in high schools.

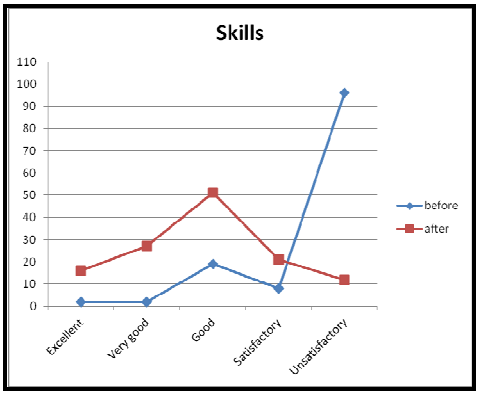

Figure 13. Comparison of the results of skills tests at the beginning and end of the semester.

From the graph Figure 13. shows that most students are not learning basic IT skills in high schools.

VI. CONCLUSION

Based on the results obtained from primary and secondary research, we can conclude that the ICT competencies of students on the Faculty of Transport and Traffic Engineering in Doboj after listening to the course "Informatics" within one semester raised to a higher level. The reasons for raising the ICT competences students can justify the use of teaching syllabuses which are compliant with IT standards of the European Union. Implementation of the course "Informatics" at the university level is based on the introduction of new methods of modular teaching. In teaching computer science are implemented modern technology in the form of educational portals and on-line assessment of students. Curricula are supported using the appropriate textbooks. Monitoring curriculum in the form of evaluation and self-evaluation is done for the purpose of further raising ICT competencies of students on the Faculty of Transport and Traffic Engineering in Doboj. Implementation of value system, in order to control future steps in organization of future IT education and to accomodate the IT education to the needs of The Faculty of Transport and Traffic Engineering.

REFERENCES

[1] V.Banđur, *"Kritičko preispitivanje vrednovanja rada učenika i njihove participacije u vrednovanju, u: Činioci i indikatori efikasnosti i metode unapređivanja osnovnog vaspitanja i obrazovanja"* (ured. M. Ratković), Beograd: Zajednica Učiteljskih fakulteta Srbije, 1997.

[2] Г. Јаушевац, Г. Јотановић, Саобраћајни факултет-Добој, „*Analysis ICT Knowledge Of Students: Faculty Of Transport And Traffic Engineering*", Међународна конференција ITRO CONFERENCE [5.0] ,University of Novi Sad Technical faculty "Mihajlo Pupin" Zrenjanin, Republic of Serbia, Зборник радова, страна 146, COBISS.SR-ID 287020807, ISBN 978-86-7672-225-9, Јуни 2014.

[3] European commission, Directorate-General for Education and Culture, *Implementation of "Education and Training 2010" work programme*, Working group on Basic skills, entrepreneurship and foreign languages. Progress Report November 2003.

[4] Mcclave T. James and Frank h. "*Dietrich II: Statistics*", Dellen publishing company, San Francisco, Collier MacMillan publishers, London, 1988.

[5] G. Petty "*Moderno obrazovanje*". A Practical Guide. Vilnius: Blackwell, 2007.

[6] Lj. Bakić-Tomić, M. Dumančić "*Odabrana poglavlja iz metodike nastave informatike*",*Učiteljski fakultet*, ISBN 978-953-7210-65-6, april 2012. godine, Zagreb.

MOODLE - TOOL FOR E-LEARNING

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Review Scientific Paper

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Abstract - E-learning is a broad term that includes the use of information technology in education. It is now increasingly encountered in practice. Among the many software for e-learning allocates to Moodle. He is a good solution for the production and maintenance of online courses through the Internet. There are a number of good characteristics: free, adaptive, transparent, simple navigation, content and visually well-connected.

Keywords: e-learning, moodle, learning

I. INTRODUCTION

Moodle is a software package designed to create websites and courses online. It is a global development project designed to support teaching via the Internet. **Moodle** (Fig. 1) is an open source software that is also known as a virtual learning environment (Virtual Learning Environment - VLE) [1]. This program can be purchased and used for free under the GNU public license. This means that **Moodle** is copyrighted, but its users are free to copy, use and modify if they agree to certain terms and conditions. These conditions are:

- providing programs to other users,
- original license and copyright must not be altered or removed,
- the same license must be applied to other projects stemming from **Moodle.**

Figure 1. Home page Moodle

Moodle has become very popular among educators around the world as a tool for creating dynamic web sites for their students. The word Moodle is an acronym for Modular Object-Oriented Dynamic Learning Environment (Modular Object-Oriented Dynamic Learning Environment). To serve, **Moodle** needs to be installed on a web server that supports PHP and SQL [2]. Able to work under Windows, Mac and Linux operating systems.

Moodle project is always focused on providing the best tools educators, so that they may better to create and manage online courses. There are many ways in which it can be used **Moodle.** It can be used for hundreds of thousands of students, but also can be used for the primary school. Many institutions use it as a platform to implement online courses, while some use it purely as a substitute for direct contact between students and teachers.

II. MOODLE USERS

Moodle users are students, teachers and administrators of the platform. All have their orders, depending on the role they perform (Fig. 2).

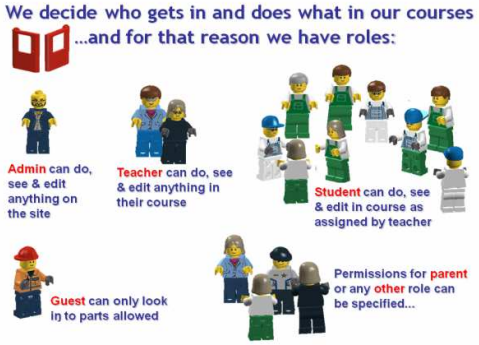

Figure 2. Moodle users

Administrator has the most important role. He has all the rights management system, such as the creation of new courses or edit existing ones, add new users, ... Administrator also maintains the server it is installed on **Moodle**.

Creator of the course is the most important role among the speakers. He is responsible for the creation of new courses, but it can not change the existing courses. He assigns course teachers and determine their order. Can some teachers to refuse to

edit courses, and in some cases you can cut them off. Creator of the course may appear as a teacher.

In **Moodle** anyone can be a **teacher,** if his face with the appropriate law (administrator or the creator of the course) is assigned to a course. Based on this and the face, which is normally the attendant rights can be assigned to the course as a teacher. Teachers regulate and maintain the courses individually or as a group. First of all, the teacher adds new material and regulate their visibility and use.

Tutors are teacherss, who can not regulate rates, or to add teaching materials and assignments to trainees. They evaluate the work of students, accuracy tasks that the participants uradilia, and also have the ability to review student evaluations.

Student processes of teaching materials, as they already have available, execute the given tasks and solve testpve exams.

Guest is a visitor who is not involved in the teaching process, and he is allowed to join a course. He can not stay a long time on the course, but can only view mode course. Administrator or the creator of the course to decide whether a guest to visit the course or system.

III. MOODLE CONTENTS

Moodle is an application for creating and maintaining courses on the Internet [3]. Development of e-learning courses and their delivery to students is very easy and simple. For this purpose we use the already existing teaching materials. **Moodle** provides the ability to organize the learning process, to analyze the teaching content, but also to assess students.

A) Static contents

It is very interesting the use of a different use **Moodle** the static material, which can be used by the participants without interaction with them. Although it is called static, these materials can rate it so dynamic.

Caption is text or image on the home page. Special sign a summary that describes the topic of the course.

Web page is on the web page, but that page is created within the course and includes text, images, hyperlinks and other multimedia elements.

Link is a link to a directory or a separate web page off course.

Course directory is a directory that stores a variety of teaching materials.

B) Interactive contents

In addition to resources, Moodle uses activity (Fig. 3), which are interactive materials. They belong to the advanced techniques that allow trainees to interact with the teachers, with a system for learning or teaching materials themselves.

Figure 3. Moodle activities

Assignment is an activity that is done outside of **Moodle**, offline. Course participants can see yadatak on the front page of the course, and when you click on the name of the task you will see what the teacher wrote in the description. Description contains the subject, method and time of preparation task, and details on how teaching and assessment. When yavrši task, the task of the teacher asks the student to the site. The teacher reviews and evaluates the job done polaznikov work.

Choice is a tool for the resolution of a disputed issue. It is a response to a question that the students can give only one correct answer. The result can be shown to everyone on the course or just certain students and teachers. **Choice** is a fast and good way of getting feedback from the group.

Database is activity, which is rarely used and is used for storage (storage) of data in a certain form. It allows more people to add data to a shared resource.

Journal writing each student separately and can be seen only author and teacher. It is created for a particular course, and it is hard to switch to another. The teacher can determine the topic that will be attendant to keep a diary, and the time limit within which the student can create it. In the journal except text can be entered and pictures.

Lessons are for courses for students. They appear in certain order and contain questions at the end. There is a jump question which assesses student understanding. The correct answer to this question goes, a false or returns back to a page for makeup. In lesson one can determine the time spent on a particular topic, and the success of students by topic.

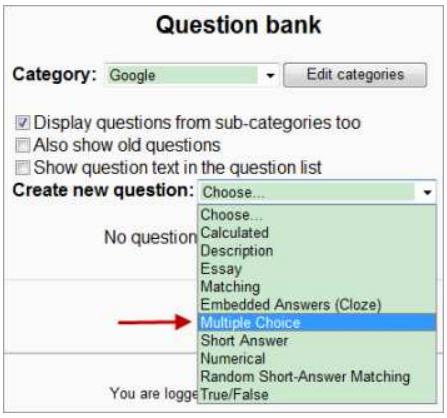

Figure 4. How to make quizzes in Moodle

Quiz (Fig. 4) contains various types of questions that can be prepared from a variety of courses. Questions can contain text, images, sound or video data. Quiz is a good way to test participants' knowledge, but a complex and challenging task for teachers. **Moodle** contains a flexible and efficient system for creating tests and everything is much faster and easier. The following tests exist in Moodle [4]:

- short test at the end of each lesson,
- timed test,
- test as a tool for learning, which allows the student fits until you reach the correct answer,
- test a questionnaire / survey, which does not affect the assessment of students, but it is important for teachers.

Moodle provides a wide range of questions:

- multiple choice – one or more correct answers,
- true/false – the student chooses one of the two options,
- short answer – a student enrolled in a word or phrase in response,
- numeric response – student to enroll,
- calculation – teacher enters a formula with variables, which are later replaced by numbers
- pairing – since I asked questions, given the list of sub-questions with a list of correct answers and the attendant need to mentally respond to each question.

Survey is pre-prepared form that was created by experts to help teachers learn about their students. On provreava current state of the course or preferences of the participants.

C) Social contents

In addition to all the above mentioned activities, there are a few that allow communication between students and teachers. These activities are usually used for peer and group learning.

Forum is form of asynchronous communication between teachers and students. Posts on this forum are durable and can be re-reviewed, and it is not possible for synchronous communication.

Chat is a synchronous form of communication in which the speaker directly answer the question of students. Chat creates room where participants can talk in real time (online). It is a place where the participants agreed, to exchange views and information. Of particular concern is the safety of the chat, which is achieved by within a room can communicate only students of a particular group.

Dictionary is a very useful activity, which allows you to create a list of concepts that students supplement and correct. Because of this, a powerful vocabulary the means to group learning.

Wiki page is an activity for teamwork. This page allows participants to work together to create a web page, adding and changing content. Wiki does not delete old versions of the pages, so you can quickly correct errors.

IV. LEARNING USING MOODLE

Design and development of **Moodle** is guided by a philosophy of learning and thinking, which in theory is abbreviated as social constructivis (Fig. 5). Social constructivism means the belief that people learn best when they actively serve the teaching materials so as to create new materials and communicate with others on these materials [5]. This theory is based on four major concepts [6]:

- **constructivism** – people actively construct new knowledge through interaction with the environment,
- **constructionism** – learning is particularly effective when you construct something for others to experience,
- **social constructivism** – extend the ideas to a group of people who construct each other, creating a common culture with its own meaning divisible,
- **related and individually** – this idea further attempts to examine the motives of individuals who participate in the discussion.

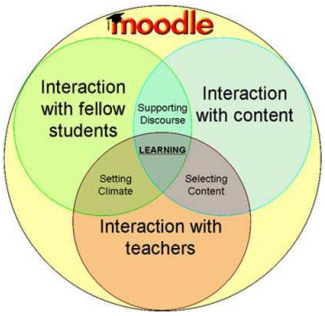

Figure 5. Moodle social constructivism

Teacher in the production of materials used HTML editors on the site. Each teaching a whole can add media files, and the author can edit an existing layout among multiple selected. Content can be displayed depending on the date and the possibility of publication more important announcements related to the course. Calendar may contain links to external sites or some other events.

Group members are added manually, so the group can be assigned to a material. The teacher can see the number of visits each page (date and time of first and last login participants in the system and the time spent in the system), a graphical representation of the time spent on each page of content for each user individually, and may have more than one course of public and secret forums and see all discussions and messages of each user.

