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APPLICATION OF INFORMATION AND COMMUNICATIONS TECHNOLOGY AS A SUPPORT TO STUDENT MOTIVATION IN TEACHING MATHEMATICS

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SUMMARY

The rapid development of Information and Communications Technology (ICT) has caused many changes in society and, consequently, in the education process. The integration of ICT into the teaching process transforms traditional teaching into new teaching that is ready to respond to the demands and needs of a contemporary learner in order to increase the quality of education: better student motivation, use of different sources of knowledge, development of functional abilities of students, and the goal of everything is to increase the learning outcomes. In this paper, an assessment of the motivation and achievement of two groups of students were carried out. The control group and experimental group attended classes in a traditional way and by using ICT, respectively. The results of the research have highlighted the huge advantages of introducing ICT into the teaching process.

KEYWORDS: *teaching process, ICT, mathematics, motivation*

PRIMENA INFORMACIONE I KOMUNIKACIONE TEHNOLOGIJE KAO PODRŠKA MOTIVACIJI UČENIKA U NASTAVI MATEMATIKE

SAŽETAK

Brzi razvoj informaciono-komunikacionih tehnologija (IKT) izazvao je mnoge promene u društvu, a samim tim i u obrazovnom procesu. Integracija IKT-a u nastavni proces transformiše tradicionalnu nastavu u novu nastavu koja je spremna da odgovori na zahteve i potrebe savremenog učenika u cilju povećanja kvaliteta obrazovanja: bolja motivacija učenika, korišćenje različitih izvora znanja, razvoj znanja. funkcionalne sposobnosti učenika, a cilj svega je povećanje ishoda učenja. U ovom radu izvršena je procena motivacije i postignuća dve grupe učenika. Kontrolna grupa i eksperimentalna grupa su pohađale nastavu na tradicionalan način i korišćenjem IKT-a. Rezultati istraživanja su istakli ogromne prednosti uvođenja IKT u nastavni proces.

KLJUČNE REČI*: nastavni proces, IKT, matematika, motivacija*

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INTRODUCTION

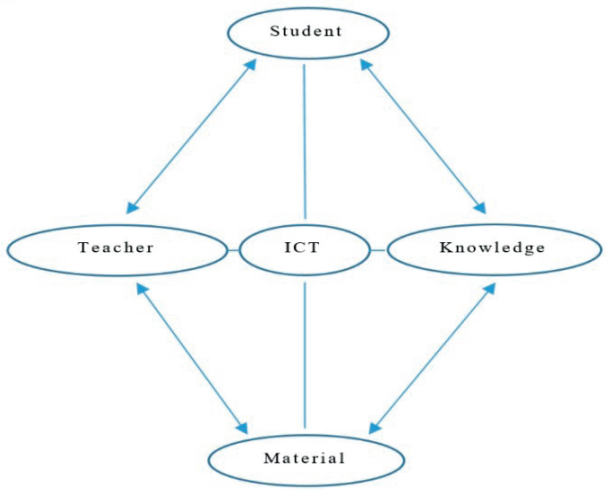
Introducing innovations is one of the important developmental aspects of the teaching process. Positive changes must be made in teaching. In recent years, especially during the period of transition, the activities on the introduction of novelties into the teaching process have been intensified. Lee and Hollebrands (2008) ststed that in addition to major changes in the education system, certain changes are introduced in the organization of teaching through new teaching aids, modern forms of teaching work and innovative teaching methods. The introduction of information and communications technology (ICT) into the educational process is an integral part of school education. Садыкова (2017) found that the use of ICT in all classes, including mathematics classes, allows the teacher not only to transform traditional forms of learning, but also to solve various problems because it significantly increases the visibility of teaching, facilitates control of student knowledge, expands interest in the subject, develops students' cognitive activities, respects individual abilities of students.

In the modern implementation of the teaching process, information and communications technology represents, in a narrow sense, an indispensable teaching tool which provides support to the teachers in the traditional way of learning. According to the Denic and others (2017) in a wider sense, ICT represents a new methodical approach through different ways of realization of learning and teaching.

According to the Clark-Wilson and others (2014) current education is required and expected to "produce" a highly educated person who is able to respond to the demands and follow the development trends of modern society.

The relationship between students, teachers and teaching content is enriched by the knowledge component. The well-known didactic triangle gets its fourth component and changes to a new form, i.e. didactic quadrilateral. ICT represents the link between the components of the didactic quadrilateral (Figure 1).

Figure 1: Didactic quadrilateral



The characteristics of the innovative, modern teaching of mathematics are the conditions in which the student becomes the subject of the teaching process, and it is essentially oriented towards the development of mental, especially thinking abilities and the entire personality of the student. Gavrilovic and others (2016) stated that mathematical way of thinking should be developed in a targeted manner throughout schooling, because it is becoming increasingly necessary in the world influenced by new technologies. A student's development becomes the main goal not only of a teacher but also of the student himself. When a student feels the need and ability for improvement and self-development, then the teaching process acquires a clearly defined purpose for him, that purpose being his own comprehensive development. Nadrljanski and Soleša (2002) stated that the students have a strong motivation, so the teacher has the role of organizer of successful cooperation, consultant and manager of the learning and development process.

SUBJECT, OBJECTIVE AND HYPOTHESES

The subject of this research is the teaching process of mathematics carried out in two different ways: the traditional way and the modern way using ICT. The experiences of many mathematics teachers have shown that the biggest problem the students face is acquiring the content of this subject. Motivation is a very strong factor that can have an influence on overcoming this problem. This is where the idea came from to determine which way of teaching can influence the level of motivation for learning mathematics. The goal of this research is to make a contribution to the establishment of a positive attitude of students towards mathematics by encouraging motivation in order to acquire new knowledge, as well as to contribute to the development of mathematics teaching methodology.

Based on research of the Nikolić and others (2019) and Gavrilović and others (2018) the following hypotheses can be formulated:

- The use of ICT in the implementation of mathematics units directly affects better motivation of students
- Students who are more motivated to learn mathematics achieve better results.

DESCRIPTION OF RESEARCH AND METHODOLOGY

A total number of six classes from three schools and three cities (Technical School Trstenik, Technical School Mladenovac, Sixth Belgrade High School) took part in this research. There was an experimental group and a control group at each school. All the students were second-graders. Students of the Technical School Trstenik, on the principle of active teaching "from station to station", processed a teaching unit in two school classes: *Measurement of angle, trigonometric circle* from the teaching topic: *Trigonometry*. The students adopted new knowledge in three "stations". At the first "station" they listened to the classroom in a traditional way, PPT presentations were used in the second