Check students' knowledge enabled the creation of multiple-choice questions, matching questions, issues with replenishment, issues with self-enrollment response and so on. Each test can limit vrieme resolve and define the score for all attempts and can collect user points from multiple exams. Users can attach their tasks as file.

Moodle provides teachers a full computational support for the organization and implementation of on-line courses. Some of the important features of **Moodle** are [7]:

- development of a large number of courses on a single system in a variety of forms,
- planning courses - schedule, calendar,
- management of user roles and user groups in courses,
- work with existing files and educational facilities,
- development of different types of on-line tests,
- monitor all user activity,
- numerous tools for communication and collaboration,
- create a vocabulary of technical terms,
- system management - backup, statistics, approaches
- a comprehensive system of assistance in exporting classes.

One of the great feature of **Moodle** is its extensibility. There is a huge variety of activities that can be added in the form of so-called **Moodle** module. With the addition of modules can facilitate the creation of mathematical formulas or easier to ask lessons in chemistry from the module that allows printing of chemical formulas. There are modules that enable the delivery of tests on mobile phones students, inserting flash files, creating multiple copies of courses and many others. Each module will be additionally installed.

V. CONCLUSION

Moodle is flexible and fast free software solution, which supports two databases: MySQL and PostgreSQL, for a large number of languages. The popularity of this tool is based on a simple and quick installation, low demand for computer resources on which they are running, simple integration into existing systems and logical interface for students and mentors.

Moodle has quickly gained popularity among teachers because of their adaptability and pedagogical foundations of an academic environment. Although there are fewer possibilities of commercial software solutions, can meet a large number of users because it allows them quickly mastering tools.

REFERENCES

[1] Moodle, About Moodle. http://docs.moodle.org/en/About_Moodle

[2] B. Beatty, C. Ulasewicz, Online Teaching and Learning in Transition: Faculty Perspectives on Moving from Blackboard to the Moodle Learning Management System, TechTrends, vol. 50, no. 4, pp. 36-45, 2006.

[3] J. Cole, H. Foster, Using Moodle, O'Keilly Media Inc., 2008.

[4] W. H. Rice, Moodle E-learning, Course Development, Packet Publishing Inc., 2006.

[5] Mušanović M., Konstruktivistička teorija i obrazovni procesi, Zbornik skupa: Didaktički in metodični vidiki nadaljnega izobraževanja, Maribor, Univerza v Marbiroru, Pedagoška fakulteta Mariboru, str. 28-35, 2000.

[6] M. Muslin, Vrednovanje sustava e-učenja metodom eksperimenta, Prirodnoslovno-matematički fakultet, Sveučilište u Splitu, 2011.

[7] D. Milanov, I. Berković, V. Jevtić, V. Burnać, Use of Moodle platform in corporate e-learning, YU-INFO confernce and exhibition, Kopaonik, Serbia, 2013.

USE OF THE COMMERCIAL SOFTWARE TOOLS IN THE PREPARATION PHASE OF MILITARY PILOT EDUCATION AND TRAINING

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Professional Paper

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Abstract - The education and training of military pilots is a very long, complex and expensive process. One of the methods how to improve this process and make it more economical is wide use of commercial software tools, especially in the first phases of the military pilot education and training. The scope of applied software tools is wide, starts from the software used in psychological selection, and continues with simple flight simulators, broad range of interactive learning training materials and some form of e-learning platforms. This paperwork primary describes some innovations and use of commercial software in the preparation phase of the military pilot education and training.

Keywords: military pilot, education, software tools, moodle

I. INTRODUCTION

The only high education institution in the Republic of Serbia, which has the study program in aviation, within its graduate studies, is Military academy. This study program, named Military Aviation is specific in many ways. First of all, it is recognized by Bologna process standards and also satisfies all the air force requirements. Because of that, the program is unique.

The purpose of the program is the education of the Military Academy cadets (military term for students) for the occupation of Aviation officers – aircraft pilots or helicopter pilots, as well as traffic engineers. Undergraduate studies in Military Aviation are performed during four academic years (with total number of 240 ECTS).

Cadet gains a degree of Traffic Engineer and in addition to a Diploma, a cadet is also issued with a Diploma Supplement, which means the cadet's competences for professional Air Force pilot. This is the reason why the path to be an Air Force pilot is very complex. The whole process is very demanding for cadets and their professors and instructors. The study is divided in two main parts. The first one which lasts five semesters is realized in the Military Academy headquarter which is situated in Belgrade. The main goal of that phase is theoretical preparation for the upcoming flight training in an airbase near Belgrade. This phase is also considered as a preparation phase in terms of core activities (flying) during studying. The second phase is flight training on airplanes and helicopters and it is crucial for the cadet-pilots.

Having in mind that the first (preparation) phase has very important role regarding to quality of flight training as a crown of education process, there is permanent task to improve this process and make it more effective and safer.

Swift progress in the field of commercial software that can be applied in this specific teaching process and its affordability provide new opportunities, especially in the preparation phase.

The scope of applied software tools is wide and starts from the software used in psychological selection and continues with simple flight simulators, broad range of interactive learning training materials and some form of e-

learning platforms. This paperwork describes and explains some of the commercial software tools, which are implemented in study program Military Aviation. The emphasis is on the tools used in selection process and theoretical part of studies, which are prerequisite for the flight training in the last two years of study.

II. SELECTION OF CADET-PILOTS

The study program Military Aviation is also specific by its selection process of future pilots. It consists of medical check, basic parachute training and flight screening.

The medical check is the task of Aero-medical Institute in Belgrade. One of the core activities within medical check is psychological assessment. Department of Psychology of the Aero-medical Institute deals with the activities of narrowly specialized, expert assessment of capability and suitability of different work profile flight personnel. Through aimed selection and qualification tests, the adequate narrowly profiled staff of military and civilian pilots, military flyers, parachutists, air traffic controllers, aircraft hosts is selected.

Selection and classification tests of flight personnel are realized through battery of tests, which examine cognitive, conative and psychomotor aspect of personality. Traditionally, the main tools are paper-and-pencil tests.

This year, Aero-medical Institute made a great step forward with the implementation of the Vienna Test System. This is a computer-assisted application of a large number of highly diverse psychometric tests, measuring reaction times in a task that required choosing among complex stimuli.

Hardware parts of the Vienna Test System with peripheral devices to measure sensomotor /psychomotor skills: eye-hand-leg coordination, three-dimensional eye-hand coordination, hand fine motor skills, peripheral vision and reactive behavior (simple or multiple-choice decisions) are shown on Figure 1.

The use of the computer ensured the highest possible level of objectivity and precision and enables dimensions to be tested that could not be measured by traditional paper-and-pencil tests. In addition, the scoring of test results is guaranteed to be fast and accurate. Vienna tests are used to assess the suitability criteria specified in the JAR-FCL3 guidelines.

Figure 1. Vienna Test System hardware with peripheral devices

This assesses all the ability and personality factors recommended in the international JAR-FCL3 guidelines, including logical reasoning, attention and concentration, memory, numerical and perception functions, spatial processing, psychomotor coordination and decision quality (depend on executive functions and personality traits).

With the help of these tests, it was possible to preselect reliably applicants for pilot training by checking both for specific abilities and for relevant personality traits.

The flight screening or Ab-initio training is the very first stage of flight training. The flight screening is a flying-based assessment of potential candidates. This is intended to establish whether the student has the necessary aptitude to become a military pilot in a reasonably short time. It will eliminate, for example, those who get airsick or lack co-ordination or judgment. Experienced instructors make qualitative assessments of applicants.

The airplane, which is used in the flight screening, is UTVA-75, domestically produced piston-engine trainer. This plane belongs to the older generation of piston-engine trainers and new trainer will replace it by 2016th. Such situation imposes consideration of additional teaching tools only after the new plane adaptation. Because of waiting a new airplane, there are no big possibilities to improve the existing process. The other reason is fact that candidates are still no belongs to any category of military personnel neither cadet.

III. THEORETICAL STUDIES

After successfully completed selection process, cadets entering Military Academy and they are starting to attend Military Aviation study program.

As mentioned before, the study program is basically divided in two main parts. The first one lasts five semesters and it has focus on theoretical preparation of future pilots. During this, phase cadets attend 31 subjects. The first groups of those subjects are theoretical, methodological and scientific ones. The second groups are professional and applicative subjects. The study of second groups of subjects performs at the 2nd academic year and 5th semester. It includes subjects such as General and Radio Navigation, Communications (Phraseology), Mechanics of Flying, Aerodynamics, Aircraft Construction, Meteorology, Aircraft Engines, Flight Instruments and Systems and Air Law.

Because of international standardization most of the listed subjects are compatible with similar subjects who are part of studies in other aviation universities all-round the world. Military Academy's professional and applicative subjects respect the standards recognized by Civil Aviation Directorate of the Republic of Serbia. It means revision of national protocols and harmonization with the demands of JAA Europe, as a fully-fledged member of that aviation family encompassing 44 European countries. The Civil Aviation Directorate has agreed to bring the national aviation in compliance with European standards thus make Serbian aviation an integral part of the European and World aviation area [1].

Joint Aviation Requirements (JAR) are a series of accepted comprehensive aviation rules created by the JAA, more specifically the joint aviation authorities of European countries.

The new system of European aviation rules (EASA - European Aviation Safety Agency). The CAD has standardized many fields and the most important from the Military Academy standpoint is standardization of requirements for airplane pilots - JAR FCL 1.

It means that learning objectives of all professional and applicative subjects (except the flight training syllabus) has to be standardized, including subject description. After the Military Academy has adopted those learning objectives, it was reasonable to find appropriate literature and other learning materials, including interactive.

A. Interactive learning materials

Today there are broad ranges of interactive learning materials, which provide cadet pilots with the aviation knowledge they require to prepare for the theoretical examinations and to become safe and competent pilots. After evaluation, Military Academy opted for CAE Oxford Aviation Academy interactive materials. These materials take the form of full color textbooks and multimedia computer-based training (CBT), both comprehensively covering the theory but delivering it in a different way [2].

Each book features comprehensive explanations of the relevant concepts and applications in order to cover thoroughly its subject matter. There are thousands of illustrative diagrams that help to explain the more difficult concepts and multiple-choice questions, which allow students to test vital elements of their knowledge. An example of illustrative diagrams is shown at Fig.2.

Within the CBT, each lesson is accompanied by clear precise narration, which instructs students through each essential teaching point. The lessons are built with an effective combination of graphics, animations, audio voice-overs, textual key-points and revision questions, providing a unique and effective way of mastering difficult concepts in an engaging way.

During the two years of CBT application, cadets demonstrated better results in subjects in which the CBT were used. The comprehensible manner gave cadets a lot of good examples and advices on how to deal with the problem in tomorrow's flight training.

Figure 2. An example of illustrative diagrams in Radio Navigation CBT

B. Flight Simulator X

Microsoft Flight Simulator X, also known as FSX, is a 2006 flight simulation computer game originally developed and published by Microsoft for Microsoft Windows. It is the next in the sequence after Microsoft Flight Simulator 2004. It is the tenth and last installment of Microsoft Flight Simulator series. It includes a graphics engine upgrade.

Flight Simulator X was released in three editions: Standard, Deluxe, and later Gold. The Deluxe

Edition incorporates additional features, including an on-disc software development kit (SDK), three airplanes with the Garmin G1000 Flight deck, and the ability for the player to act as Air Traffic Control (ATC) for other online users with a radar screen.

The Deluxe Edition features 24 aircraft compared to 18 in the Standard Edition; 45 high-detail airports compared to 40; 38 high-detail cities compared to 28; and 51 structured missions compared to more than 30. Microsoft Flight Simulator X: Gold Edition combines the Deluxe Edition and the Acceleration expansion pack into one.

The Matrox TripleHead2Go expands Flight Simulator X across three displays (Figure 3.), providing a panoramic view that lets you see more of your virtual cockpit and improves your flight visibility at the same time. This extended view provides a more realistic flight experience by fully engaging your peripheral vision on the side displays.

Speaking about assessment and worthiness of kind of software like Flight Simulator X is we must first mention what kind of simulators and simulation there are on the market. Simulation can consist of virtual modeling on a computer workstation, part task devices with actual system hardware and software, or full-mission man-in-the-loop simulators with visual systems and motion. All have their place in the process, and all play a role in shortening development time and cost [3].

Figure 3. Expanding of FSX across three displays

So this Microsoft flight simulator software can be classified as virtual modeling on a computer workstation.

One of the enduring problems with any flight simulator is the restricted field of view (FOV) imposed by the computer display screen. This restriction severely limits peripheral vision, which in turn detracts from perceived realism. High-end military simulators use multiple screens to provide a wider field of vision (FOV) in our case we use The Matrox TripleHead2Go to expand scenery over 3 displays (3 HD projectors), but that is not very practical for PC-based simulation.

FSX simulator is mainly used to demonstrate cockpit views and basic systems characteristics in the aircrafts used in real flight training (UTVA-75, Supergaleb G-4, Gazelle). It works with obvious success.

However, it is important to stress that during the flight-training phase in military jets (G-4 Supergaleb in our case) full-scale flight simulator is used [4]. However, the use of this simulator is expensive and impracticable in the theoretical study phase, which is our point of consideration.

C. E-learning in flight training preparation phase

After completing the first five semesters cadets go to Batajnica airbase where they are starting with their flight-training program. Although the Batajnica is not so far from Belgrade, cadets are not in possibility to visit Military Academy's facility every day and communicate with their professors in charge for subjects directly connected with flight training syllabus. After consideration, the Military Academy staff has decided to implement MOODLE e-learning platform in Military Aviation study program (http://adl.elearning.mod.gov.rs/).

MOODLE (Modular Object-Oriented Dynamic Learning Environment) is a free source e-learning system shell (LMS - Learning Management System), written in PHP.

It is an important tool for e-learning and blended learning, which provides a framework for preparing courses and for learning over it. There are the following levels of permissions in the system: system administrator (highest level of permissions), course creator (permission to create courses), teacher (may teach in the assigned course – create contents and score); student (learns and performs tasks within the chosen course). Users may define the permissions of other users below their level (the course creator assigns teachers to the course; the teacher registers students to the course).

Various content is provided over this system shell (texts, pictures, optional files, links, multimedia etc.), but the tasks related to them that can be scored are also important (assigning tasks in the form of online text, file, varied types of tests, offline tasks etc.). This system unifies and presents in a single surface all the services that are otherwise applied by teachers on parallel surfaces, often offline (sharing documents and information, sending messages, evaluation etc.) [5].

The first implemented course over the MOODLE platform is General Navigation. After the finishing semester, it was possible to identify

some advantages. First, MOODLE allows for many different types of content formats to be uploaded and available for use by the students and the professor (instructor). MOODLE not only allows for learning to be done online or at a distance but also it allows resources to be available to students in who are in instructor-led classes. MOODLE also has different options and tools available for use. MOODLE allows communication to happen between the professor (instructor) and students and students can also communicate with each other. Communication in MOODLE range from forums, blogs, chats and messages among the individuals who are enrolled within a course. This is an advantage because if the course is an online or distance-learning course, communication is key to ensure that the lesson is effective and if there is a problem, there are resources available to allow for effective communication.

D. Other software

By the modernization of the Serbian Air Force, a lot of new electronic equipment has been installed inside the cockpit of the airplanes. That equipment primary is primary intended for navigation and communication use. Introducing modern navigation and communication equipment and pilot-static instruments too, brought a new human-machine interface. The main reason is conversion from analog to digital interface. For example, typical instruments presented the bearing of non-directional beacons and VOR/ILS stations with needles in the center of instruments display. The same situation was with primary flight instruments (based on Pitot principle) such as altimeter, airspeed indicator, vertical speed indicator etc. The difference between visual interfaces of analog and digital instruments is shown at Figure 4.

Embedding the new instruments imposed the new training approaches. Because of Garmin origin, Military Academy introduced dedicated Garmin software and hardware simulator for its complex devices such as Garmin G500/600. The basic variants of this simulator can be viewed and downloaded at Garmin support pages (http://www8.garmin.com/support/download_details.jsp?id=4867). This simulator allows cadets to perform basic functions within the Garmin system. It is possible to learn how to input data and frequencies using tips and tricks for “best practices”. You will be able to navigate using flight plans and GPS direct courses. The cadet will be able to navigate the pages and page groups of the Flight Management System, while recognizing the most important functions using tips and tricks.

Figure 4. The difference between visual interface of analog and digital instruments

The first generation of cadet pilots who started their flight training after practicing this simulator shows better performance in basic stages of flight syllabus.

IV. CONCLUSION

Improving the process of selection and theoretical education of the cadet pilots is permanent task of the Military Academy staff. During the last two years, several categories of commercial software were introduced in the preparation phase of the military pilot education and training. Application of commercial software starts with the selection process using Vienna Test System in the field of psychological assessment. This assessment showed many advantages especially by level of objectivity, precision and reliable preselecting of applicants for pilot training.

Military Academy theoretical study program emphasis is on the professional and applicative subjects. Study of those subjects is improved by implementation of multimedia computer-based training created by CAE Oxford Aviation Academy. First exams demonstrated significantly better results and better understanding of curricula and learning objectives.

Parallel with CBT, the FSX simulator is used to demonstrate cockpit views and basic systems characteristics in the aircrafts used in real flight training (UTVA-75, Supergaleb G-4, Gazelle). It works with obvious success.

Military Academy staff also implemented MOODLE e-learning platform in Military Aviation study program. The platform is intended for cadets who completing their flight training in airbases from Military Academy headquarter. It helps cadets to keep communication with their professors in charge for subjects directly connected with flight training syllabus.

Modern teaching methods are also supported by using dedicated software and hardware simulator for navigation and communication equipment as well as basic flight instruments.

All of these commercial software tools significantly improved the preparation phase of the military pilot education and training, and creates preconditions and basis for better, safer and more economical flight training.

REFERENCES

[1] http://www.cad.gov.rs/en/standardizacija.php (accessed April 2014)

[2] http://www.caeoxfordinteractive.com/ (accessed April 2014)

[3] A.E. Dillard, “Real-time operational evaluations using advanced flight simulators,” Digital Avionics Systems Conference, 17th DASC, vol.1 pp.E16/1 - E16/7, 1998.

[4] S.Vlacic, “Training devices and flight simulators variants of application in pilots training on the aircraft Lasta”, OTEH conference 2011, Belgrade, 2011.

[5] Z. Namestovski, B. Arsovic, “Possibilities of implementing web 2.0 tools in education”, Proceeedings ITRO 2013, pp.43-46, Zrenjanin,2013.

THE EFFECTS OF EDUCATIONAL COMPUTER SOFTWARE ON MOTIVATION OF STUDENTS IN EVOLUTION BIOLOGY

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Professional Paper

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Abstract - The paper analyzes the effect of educational computer software on the development of motivational processes in biology on grammar school students. This experimental study was conducted in a grammar school in Zrenjanin, Serbia. A stratified random sample consisted of 60 students 4th grade of grammar school, wich were randomly distributed into control and experimental groups. The students in the experimental group learned a biology content by educational computer software, while the students in the control group learned the same content by the traditional teaching. After elaborating on the teaching material, a survey was conducted for students of the experimental group. The survey results show a great interest by students and reported high motivation for adopting biological content using such a didactic model.

Keywords: software, biology, evolution, curriculum

I. INTRODUCTION

According to the current Biology curriculum for the 4th grade general vocation of grammar schools, the following teaching units are studied: The basics of molecular biology (10 lessons), Biology of animals' development (14), Inheritance mechanisms (15), Ecology and environment protection and improvement (16) and The basic principles of evolutional biology (9). In conducting them and in teaching practice in most of the schools in Serbia there is traditional lecture with frontal teaching method and verbal-textual teaching methods. The main request in Biology lectures in Serbia is for students to acquire as larger number of facts as possible. Learning comes down to piling up the knowledge, lectures to verbalism and students are overburdened with the material, and unfortunately incapable of applying acquired knowledge due to non-understanding. This traditional Biology lecturing does not take into consideration equal respect and development of educational, forming and functional tasks of lectures. In this kind of lectures forming of attitudes, scientific point of view and enabling students to learn, think and prepare for permanent education is forgotten.

With the introduction of technology into everyday life, it is becoming essential that the use of this technology forms part of the school curriculum. Generally informational technology will be applicable in Computer Assisted Instruction (CAI); Computed Aided Design (CAD); Teleconferences and Library Computer System (LCS). The utilisation of informational technology fundamentally changes traditional forms and methods of work in the educational-pedagogical process, and demands a suitable didactic-technical environment in which teaching is being realised. This is confirmed by a great deal of research. Thus, the use of computer in the process of teaching develops the abstract thinking and individual improvement of pupils in acquiring knowledge [18]. By using computers in teaching, pupils acquire the ability of conducting their cognitive functions and also develop their metacognitive skills [24]. In comparison with traditional methods of teaching, the use of computers in teaching offers numerable advantages, because it enables pupils to see their own improvement and makes conditions for the development of self-criticism [18], but also develops divergent thinking [21].

There are a lot of assumptions that students are interested in using computer; they found it more pleasant, more appealing, and more motivating to study with computers than with traditional means. Teaching and learning of biology could be made more interesting if the lesson presentation using Power Point or multimedia education software to motivate students to learning and to make more interesting, to attract more students. Software can be provided to the students to allow them to engross the biology as subject, thus making

learning more meaningful. The use of educational computer software will bring new, exciting, actual and rewarding educational experiences for both students and teachers [13]. Educational computer software (ECS) must be projected so that it satisfies the needs of all participants in the educational process. The simplicity in using the software must be provided for pupils, as well as a high degree of obviousness of teaching material which is being presented in this way. Besides, software should be interesting and stimulating to motivate pupils for studying [16]. Adequately created teaching software should become an integral part of teaching and learning [10].

Numerous works of research have confirmed the efficiency of the utilization of the computer and teaching software in the realization of teaching material in Biology. The use of teaching softwares as tutorials contribute to better understanding of notions in genetics, while the use of software as teaching games develops positive attitude among pupils towards Biology [26].

The use of educational software with animation and illustrations contributes the better understanding of teaching contents in presenting the teaching theme “Genetics“ [17]. Multimedia softwares have contribution in better understanding of biological notions and processes [4]; [5]; [6]; [25].

Research works in the efficiency of the use of educational computer software in teaching Biology in the Republic of Serbia are very few. The reason for this is the lack of issued educational softwares, then the lack of computers in schools as well as inadequate training of teachers for the use of modern educational technology [23]. Several authors did some research in the field of the efficiency in using the multimedia softwares in teaching Biology comparing it with traditional ways of teaching: in the realisation of the teaching theme “Hidden seeds“ in the 5th form of primary school [12]; in realization of the theme “Biology of Animal Development“ in the 3rd form of Grammar school [8]; [9] and in the realization of the teaching theme “Cell splitting“ in the 1st form of Grammar school [22]. The results of their research have showed that such a model of learning in Biology teaching is much more efficient than traditional one, considering the aspects of quality, duration and implementation of pupils' knowledge, motivation and performance.

Many researches argued in their investigations that use of educational computer software (ECS) on the achievements of pupils are increased, the speed of learning is greater, the understanding of abstract phenomena and processes is enabled and the motivation for learning is growing [14]; [26]; [2]; [7]. Due to presented advantages and positive effects of the ECS on their implementation in teaching improvements worldwide, it is necessary to work in an organized way on as soon as possible introduction of computers and computer softwares in teaching Biology and other natural sciences in the Republic of Serbia.

II. PURPOSE OF THE STUDY

The aim of this paper was to investigate the effects of educational computer software on motivation and performance of students in Evolution biology. Specifically, the study examined the effects of the ECS at the development of student motivation. Students are expected to be active, and independently develop their own creative possibilities.

III. RESEARCH METHODOLOGY

According to the Teaching programme of Biology in Grammar school at natural science-mathematical vocation considering the teaching theme “Evolution biology“ during 9 classes (Official Gazette of the Republic of Serbia, no. 8/2008).

Due to the importance of correct understanding of contents in evolution which are the very essence of life and Biology as a science the aim of this research has been the methodological work towards the contents of the teaching theme “Evolution biology“ in the IV form of Grammar school by using the ECS, and then the analysis of the efficiency of adopted knowledge of the students (quantity and quality) in comparison with the same teaching materials and contents taught in a traditional way.

In the pedagogical research two classes with the total of 60 pupils of the IV form in Zrenjanin Grammar School took part. The experimental (E) group consisted of three classes with 30 pupils, and the control (C) group had three classes with 30 pupils. At the beginning of the research, before the introduction of the experimental factor in the E - group both groups were made equal on the basis of general success of the pupils, their success in Biology at the end of the III form of Grammar school and the initial test of knowledge in Biology. After making the groups equal the pedagogical experiment was done.

In the experimental model of teaching, while doing the teaching theme “Evolution biology“, the teaching process was performed in the computer science specialized classroom where pupils used ECS individually. The teaching software was prepared for the pupils of the IV form of Grammar school as a substitution of the textbook during the

presentation of the contents in Biology. When the programme is started (Figure 1) there are links for the parts contained in the software: The Introductory Lecture, Teaching Material, Interesting Facts, A Gallery and The Final Test.

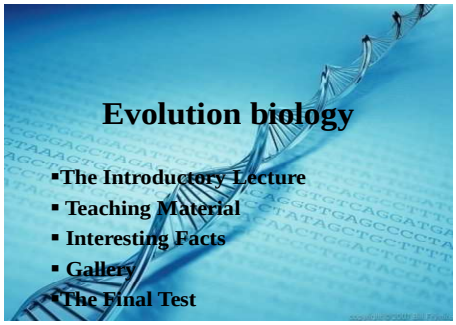

Figure 1. Software Home Page

"The Final Test" there are questions for checking knowledge about the material of the whole teaching theme at the end of its presentation. The test consists of different types of questions and problem tasks. After giving the answer to a question, a pupils gets information about the correctness of answer, a pupil gets some additional pieces of information which can help him/her to get the right answer. A special conformity in tests is the possibility of automatic change of the order of the given answers, because the programme offers every time a new variety of answers. In this way mechanical studying and copying is prevented, because each student has on his/her computer a different combination of answers. Every question, depending on its complexity, has a certain number of points.

At the same time in the controlled model of teaching, the teaching was performed in the Biology laboratory through a traditional way of teaching (verbal-textual and demonstrative-illustrational teaching methods and frontal form of work).

In order to compare the differences between the C and E groups on the initial test, final test and retest results, the independent t-test was applied.

Upon completion of the experimental research a survey was conducted for the students in the experimental group who participated in this educational research (30 students) in order to assess their attitudes and opinions on the implementation of the educational computer software of teaching with respect to biological curriculum.

In this study, there was used questionnaire consisted of 9 open ended questions of authors' own construction. The questionnaire was anonymous.

IV. Results and Discussion

After the survey the results of the pupils' responses to the questionnaire were obtained and presented in Table I.

TABLE I. THE RESULTS OF THE SURVEY

Questions	Variants of students responses	Number of students	%
1. Do you like working with computer?	Yes	29	96.67
	Maybe	1	3.33
	No	0	0.00
2. Did you enjoy the lesson with the computer?	Very much	25	83.33
	It was alright	4	13.33
	Not at all	1	3.33
3. The way in which we have covered teaching area Evolution biology was:	Very interesting	26	86.67
	Average	2	6.67
	Boring	2	6.67
4. This approach to teaching evolution enabled me to learn:	Much more	26	86.67
	Average	4	13.33
	Slightly	0	0.00
5. This way of learning biology was very useful for me.	Yes	25	83.33
	Maybe	5	16.67
	No	0	0.00
6. The use of ECS contributes the better	Yes	27	90.00

understanding of evolution contents	**Maybe**	**3**	**10.00**
	No	**0**	**0.00**
7. The speed of learning with ECS is greater, than on traditional way	**Yes**	**29**	**96.67**
	Maybe	**1**	**3.33**
	No	**0**	**0.00**
8. Would you like to realize other content from biology this way?	**Yes**	**30**	**100.00**
	Maybe	**0**	**0.00**
	No	**0**	**0.00**
9. What did you like / not like when processing the contents of the teaching areas Evolution biology			

Based on the questionnaire for students, the following conclusions can be presented:

More than 96% of studens like working with computer;

83% of students enjoyed the lessons with computer, 13.33% thought it was all right and only 3.33% didn't enjoy during the lessons (Figure 2);

Ass seen on Figure 3 the way in which we have covered teaching area Evolution biology for 86% students was very interesting, but for 14% was average or boring;

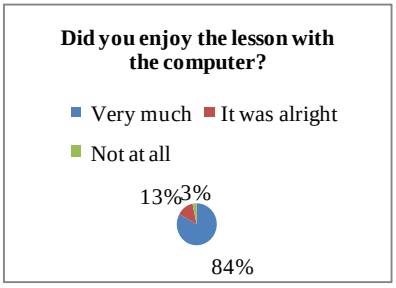

Figure 2. The Students responses on question number 2.

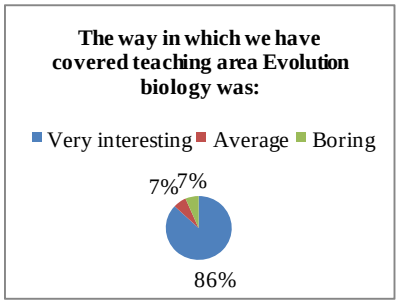

Figure 3. The Students responses on question number 3.

As seen on Figure 4 86.67% of students reported that through processing of teaching areas using educational computer software they have learned much more, 13.33% stated that this approach allowed them to learn the average and while there were not students who said they learned a bit in this way;

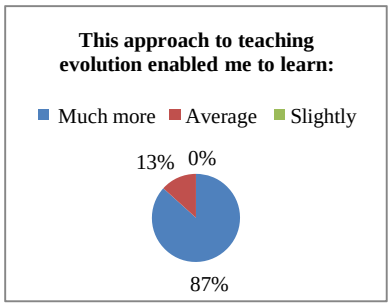

Figure 4. The Students responses on question number 4.

More than 83% of students stated that learning biology with ECS was very useful, while 16.67% of students are not sure (Figure 5);

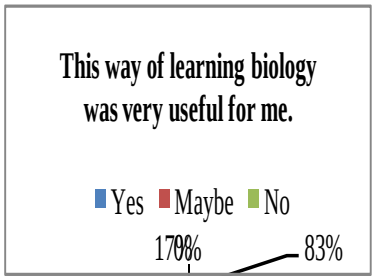

Figure 5. The Students responses on question number 5.

90% of students believe that this way of teaching facilitates the understanding of biological teaching content, while 10% of students found that this method of teaching and learning does not contribute to their understanding of content (Figure 6);

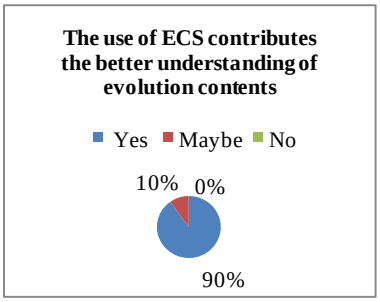

Figure 6. The Students responses on question number 6.

As seen on Figure 7, 96.67% of students believe that the speed of learning with ECS is greater, than on traditional way;

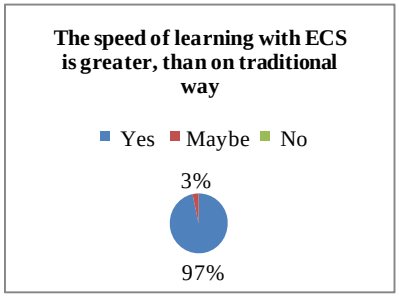

Figure 7. The Students responses on question number 7.

The question "Would you like to realize other content from biology this way?" 100.00% of the students expressed a positive attitude, and no one had a negative attitude.

In considering individual responses to question "What did you like / not like when processing the contents of the teaching areas Evolution biology?", we can point out a number of similar positions that best describe the general attitude of students on the application of educational computer software:

- "Using the computer helped me more for biology because it was interactive."
- "I like that it is on the computer and you were able to type the answers."
- "I liked the interacting problems."
- "I dont like to learn, but this way is of learning is easy and good."
- "I liked the pictures and questions."
- "Lectures are cool."
- "Better than paper or lecture."
- "I liked it because I enjoy using computers, and I learn better on them."
- "I loved the way the material is prepared, its visibility. It was very interesting for me."
- "I liked that the work is interesting and I think that this system is successful because students participate in the process of learning"
- "I like to learn all contens in Biology by application of software"

There were also conflicting opinions:

- "I prefer the classical method of teaching."
- "It was too hard for me."

Based on the survey results and students' views on the application of educational computer software in biology it can be concluded that most of the students accepted this manner of work. Students realized that such an approach in teaching facilitates understanding and mastering biological program contents. They were motivated to acquire the contents, and thus they gained quantitatively and qualitatively better knowledge of the teaching areas.

Negative responses of students indicate a particular role of classical teaching at the Grammar School, and each new form of teaching is strange for students and they approach it with a certain amount of uncertainty and caution especially towards what is new and different in the classroom.

So from this results are followed that ECS making the lessons more interesting, easier, more fun, more diverse, more motivating for the students and more enjoyable. According to the results of numerous authors [1]; [3]; [15]; [20] it can be concluded that the applications of ECS shows the important advantages and greater possibilities in teaching over traditional methods, as well as success motivation for the subject and cooperation abilities of the students are all improved.

V. CONCLUSION

Teaching and learning of biology could be made more interesting if the lesson presentation using educational computer software is supplemented with other activities to motivate students to learning and to make more interesting, to attract more students. Because students' interest in biology as subject decreases. There is much software (CD ROMs) available which can be provided to the students to allow them to engross the biology as subject, thus making learning more meaningful.

The application of ECS significantly to students' motivation to acquire the physiological teaching content, encourages the development of thinking, initiative students, develop independence in the exercise of intellectual activity. It achieved a high level of efficiency in the realization of program content in the biology, as well as increased the quality and quantity of knowledge acquired by students.

The impact of ICT on students' learning outcomes will ultimately depend on the biology teachers. They are the ones who will decide how best to influence the knowledge. The use of EDS will bring new, exciting, actual and rewarding educational experiences for both students and teachers.

REFERENCES

[1] A. Demirer, "The effect of the computer assisted teaching method (cat) and the traditional teaching method on students' academic achievements and their attitude toward science and the permanence of the acquired behaviors", Master's Thesis University of Dicle, Diyarbakir, Turkey, 2006.

[2] A. H. Hançer, A. T. Tüzeman, (2008). A Research on the Effects of Computer Assisted Science Teaching, *World Applied Sciences Journal*, 2001, 4 (2), 199-205.

[3] A. Olgun. "*The effect of the computer-assisted instruction given to 6th grade primary school students on the students' attitude toward science and their metacognitive skills and achievements"*, Master's Thesis University of Osmangazi, Eskisehir, Turkey, 2006.

[4] C. Y. Tsui, & D. F. Treagust, "Understanding Genetics: Analysis of Secondary Students' Conceptual Status" *Journal of research in science teaching*, 2007, 44, (2), 205–235

[5] C. Y. Tsui, & D. Treagust "Motivational aspects of learning genetics with interactive multimedia". Am Biol Teach, 2004, 66:277–285

[6] D. Siegle, & T. Foster, "Effects of laptop computers with multimedia and presentation software on student achievement in anatomy and physiology" *Journal of Research on Technology in Education, 2001, 34*, 29-37.

[7] H. A. Efe, & R. Efe, "Evaluating the effect of computer simulations on secondary biology instruction: An application of Bloom's taxonomy", *Scientific Research and Essays*, 2011, 6 (10), 2137-2146.

[8] J. Terzić, & T. Miljanović, T. "Realizacija programa biologije u gimnaziji i zastupljenost multimedija" (Biology syllabus in grammar school and presence of multimedia in teaching activity). *Pedagoška stvarnost*, 2009, Vol. 55 (7-8), 735-744.

[9] J. Terzić, & T. Miljanović, "Efikasnost primene multimedije u nastavi biologije u gimnaziji" (Efficiency of Multimedia Application in Biology Teaching in High School). *Nastava i vaspitanje*, 2009, Vol. 1, 1-14.

[10] J.E. Hinostroza, & H. Mellar, "Pedagogy embedded in educational software desing: Report of a case study", *Computers and Educat*ion, 2001, *37(1)*, 22 - 40.

[11] K. Voskresenski, *Didaktika za profesore informatike i tehnike*, Tehnički fakultet M. Pupin, Zrenjanin, 2004.

[12] M. Grujičić, & T. Miljanović, "Effects of Modern Didactic Media on the Efficiency of Biology Teaching", *Journal of Education*, 2005, Vol. 4-5, 327 – 337.

[13] M. Kubiatko, Z. Halakova, Slovak high school students' attitudes to ICT using in biology lesson. *Computers in Human Behaviour*, 2009, 25(3), pp. 743-748.

[14] M. K. Philip, T. K. Jackson, W. Dave, "The Effect of Computer-Assisted Instruction on Student's Attitudes and Achievement in Matrices and Transformations in Secondary Schools in Uasin Gishu District, Kenya", *International Journal of Curriculum and Instruction*, 2011, 1 (1), 53-62.

[15] M. Pektas, "*The effect of the constructivist approach and computer-assisted instruction on students'achievements and attitude in biology"*, PhD thesis, University of Gazi, Ankara, Turkey, 2008.

[16] M. Virvou, G. Katsionis, & K. Manos, K. "Combining software games with education: Evaluation of its educational effectiveness", *Educational Technology & Society*, 2005, 8(2), 54-65. http://www.ifets.info/journals/8_2/5.pdf

[17] P. E. Akwee, W. W. Toili, & V. A. Palapala, "Effectiveness of computer based technology integration in teaching and learning of gene concept among high school students, Kenya", *European Journal of Health and Biology Education*, 2012, Vol. 1, No. 1 &2, 31-52

[18] P. Greeinfild, & Z. Yan, "Children, adolescents, and the internet: A new field of inquiry in developmental psychology", *Developmental Psychology*, 2006, 42(3), 391-394.

[19] S. C. Lee, "Development of instructional strategy of computer application software for group instruction", *Computers & Education*, 2001, 37, 1–9.

[20] S. Tekmen, "*The effect of computer assisted instruction given in the physics lesson in the 9th grade on the achievements of the students, their attitude toward the lesson and its retention"*, Master's Thesis University of Abant Izzet Baysal, Bolu, Turkey, 2006

[21] T. E. Gatewood, & S. H. Conrad, "Is your school's technology up-to-date? A practical guide for assessing technology in elementary schools", *Childhood Education, 1997, 73*(4), 249-251.

[22] V. Odadžić V., T. Miljanović, K. Voskresenski, "Mogućnosti i efekti primene inovativnih didaktičkih modela u nastavi biologije u gimnaziji" (Possibilities and effects of use of innovative didactic models in teaching biology in grammar school), *Nastava i vaspitanje*, 2011, Vol. 2, 249-261.

[23] V. Drakulić, T. Miljanović, & S. Ševkušić, "*Postignuće učenika iz biologije" (Pupils' Achievement in Biology)*. In S. Gašić-Pavišić & D. Stanković (Eds.), Timss 2007 in Serbia (pp. 145 – 174). Belgrade: Institut za pedagoška istraživanja, 2011.

[24] V. D McInerney, & H. W. Marsh,"Effects of metacognitive strategy training within a cooperative group learning context on computer achievement and anxiety: An apptitude treatment interaction study", *Journal of Educational Psychology, 1997, 89*(4), 686-695.

[25] Y. G. Singh, "A Study of effectiveness of Different Modes of Computer assisted instruction in Teaching Science", *International Refereed Research Journal, 2010,* Vol II(15).29-31.

[26] Y. Kara, H. Yakar, "Effects of Computer Supported Education on the Success of Students on Teaching of Newton's Laws of Motion", *World Applied Sciences Journal*, 2008, 3 (1), 51-56.

[27] Y. Rotbain, G. Marbach-Ad, R. Stavy, R, "Using a Computer Animation to Teach High School Molecular Biology", *Journal of Science Educational Technology*, 2008, 17:49–58 DOI 10.1007/s10956-007-9080-4.

EDUCATIONAL SOFTWARE AS A SIMULATION TECHNIQUE-EXAMPLES IN TECHNICAL AND IT EDUCATION

UDC: 37.016.::62]:004.4
Review Scientific Paper

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Abstract - Modern teaching techniques and methods referring primarily to the use of animation, simulation and different interactive contents are listed in the paper; aiming to improve and modernize IT lessons and teaching. Namely, IT subject involves contents from the fields of mechanical engineering, electrical engineering, architecture, construction, traffic, transport, different modeling disciplines and informational-communicational technologies and technologies in general. Introducing modeling and simulating methods is very important, especially when it comes to the process of individualization in lesson planning and teaching. In this paper, we particularly describe possibilities given to students by using informational-communicational technologies in order to expand their previous knowledge in both qualitative and quantitative way. The aim of the paper is to show and connect theoretical and practical students' knowledge, on both primary and high school level of education, making the correlation and highlighting further advancement, as in choosing the right trajectory through their further education. Students are introduced, through simulating methods, to the fields of modern techniques and technologies, emphasizing the fact that they are important factor in human development and progress.

Keywords: educational software, simulation, education

I. INTRODUCTION

Computers have application in every field of human life and work, from art to engineering, education, medicine, trade etc.

In time we live in, time of informational technologies, there are new methods and teaching techniques that preoccupy teachers and students, early as in primary school age. Modern teaching tools, that connect computers, television, telephones, photography, computer and satellite networks, enable differentiated learning and teaching, as well as individual approach to teaching. Even though there were simulated environments in the past, like driving a car or flying a plane, today's simulations give a user a possibility to move and interact within the virtual environment. This is very important when it comes to Technical and IT education, when teaching various technical or technological processes. Learning is a process during which an individual capacities are enhanced and therefore enables one to perform better in different life situations. Even though, learning is a matter of experience, not maturity, there is a need of maturity in order to apply knowledge both in time and in quality [2]. Learning can be more or less effective, but it is cognitive as well as physical because one involves entire being in order to learn something and at the end to apply it. Learning contributes personal development because the learner enhances one's own complexity, capability and diversity. Therefore, learning enhances personal development and it is very important to guide students, even in primary schools, towards that goal. Using computers and modern informational - communicational technology (ICT) become important when using the Internet in teaching process.The Internet came to existence during 1960s, by exchanging information about the research and development in scientific and military fields [4]. It was developed in the time of 'cold war' in order to secure communications even in the case of nuclear attack. At the beginning, the Internet was used by experts, engineers, scientists and librarians. It has become important in the process of education following the development of personal computers. Communication and cooperation between teachers and students, researches and published papers lead to faster exchange and application of information, which is the ultimate goal when it comes to social development. Benefits of the particular learning are multifold both, for teachers and students. A

teacher gets more time and space to work and consult with students, while students learn by their own pace, accessing contents as they choose. Factors that can affect successful communication are teacher's and student's characteristics, that can be psychological, social or cultural. What is also important is the nature of language, as well as different semantic problems that can occur, and social and formal structure of learning and teaching processes.Many scientific experiments and tests conducted in laboratories can fail, with possible tragically consequences that can be successfully prevented by using computers. By modeling and simulating, which are inseparable terms, significant effects can be accomplished in both scientific and social disciplines.

II. THE DEFINITION OF MODELING AND SIMULATIONS

Models represent the analogy of the original system or an object which embody the most important features necessary for the research process, or as often described as simplified copies of the originals.

On IT lessons, models are most often used to show the level of application of theoretical knowledge. Within the lesson topic "Constructive modeling," students have the opportunity to express their knowledge practically, through the form of technical writing, making technical algorithms, thus following the process from the idea to final realization of an actual model. New technologies are in favor of application of computers in teaching, especially when it comes to modeling and simulations. Students usually use computers for playing games and having fun, while teachers find them useful and powerful educational tool. Therefore, there is a need to introduce interactive teaching and learning in order to make learning more interesting and creative [2].

Models are made because doing research by using originals can be expensive. Models are cheap, simple, environmental friendly, affordable and safe which is very important during the research process, when parameters, structure and dimensions of a model can be easily changed.

Simulation implies observation of a model in given circumstances, where the input parameters are provided in order to get output values in a given scale.

"Black box" model implies observing the output values in accordance to input values regardless the inner structure of a model.

This becomes increasingly important when it comes to modeling and simulation by using computers. Namely, all technical and scientific changes influence educational system, especially educators. Teachers become aware of the necessity of professional development in order to follow and apply innovative methods and techniques when teaching today's generations of students. When it come to professional development, it implies both lesson content and teaching techniques.

The great number of teachers realize the necessity to change traditional teaching methods and to apply modern teaching technologies including laptops, video-beams, interactive white boards, educational computer software and other multimedia [1]. The application of new teaching technologies is necessary in order to increase students' interests and motivation in the process of learning and acquiring new information, thus to increase the level of application of the acquired knowledge. Namely, by simulating different types of experiments and problems and by using online debates, students' motivation and interests can be influenced and a teacher becomes mentor and a guide to new knowledge.

III. EDUCATIONAL COMPUTER SOFTWARE

The term educational computer software implies any computer program that can be used in teaching process, and its use is based on the fact that students are involved both individually and interactively.

"Software in the field of education stands for intellectual technology and it is called educational computer software (ECS), which encompasses computer languages and tools, certain organization of teaching and learning and which is based on logic and pedagogy. " [2].

After the development of intelligent tutor systems which finds mistakes and "holes" in user's knowledge and work, thus they lead a user through the whole learning process, a foundation is made for a development of educational computer software. In ECS, individual elements are connected to other texts, and along with the development of eBooks which are hypertexts with limitations, we come to the development of multimedia and simulation [4].

When classifying ECS, following parameters are taken into consideration: learning methods, educational functions, control independence, ways of using computers and classification according to subjects [2].

The meaning of simulation is in experimental model of a phenomenon which has been studied. A simulation in which a student defines a model is called building model. Simulations can be used in one-on-one practice, or as an instructional help in

order to encourage group work learning in the classroom.

Technical-technological processes, which happen in factories and in laboratories, can be introduced and represented to students through different types of models and systems' simulations. In order for teaching process to be successful in the way of introducing modern teaching techniques, it is necessary to provide quality professional development for IT teachers. Teachers, and especially those who graduated twenty or thirty years ago would have to master the usage of informational – communicational technologies, especially considering simulation and animation.

Modeling methods allow not only to teach theory, but to test students without raising the stress level while making it easier and accessible with the results that can give fast feedback.

During the process of examination of learning model, teaching model and the model in teaching, it is necessary to emphasize certain questions:

- How the process of learning can be modeled,
- how the teaching process can be modeled and which model of teaching is the most effective, and
- how learning contents can be modeled.

In considering this issue, it is necessary to avoid all extremes, aspirations to scientific, mechanically centered and phenomenological approaches. For further discussion is necessary to define some general goals:

- Discover ways of modeling in the field of learning and teaching,
- to establish the function and the structure that model must possess in order to be effectively applied in a learning process, and
- measure the contribution of modern methods of modeling in solving problems when it comes to education and educational process.

The most effective way of mastering the material by the students, is for the students to learn by themselves, face to face with a qualified tutor, well- equipped with the instructional material, laboratory equipment and the like [4].

Technical and IT education as a subject that is taught in primary schools in the Republic of Serbia and the neighboring countries has been suffered significant changes in the last 40 years. From the teaching inclining to stereotypes and skills, based on manual products, where this course was taught by the people who were craftsmen, to today's teachers who are BSCs or MSCs that teach by applying and using new IC technologies including simulation and modeling, but not running away from making actual models. Practical work is now defined as constructive modeling, where students learn about the technology of materials, their use and methods of processing, about tools and machines in school workshops and classrooms [3].

All of this could not be achieved, especially when it comes to following modern tendencies in development of techniques and technologies that are taught in the curriculum, without professional development of teachers on formal and informal level.

Modern cabinets that have a room called workshop with tools and means for handling the materials, but also computer equipped classrooms have become the centre of work of modern IT teachers [5].

In this way, each student can be accessed individually and in terms of differentiated instruction which is especially important when you want to keep track of students' progress, his future professional development and commitment to the profession, which is also one of the aims of technical and IT education.

IV. Possible Applications of Computer Software in Technical and IT Education

The use of Educational Computer Software (ECS) has immense possibilities in technical and IT education, as a source of information and in terms of safety and protection, especially when it come to primary school students [1].

Materials and tools ease the process of teaching and learning, and as such, they mediate between curriculum, a student and a teacher. The teacher and the tools cannot be in confrontation, especially knowing that the tools themselves are not enough to enhance the process of learning [5].

Application of educational tools in modern teaching depends on various factors, the most important ones are:

- positive attitude of a teacher towards new teaching technologies and techniques;
- teachers' clear understanding of an innovation;
- innovation should be within a scope of a teacher's abilities;
- necessary resources should be provided;
- administration and organization;
- providing information through communicational channels;

- time needed for the application and acceptance of an innovation etc.

Educational Computer Software allows interaction and it has very significant role in mastering the curriculum by every individual student [2].

V. THE EXAMPLES OF APPLICATION OF EDUCATIONAL COMPUTER SOFTWARE IN TECHNICAL AND IT EDUCATION

Modern educational tools find great deal of application in the process of teaching and learning. The concept and the way of teaching technical and informational education has been changed through time and adapted to contemporary concepts of learning and development of students' abilities due to technological enhancements and innovations.

Technical disciplines, as a base for technical education in technical fields, and technical contents in general educational subjects formative for the development of technical culture, have physical and material parameters of phenomena studied. Apart from the fact that in technical sciences contents are expressed as abstract and general knowledge in the complex term system, it is necessary to rely on higher level of actual and shown.

Computers, the Internet and multimedia have become structural parts in the process of technical education. In schools, today, there have been used general software for a large number of potential users, as well as a large number of specialized software developed to solve specific problems, to do specific tasks, activities etc.

The best known educational software used in teaching today are part of the Microsoft Office suite. This suite was primarily planned to satisfy the needs in different fields. However, it has quickly appeared on personal computers.

The examples of simulations, animations and use of educational computer software in the subject of electrical engineering are the following:

a) *Designer's school*

Software for design, analysis and simulation in fields of electronics:

- electronics,
- microprocessors and microcontrollers,
- RF modules,
- interface and development of small projects

b) *MACROMEDIA DIRECTOR*

Macromedia Director is a software tool used for making multimedia applications, and as such, it has a significant place in the multimedia system.

Software tool, Macromedia Director, is based on so called Stage concept. Creating applications by using these tools starts with a blank screen, or a stage, in which we put objects that will be used in actual presentation. Each object is assigned with a certain number of sequences in which it will appear, a path it will follow on the screen and a certain action that it will do, whether they are provided with a tool or created by a user themselves. Director stands for most widely used authoring system. Director is an application that is used primarily for creating multimedia presentations and has excellent characteristics in terms of ease and speed in which the application can be made. It uses timeline approach, scripts and objects, and each object can have numerous features, effects or behaviors.

Director posses its own internal programming language, which is easy to learn and provides numerous possibilities. Its name is Lingo. This suite generates executable code and this is its good characteristics. In which way the application will be created depends only on author's knowledge and imagination.

Creating software in this programming tool looks like making a movie. In the following pictures the applet is shown, which represents the principles of working of a four-stroke engine. Applet is demonstrative and suitable for using in technical and IT education [7].

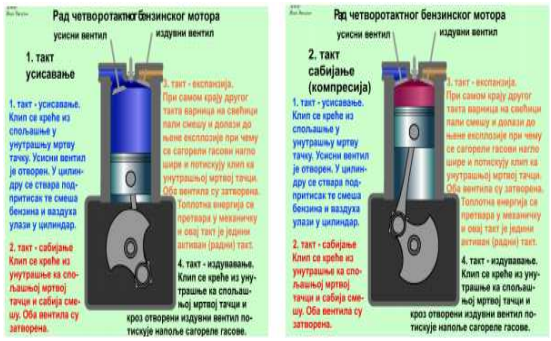

Figure 1: Principle of working of a four-stroke engine - first and second stroke

Figure 2: Principle of working of a four-stroke engine - third and fourth stroke

Another important project in the field of ECS and simulations is Vlabs Electricity, which represents the use and composition of electrical circuits in a simple way. This is very important for 8th graders, because this topic is in their curriculum for IT education.

Figure 3: Tutorial Vlabs Electricity

Software usage is depicted in picture 3. It is intuitive and very simple to use by students, and all others that are interested in the field of electrical engineering.

Figure 4: Starting work in Vlabs Electricity

Picture number 4 represents user interface, where its content and possible ways of usage are shown while simulating work of electrical circuits.

VI. EXAMPLES OF SIMULATIONS IN IT EDUCATION-FIELD OF ELECTRICAL ENGINEERING

Educational computer software made by using Macromedia Director, can be evaluated before its active application in educational process, relying primarily on objectivity of an evaluator. On this occasion, the ECS is made to explain Ohm's law which is unavoidable when it comes to explaining of electrical circuits in IT education.

One of the basic laws in the field of electrical engineering is **Ohm's law.** It is one of the first lesson topics that is mandatory for every future electrical engineer.

$$I = \frac{U}{R}$$

I stands for electrical current, U stands for voltage, and R stands for resistance.

This formula defines principles of change of electrical current in electrical circuits, which is directly proportional to the change of voltage and inversely proportional to a circuit resistance [6].

Considering the fact that electrical current is not visible to a human eye, students may have difficulties to imagine and understand that micro world. In order to demonstrate them what the formula means in practice, the model of a simple electrical circuit can be used.

Program that is used for this simulation is Macromedia Director MX, Version 9.0 [7].

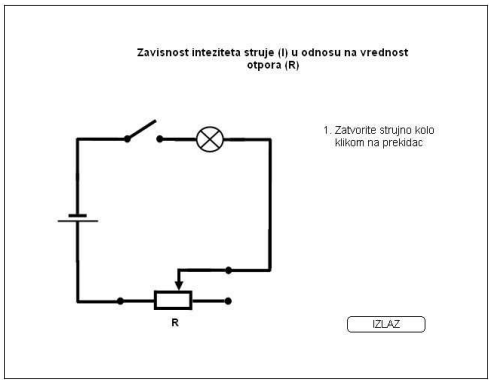

Figure 5. Opening screen

On the opening screen, there is a simple electrical circuit scheme with a switch in an open position. Next to the scheme is an instruction for starting the simulation and a key to exit the program at any time.

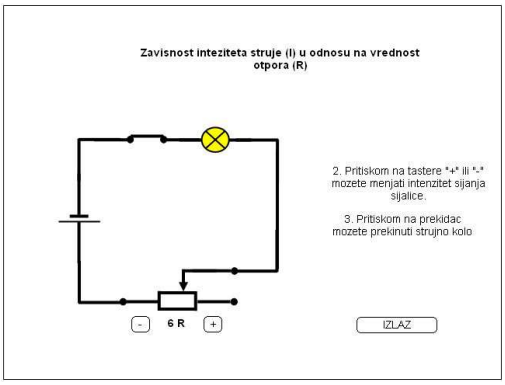

Figure 6. A circuit with medium intensity of electrical current

When the switch is in a close position, the circuit is closed and the light bulb glows with medium intensity.

If the intensity of electrical current is increased (which directly influences the intensity of a light bulb glow), a user can click "+" or "-" in order to decrease intensity. Students will comprehend that the intensity of resistance will fall, in order for the intensity of electrical current to rise, or vice versa.

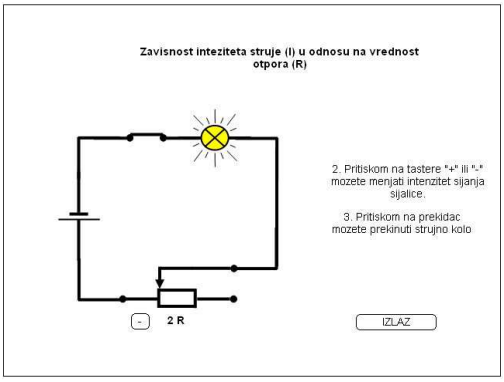

Figure 7. Circuit with maximum electrical current intensity

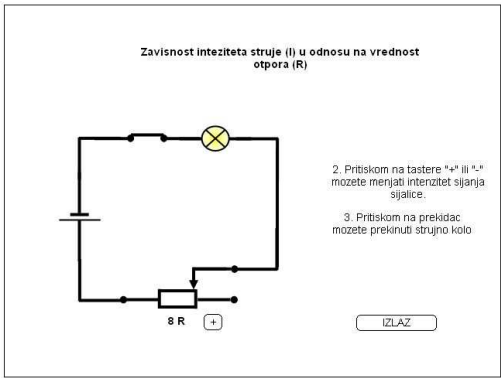

Figure 8. Circuit with minimum current intensity

In this example, resistance is constant and it does not influence the current change.

Simulation model is very effective educational tool because it communicates with students using pictures that are clear and unambiguous, as words themselves can be.

Safety when dealing with real electrical circuits can be compromised, which is completely avoided by using a model. Students can start the simulation independently without a teacher at any time that suits them.

VII. Advantages and Disadvantages in Using Educational Computer Software in IT Education

Advantages of using ECS as a simulation technique in IT education are numerous, starting from students' safety and health to better and faster level of acquiring and mastering new contents.

However, teachers that prefer practical work and direct contact with machines and appliances, will probably find reasons for deficiencies. Namely, it is clear that practical work is irreplaceable, especially in cabinets, factories or craftsmen's workshops. However, it should be bear in mind that the pace of technological process in factories does not tolerate students' slow pace, but requires skilled employees that will contribute equally along side with their experienced senior colleagues.

On one hand we have advantages when it comes to acquiring new knowledge and information provided by ECS, and using new software solutions. On the other hand we have deficiencies, especially when it comes to teachers' lack of aspiration for further professional development.

VIII. Conclusion

First simulations appeared for military purposes, all new, innovative that has been created for military usage, only to find their application in every day education, as useful educational tool. [4]

Techniques and informational technologies studied in the subject of Technical and Informational education are not static, especially in the way of teaching the same. These disciplines changes constantly and therefore, teachers have to invest in their professional development in order to follow modern technologies. [3]

Teaching process, now, put students in focus, and a teacher is a mentor and a guide through learning.

A choice of appropriate program depends greatly on curriculum, students' interests and motivation, life standards, tradition etc. Curriculum has to be up to date, dynamic, accessible and interactive in order to be understood and applied. Students have to be given the possibility to access contents in time and place they find fit. Thus, modeling and simulations have enormous significance.

Basic aim of applying simulation techniques was to provide real states models, repeating scenarios, learning by discovering and learning on mistakes, in a simple and affordable way. Nowadays, a large number of producers use computer simulations as in computer games or making SF movies, while the number of those interested in their educational application increases constantly.

References

[1] Nadrljanski Đ. (1998): Informatičko i tehničko obrazovanje, Tehnički Fakultet " Mihajlo Pupin", Zrenjanin.

[2] Nadrljanski Đ. (2000.): Obrazovni softver – Hipermedijalni sistemi, Tehnički Fakultet "Mihajlo Pupin" Zrenjanin.

[3] Popov S., Danilović M. (1998): Technical Education Story new concept, the Association of Teachers of Technical Culture of Vojvodina, Novi Sad.

[4] Radosav D. (2005.): Obrazovni računarski softver i autorski sistemi, Tehnički Fakultet "Mihajlo Pupin" Zrenjanin.

[5] Vilotijević M. (2005): Systemic-computer basics of teaching, educational technology, Belgrade.

[6] http://sr.wikipedia.org/sr/omov_zakon

[7] http://macromedia-director-mx-trial.software.informer.com/9.0/

STUDYING WITH TABLETS

UDC: 159.953.5:004.382.73
Review Scientific Paper

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Abstract - Introduction of information technology in education improves better conditions for students learning. Tablets are product of development information technology. They helps students to learn faster and more interesting. Thick textbooks can be presented into a simple, easy-to-read ebook. On each tablet can be stored many different textbooks and students can follow their lectures outside of the class. Atmosphere in classroom is more dinamic and students are more involved. Information tecnology has a large impact on education system. Using tablets for educational purposes will change the traditional way of learning.

Keywords: tablets, studying, textbook, smart board, social network, class, school, student.

I. INTRODUCTION

Today, information technology is very important for education because technology can help a lot for understanding education material. Another important thing is that the computers, phones and tablets are cheaper today. Using information technologies for educational purposes are, definitely, future. Learning with tablets is more interesting and students can acquire new knowlage through teamwork. Tablets allows students to learn in group and makes easier learning with many diferent multimedia contents. Considering that progress of information technology develops fast students will replace their textbooks with modern ebooks. In fact, tablets will make easier way for learning and student will be able to get their informaton from the internet.

II. INFORMATION TECHNOLOGY IN SCHOOL

In the next few years everyone will use his own laptop or tablet in school. So, why information technology is important for education? At first, students will be more involved in school thematic. Today, activities on social networks are become a normal part of our life. Mostly, students spend their free time on social networks such as Facebook, Twitter Google+, etc. Education material will be shared on these networks and students will still be able to take this material and use for their learning. Using internet, as one of information technologies, every student is able to ask his professor or teacher about education material. If they have any problem with their learning they can ask their professors and get the answer instantly. That is why information technology is very important for education. Teaching with technology is different from teaching in a typical classroom. Teachers must be trained in how to plan, create, and deliver instruction within a technological setting. It requires a different pedagogical approach. If teacher wants to use technology effectively, they need to be trained in using technology and they need to develop a good understanding of it. The most important thing about using information technology in school is that the technology is used to enhance learning. If teachers do not understand how to use technology they need to be trained. Using interactive electronic boards and LCD PowerPoint presentation is the most effective but there are many more applications available for students to be hands-on with their learning and gain deeper knowledge than they could before. Teachers also need to learn about new technologies and ways to integrate them effectively in their classroom. Information technology will, definitely, remake our schooling system. Modern information technology including software, hardware and communication technologies enables this new form of pedagogy to be applied effectively. Sometimes when students were used technology on classes to improve their knowledge, in many cases, it showed good results. Information technologies in schools need to have pedagogical applications of hardware and software that maximize the ability of young people to control information technology and use it creatively. As information technology becomes more useful for education purposes, unfamiliarity with information technology will increasingly limit students educational opportunities. Today we have more different application for education purposes. Those applications are specially designed for different subjects such as math, graphic design, development etc. Application

gives all information about certain domain. Those applications are specially designed. Teachers should know which material is the best for their students. A good thing about using information technologies in schools is that the students are work in group. Every student use material in front of him on his laptop or tablet (*picture 2*). All computers are in network so students in classroom can share education material. Teacher need to keep attention on their classes and using information technology helps them a lot. As the rate of using the Internet rapidly increases in countries across the globe and the investment in technological infrastructure in schools teacher training, and software too, is surely one of the important things in education system.

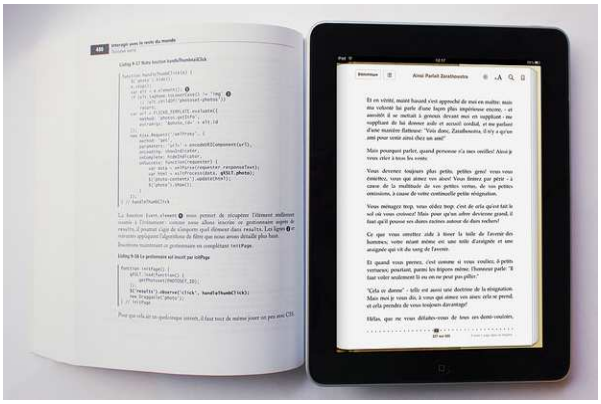
III. WHY USE TABLETS?

Before we use to talk about why is good to use tablets in school we should tell something about tablets. What is tablet? Tablets are highly portable, touch screen, internet enabled hand-held computers. In comparison with laptop tablets have some benefits. Tablets are smaller and they have better price point. But each tablet and operating system will have its own benefits and drawbacks. Using the internet, as source of information will enable schools to make informed decisions about tablets and their use in an educational environment. Proponents of tablets say that they are supported by most teachers and students, are much lighter than print textbooks, and improve standardized test scores. They say tablets can hold hundreds of textbooks, save the environment by lowering the amount of printing, increase student interactivity and creativity, and that digital textbooks are cheaper than print textbooks. This is a good side of using tablets in school but there is another side which is against of tablets in school.[5] Opponents of tablets say that they are expensive, easy to break, and costly/time-consuming to fix. They say that tablets contribute to eyestrain, headaches, and blurred vision, increase the excuses available for students not doing their homework, require costly Wi-Fi networks, and become quickly outdated as new technologies emerge. Tablets are portable and assist inclusion on classes.[4] Students can get instant feedback from their teacher and they can do their exams on tablets. Students can easily work together in online blogs and education-focused social networks. A good thing about doing exams on tablets is that the students cannot cheat. Because they do their exams on specially designed software for that purposes. Teachers have access to their tablets in any time and they can see what student doing. Every tablet has a video camera and gives students more opportunities. If, for some reason student is unable to attend on classes he can follow lectures online via internet. Students can be involved even if they do not attend their lectures and they can ask questions. If the school decides to use tablets, their classrooms should be with digital environment. The research points to how devices and software will enable learning. Some of them are: access to anywhere, anytime learning during and after schools, school and classroom connections and collaboration between students, parents and teachers, intuitive and easy-to-use devices for younger learners and educational applications and digital content such as digital textbooks. Tablets make communication of outside of school easier for students and teachers. All types of applications and programs on tablets can allow students to have better access to homework, study-guides, test reviews, upcoming tests and papers.[3]

IV. SHOULD TABLETS REPLACE TEXTBOOKS?

Thick textbooks can be presented into a simple, easy-to-read ebook while innovative learning apps can be accessed all through tablets. Electronic books can be the same as textbooks and they can be stored on tablets. Advantage of using ebooks is that a single tablet can hold hundreds of textbooks. Tablets also can hold quiz materials and animated illustrations, and students can even highlight text.[3] Today every student can have a library of books on his tablet. Those books are written in electronic form and do not take up much storage space on tablets (*picture 1*). Another important thing about ebooks is that they are cheaper than printed versions of books. Students can share their textbooks and those books can't be damaged so many generations can use them. Ebooks may be easier to find than printed versions. Tablets give users the ability to highlight and edit text and write notes without ruining a textbook for the next user. Tablets have a search function, a backlighting option to read in low light, and a built-in dictionary.[9] Interactive diagrams and videos increase student creativity, motivation, attentiveness, and engagement with classroom materials. An interesting thing about tablets against the textbook is that the print textbooks are heavy while tablets are lighter and can store several books. Students that learn technology skills early in life will be better prepared to pursue relevant careers later in life. Sometimes students are using old books with outdated material but on their tablets ebooks cannot be outdated because they can be updated instantly to get new editions or information. E-textbooks and other files can be stored on "cloud" servers and accessed on any equivalent device. Users can sign into an account on a different device and access all of their information. This is the good thing because students and teachers can access to their files at

anytime. There are thousands of education and tutoring applications on tablets and they are allows teachers to better customize student learning. Possibilities for teaching with tablets may be fun and exciting. On the other side there are some facts about bad things of using tablets. At first, using tablets is more expensive than using print textbooks. People who read print text remember more than those who read digital text. The brain interprets printed and digital text in different ways, and people generally read digital text 20-30% slower than print. Unlike tablets, there is no chance of getting malware, spyware, or having personal information stolen from a print textbook. Print textbooks cannot crash, freeze or get hacked. Another problem is also that many textbooks are not available in digital format or on the specific tablet used by a school. Using tablets is still a new technology which is introducing into a schools system. Because information technology is develops rapidly for next few years tablets will surely replace textbooks. Tablets will be cheaper and more accessible to students.[9]



Picture 1: Differences between textbook and ebook

V. USING TABLETS IN THE CLASSROOM

In fact, tablets are even suitable for young children due to its portable format, fast load-up time and responsive touch screen.[8] In any case, interactive technology makes learning more engaging and memorable. Instead of searching for a dictionary and flicking through the pages to find the definition of a word, students simply can use the dictionary on the tablet making learning five times faster. Other tools like audio and video recorders can contribute a better education, too. For instance, foreign language teachers can use the tablet's audio recording tool to record students speaking in a foreign language, play it back and subsequently advise them on diction and technique. There is also a teacher-to-teacher benefit. Documents can be emailed straight over to colleagues during a meeting, for example.[8] On a student-to-teacher basis, students can engage in a Skype call with their tutor to find out more information about a piece of homework or a particularly tough subject. If a student has forgotten their textbook, the teacher can take a photograph of the relevant study page and send it over. It is very important to mention work in groups.[6] When students in classroom work in group their attention is focused on specific educational content. For example, teachers can use Twitter on their class to promote discussion, and tablets can make it easy for them to quickly type out a tweet to their students using their class hashtag* from anywhere in the room. Also, smart-boards are very useful during the lectures. Smart boards help improve learning outcomes. Combining the smart board with the tablet, the smart board lets you deliver dynamic lessons, write notes in digital ink and save your work – all with the simple touch of a finger. The smart board accepts touch input from a finger, pen or other solid object. Smart Board can be used for teaching, training, conducting meetings, and delivering presentations. Using smart board and tablets in classroom are the best combination when we talk about using information technology in school.[1] Tablets can change dynamic in classroom. Specially designed software for education purposes can make learning more interesting. Sometimes textbooks can be boring but animations and video clips on tablets keeps student attention. There might be some technical problems like battery life of tablets. The length of the battery charge varies widely among tablet devices, and finding enough electrical outlets in the classroom to charge several tablets at once can be difficult. Not all apps or software will work on all tablets.[2] Many applications use software written for special brand of tablets and won't work on another tablets. In this case schools should decide which brand of tablet they will use.[8]

Picture 2: Using tablets on class

*Hastag - a word or phrase preceded by a hash sign (#), used on social media sites such as Twitter to identify messages on a specific topic.

VI. STATISTICS OF USING TABLETS IN SCHOOL

As it is already mentioned above, tablets are increasingly popular in schools around the globe. Here are some statistics about using tablets in school:

- Over 50% of polled believe mobile devices will become an important part of the teaching tool kit in next five years.
- Over 50% needed more technology training.
- Over 90% consider technology an essential or useful teaching tool.
- Over half see their school using the technology "somewhat effectively".
- 62% noted their school did not provide adequate support.

Those statistics are the result of research conducted in schools around the UK. About 62% of polled think that their school did not provide adequate support which is not so good and schools have problem with this. Because information technology is increasingly represented around the globe and develops rapidly so this might be a problem for schools because of adequate support. Schools do not have the financial means to follow the development of new technologies. Over 50% of polled believe mobile devices (such as tablets) will become an important part of the teaching tool kit in next five years which shows how information technology will be represented in schools. Today students use digital technologies for educational purposes a lot. All the necessary information for their study search on the internet and less from printed versions of books. The reason of this is because taking a lot of time when they searching for the information. Information from the internet is obtained instantly and don't take much of their time. [7]

VII. CONCLUSION

As information technology develops learning with tablets will surely be one of the main things in educational system. Information technology will enable easier communication between students and their teachers. Increased development of application for tablets that helps for student learning may be the reason of using tablets for education purposes. The main factor is easy organization and work as a whole on classes. Tablets keep students attention and gives them many opportunities such as access to their education material at anytime and communication outside of the classes. Electronic books may be more represented and textbooks may be replaced but the question is will them be more useful and easier to learn for students. One thing is sure that using tablets and information technologies in schools makes easier work for teachers and learning for students.

REFERENCES

[1] D. Karuović and D.Radosav, "Interakcija čovek računar", Univerzitet u Novom Sadu, Tehnički fakultet "Mihajlo Pupin", 2011, Zrenjanin.

[2] A. Smith, (1996) Accelerated Learning in the Classroom, Stafford: Network Educational Press

[3] Margaret Rock, "The Future of Education: Tablets vs. Textbooks," mobiledia.com, Apr. 4, 2011.

[4] "Tablets in Education: Is Your Network Ready? ", Americas Headquarters,Cisco Systems, Inc.San Jose, CA (2010)

[5] Case study, (2013) Tablets with Google Play for Education Help Hillsborough Township Public Schools Transform Classroom Learning

[6] Ash Curtis on behalf of Hardsoft Computers, „Using Tablets in Education", Oct. 19, 2013.

[7] http://www.teachwithtablets.co.uk/schools/why/the-tablet-climate-in-education/

[8] http://www.howtolearn.com/2013/10/how-tablets-can-be-used-in-education/

[9] http://tablets-textbooks.procon.org/

MIHAILO PUPIN – SCIENTIST, PUBLICIST, HUMANIST, PATRIOT

Informative annexes

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„The knowledge, are the golden ladder by which one goes to heaven; knowledge is the light that illuminates our path in life and lead us into the future life full of eternal glory. "

Olympiada Pupin

Abstract - This paper is an attempt to highlight of the life and work of the famous scientist Mihajlo Pupin Idvorski, his scientific contributions to the world, soothing book „From Immigrant to Inventor", which he devoted to his mother, published 1923rd year, which is one year later awarded the „Pulitzer Prize", as well as his humanity and patriotism. Scientist of world renown, one of the most famous in the history of life has become famous. However, 160 years after his birth, as evidenced by the memorial complex in his hometown Idvor, the place of which he cared so much, it is far away from worrying state that he never forgot.

I. INTRODUCTION

Mihajlo Pupin (1854 - 1935), was born in Idvor, October 9th, in todays Kovačica municipality, in Banat, and went from living on March 12th, far from the homeland, in his second homeland, the United States, where he gained international fame by inventions and teaching. In the big farmers family, father Constantine and his mother Olympics, raised along with Michael, another four sons and five daughters.

He grew up in a carefree gentle pasture plains, near river Tamiš, listening to stories from the past and the sound of the shepherd's pipe, „tuning" of bagpipes, taught knowledge, clear the mind and wisdom of illiterate parents, who taught him the virtues, courage, honesty, love and faith, hard work and work, developing a desire to learn and curious spirit ... from the hearth oral tradition here is Pupin imbued with the glory of the great freedom fighters like Karađorđe, Hajduk Veljko, Garibaldi, who was called the Italian Karađorđe, Marko Kraljević, Lincoln, which for him was „American Prince Marko" because he abolished slavery in America. Pupin said that Baba Batikin, a participant in the Napoleonic wars, who „spoke like a fiddle", his first and best teacher of history.

During education, Pupin crossed a thorny path, which is sprinkled stars, from Idvor through Perlez, Pančevo, Prague, New York, Cambridge, Berlin and New York again. On this journey he never forgot his hometown. All his life he cared about Idvor, its barriers and wells, helped build a legacy and dream of education of generations to come, a better and happier life of his countrymen. With the same love and passion devoted to scientific truth, contributing to the establishment and development aid funds earmarked for education of gifted students and the poor, in the region of former Yugoslavia, fought for the just boundaries of their homeland, the protection of its cultural heritage and traditions.

II. SCIENTIST, JOURNALIST, HUMANIST, PATRIOT

Pupin realized the dreams of his mother. He became famous thanks to his own commitment and abandonment. He was president of the New York Academy of Sciences, became a member of the American Academy of Arts and Sciences, president of the American Institute of Electrical of radio engineers, president of the American Association for the Advancement of Science, member of the French Academy of Sciences, member of the Serbian Academy of Sciences. He

is the founder of NASA, a professor at Columbia University, a personal friend of U.S. President Woodward Wilson, the great benefactor. Gifted pupils and students educated thanks to his money. Painters were calmer dealt with art and scientists, with science.

He left his mark on everything he tackled. Legacy of Mihajlo Pupin in the National Museum in Belgrade contains, among other things, a representative artwork of his friends, one of the largest academic realism artist Mihajilo Predić and Paja Jovanović. Thanks to his influence and connections to Carnegie hall, the University Library Svetozar Markovic" was build. Between the books that he gave at the end of his life to this student institution, there are books that he used during studies in Cambridge and interesting notes on the manner and course of study and his own observations, as well. There are the books that he got from friends, with a dedication to one of the ones that attract the attention the Lagrange tractate "Analytical Mechanics", in which he found the theoretical basis for his most important discovery.

The contribution of Mihajlo Pupin geographical map of his native country is immeasurable and priceless. With his esteemed personality and reputation he was able to convince the world political superiors to draw new boundaries, when they have already been shaped by the Paris Peace Conference 1919th year and agreed by the London Agreement, even in 1915th. According to the agreement of the great powers, he should, after the end of World war, which was on the winning side, to make territorial concessions to Serbia Romania and Bulgaria. To this effect Banat and today in Romania, as well as Pupin's birth place, Idvor.

Pupin was able to explain, first of all thanks to the understanding then of President USA, Thomas Woodrow Wilson, to his home village can not remain outside the borders of his country. In his autobiography, „From pasture to Inventor" Pupin wrote: „My birthplace is Idvor, and this fact shows very little because Idvor not be found on any of the map. It is a small village located near the main road in the Banat, which was then part of Austria-Hungary and is now an important part of the Kingdom of Serbs, Croats and Slovenes. The province at the Peace Conference in Paris, 1919th year, looking for Romanians, but her request was in vain".

Mihajlo Pupin Idvorski was married to an American Sarah Katherine Jackson from New York, with whom he had a daughter Barbara, married Smith. At the cemetery in the Bronx, Woodlawn, a modest gravestones mark the end of the one that marks the grave of his wife, and that wrote Idvorsky Michael Pupin, Born October 4. 1858. Died March 12. 1935.

III. EYES TO READ AND WRITE

Pupin Education began in Serbian language in the elementary school in Idvor continued in German in primary school in Perlez and then in secondary school and civic, in Pancevo, where, in summer, 1872. He graduated fifth grade. Diligently taught from the beginning of schooling and an excellent student received, in 197. received a scholarshipe.

After participating in the Youth Serbian conflict with the German authorities, on the mother's request and with the help of priest Matija Živkovic and teacher of physics and mathematics Simon Kos, he traveled to Prague to continue his secondary school. Scholarships in Pančevo did not regularly arrive, he mourned for homeland and was impressed by the ideas of Pan-Slavism, more than he cared about uninteresting teaching of new teachers. When he was only twenty years old, he decided to try his luck in the United States by boat, via Hamburg, moving into the promise land, the United States.

Beginning his life in the United States, as well as the subsequent period, Mihajlo Pupin vividly describes in his autobiography, „From Immigrant to Inventor", published 1923rd year, that is, a year later, was awarded „Pulitzer Prize", was published in Serbian in 1929 ., in Matica Serbian from Novi Sad, in the translation of Milan Jevtic, titled „The pastures to Inventor". The book was dedicated to his mother, whose advice he never forgot: „My child, if you want to come into the world, about which you've heard so much on our rural party, you have to have another pair of eyes - the eyes to read and write. In the world there are many things which you can not learn if you do not know how to read and write. Knowledge, are the golden ladder by which one goes to heaven; knowledge is the light that illuminates our path in life and lead us into the future life full of eternal glory". Later, the Pupin announced two more books, „The New Reformation: the physical, the spiritual reality" and "Romance of the machine".

Painstakingly in America worked as a laborer, he performed field work, was a carrier of coal, a factory worker toast in New York while attending night school of Cupper. He became assistant clerk successfully, in 1879, and passed the entrance exam at Columbia College in New York. At Columbia he became a professor in 1889 and today Department of Physics has name Pupin and there are his bust, in the front of classroom where he taught, work of Ivan Mestrovic. This is the most important Museum.

As an excellent student, is exempt from tuition fees and at the end of the first year received cash prizes of Greek mathematics and a livelihood gained not only the income of physical labor, but also teaching students. Education in the United States he ended in 1883rd and obtain a first academic degree of Bachelor of Arts, just a day before he received American citizenship.

He received his doctorate in Berlin, with the theme „Osmotic pressure and its relationship to free energy", where he studied from 1885th to in 1889th, and taught since then famous professors and scientists Hermann von Helmholtz and Kirchhoff. Previously, he completed studies of mathematics and physics at Cambridge University in the UK, since 1983rd to 1885th as excellent student, wit scholarship.

Forty years later, in 1889. until 1929. Mihajlo Pupin has been work as a teacher of physical mathematics professor in the Department of Electrical Engineering at Columbia at Columbia University in New York where he taught theoretical electrical engineering from in 1901. When he was forty years old, he became a full professor.

The results of his rich scientific activity are 24 inventions, mainly in the field of telephony, telegraphy and radio, for which he gained fame during his lifetime, many prizes, awards and honors. He was the first in America who constructed X-ray machine very quickly after Rentgen scientist detected X-rays. The invention process and elements that enable the transmission of electrical print and speech signals over long distances which called „pupinisation" or „Pupin coils" celebrates the joining and possessions, which funded his charitable activities.„ Pupinisation" is a special procedure in which the wired telephony conductors in places added by self-induction „Pupin coil", and achieved significantly higher self-induction, and prevents the harmful effect that is due to the length of the cable.

Studying electrical resonance, he patented in 1892. Electric circuit, and sold the company Marconi. When the scientific community has been a conflict between supporters of alternating and direct current, he was on the Tesla's side.

During the Second World War Pupin and his associates were research to develop a system for detecting submarines and telephone communications in air traffic.

Eight years, from 1912th until 1920th Pupin served as honorary consul to the United States. He personally sent a memorandum to Wilson the president of the United States, April 19, 1919th year, in which he explained the historical and ethnic design feature border of Dalmatia, Slovenia, Istria, Banat, Medjumurje, Baranja and Macedonia. Just three days later, President Wilson said he did not recognize the Treaty of London ally with Italy.

With a biography of a famous scientist, presented on the website of Columbia University has written: „The great scientists in the world have never discovered how to make grass into milk." More about Pupin can read the Encyclopedia of Colombia.

IV. PUPIN HAS CHANGED THE WORLD

In the year in which be marks the 160th anniversary of Birth the birth of Mihajlo Pupin, apparent are attempts, from Belgrade to Pančevo, Zrenjanin and Idvor, to approach the world and his former compatriots, the life and work of famous scientists. The results are modest and October is approaching.

Research a few years ago for the purpose of a master's thesis, „The people who changed the world - Nikola Tesla, Mihajlo Pupin, Milutin Milanković, Mileva Maric Einstein" at the Technical Faculty „Mihajlo Pupin" indicates unacceptable modestly know about our famous scholars among students High School in Zrenjanin. Meanwhile, moving in a positive direction when it comes to biographies of Tesla and Pupin, barely noticeable, but it is evident that our history and culture, until the Pupin in

2014th. Others in isolated circles and the younger generation does not know about it almost anything .

Idvor is an example of negligence. In this 2014th, when we mark the 160th of his birth certificate it is Zrenjanin too. Pupin is an honorary citizen of Zrenjanin. However, a building that was once bought and which is registered in his name and dedicated to the education of young people, has not been brought intentions. Initiative of the year Pupin, to realize the plan of the great scientist is - only idea.

Is it Idvor enough done to achieve Pupin dreams? True, renewed his birthplace, dilapidated from years of neglect, the building of his elementary school in 1846, Now a museum, the Church of the Annunciation of the Virgin, in which he was baptized, and in which he spoke so beautifully inspired by his mother's advice, about Saint Sava, when he impressed the villagers, teachers and pupils, the National House, built in order to become the center of education of his countrymen in the field of agriculture, all crying out for renewal!

Bust Mihajlo Pupin, work of his friend Ivan Mestrovic feels out of time, with standing years and contributes to the impression that there is still hope for the memorial complex. At the same time, the school building is unacceptable ignored, modest setting collapses and revitalize it is necessary. Iconostasis in the church is darkened, as well. Is it the kind of National Home Education Center Pupin what is pictured although it coming talented students? The man who talks about Pupin, with dedication and without charge, a former teacher.

The bright side of this sad story is the fact that the memorial complex of Mihajlo Pupin open to the public. Students camps are sometimes fiil with their energy a, and optimism, by coming a temporary exhibitions, and organize meetings where scientists trying to tell their colleagues, Idvor and the world something new about life and work of the great scientists. In line with modern creativity the Virtual Museum of „Mihajlo Pupin" in Belgrade and Pancevo. And guidelines for Idvor contributions „discovery“ Pupin hometown and have not yet caught the eye of „destroyers“.

V. INSTEAD OF A CONCLUSION

The lack of money to which the Serbian accustomed, as a natural consequence of the crisis, but also the distribution of money by the standards of political power, Idvor not alone instance of neglect and indifference. But, as indicated by the Committee Chairperson of Culture and Information of the National Assembly of the Republic of Serbia Vesna Marjanovic „Idvor is an example of ignorance and indifference of the state decision-making.” And it is obvious that this place survives thanks to the efforts of local communities, individuals and certain scientific circles. And it would naturally be an oasis of science, especially for the young and talented, curious gathering place for students and a place where history is taught directly, past studies on the abundance of valuable facts and identity introduces originally.

Those who think that any country that is „serious concerns for his history of this place on a cultural and tourist center” are right. But the question is what is serious, especially in Serbia, perhaps, responsible, whatever that means, if they contribute to the improvement. Pupin was truly born in Idvor. He is truly one of the world's greatest scientists. Nikola Tesla, Milutin Milanković, Mileva Maric Einstein are our proud too. Those are pearls of pride and for the presentation of a world without masks and veil. Those are representation of own country and people, with pride and joy, with the faith that we have our own heroes in science, culture and life.

It's been four years since Serbia has ratified the Framework Convention of the Council of Europe Convention on the Value of Cultural Heritage for Society - FARO convention. This is a very important instrument of protection whose implementation the Government of the Republic of Serbia does not care. A Convention requires signatories to provide a legal framework that enables the realization of the rights of citizens to participate in the preservation and understanding of their cultural heritage.

Serbia still does not have a law on the protection of cultural heritage. The Convention also calls to adopt strategists for cultural development. We have not the national strategy. Until we move away from the start, one would expect the state to pay greater attention to the protection of cultural heritage, keeping in mind the economic and social value of the investment. It also includes tax incentives, soft loans, greater support for civil society, universities and schools involved in a project whose realization contributes to the preservation and understanding of their own cultural heritage.

Serbia's bid to join the European Union opened the door to European funds. Between Pupin desire resting on valuable possessions and European treasury needed to build bridges of trust and responsibility that will fertilize the treasure of cultural heritage that is left to future generations for the future to come. Virtual Museum of Mihajlo Pupin in Idvor and storks in flocks on gentle place of Banat, could be a hint of the changes that will shed the light on the great man, scientists, humanist and patriots, not only to us, but also to the world.

REFERENCES

[1] Abel, G., Singer, B. Science and the Paranormal. (1980), Simon and Schuster, New York
[2] Bokšan, S. (1951), Mihajlo Pupin, Matica Srbian, Novi Sad
[3] Bjeletić , D. (1998), Letter of the greats, UIKJ, Beograd
[4] Bokšan, S. (1951), Mihajlo Pupin, Matica Serbian, Novi Sad
[5] Ćurčin, M. (1935), Death of Mihajlo Pupin, New Europe“, Zagreb
[6] Encyclopedia Americana, Americana C., New York, 1973
[7] Erdeljanović, J. (1926), Serbs in Banat, SANU, Beograd
[8] Gledić, V. (1991), Greats of our science, Stefan Graf, Cetinje
[9] Jajić, B. (2007), Nikola Tesla i Mihajlo Pupin – example for young scientists today, seminar paper, TF Mihajlo Pupin, Zrenjanin
[10] Jajic, B. (2007), People who changed the world – Nikola Tesla, Mihajlo Pupin, Milutin Milanković, Mileva Marić Anštajn, master of Science Thesis, TF Mihajlo Pupin, Zrenjanin
[11] Jevtić M. (1916), Small Serbian, Serbian diaspora in America, New York
[12] Jireček, K. (1978), History of the Serbs, Letter ljubve, Belgrade
[13] Jovanović, M. (1998), Uroš Predić-monograph, Matica Serbian, Novi Sad
[14] Kovaček, B. (2004), Unknown letters Mihajlo Pupin and archival materials to bond with them, Matica Serbian, Novi Sad,

2004.

[15] The Chronicle of Matica Serbian, (1975), Matica Serbian, Novi Sad

[16] Lomas, R. (2000), The man who invented the 20th century, DN Centar, Belgrade

[17] Marić, S. (1971), About invention Pupin coils, Cultural Center, Novi Sad

[18] Marjanović, V. Culture, art, science, politics, June 14, 2014 Belgrade

[19] Miljanić, P. (1952), The theoretical principles of electrical engineering, scientific book, Belgrade

[20] Popović, B. (1976), Fundamentals of Electricak Engineering, Building Book, Belgrade

[21] Popović, V. (1951), Mihajlo Pupin, Technical books, Belgrade

[22] Pupin, M. (1926), From immigrant to inventor, Matica Serbian, Novi Sad

[23] Pupin, M. (1927), The New Reformation, Scriber's Sons, New York

[24] Seifer, M. Wizard (1999), The Life and Times of Nikola Tesla, Biography of a Genius, Carol Publishing Group (2)

[25] Pupin Idvorski, M. (2013), From immigrant to inventor, Fond Mladen Selak – The young inventor, Belgrade

[26] Pupin and his fight for truth, Special supplement, Daily newspaper Politika, October 9, 2013, Belgrade

[27] Tasić M. (2002), Serbian greats of science, Bookland, Beograd.

[28] Todorov, S. (2004), Idvor-monograph, Pancevo

[29] Tomašević, Đ.V. (2000), Portraits of Serbian Achievers, "Serbian Literary Company", Toronto

[30] Vajthed, A. N. (1976), Science and the modern world, "Nolit", Belgrade

[31] Great discoveries and inventions (1988), BIGZ, Belgrade

[32] Vidosavljevic, D. South Banat, Dimes, Belgrade

[33] Viher, D. (1935), In memory of Mihajlo Pupin, the high technology and Yugoslavs, Maribor Večerník "Mornings, Maribor

[34] Vuić V. P, Pupin among Serbs in America (1935), Businessman, Zagreb

[35] Šajn, Ž., Mihajlo Pupin - Roads of diplomacy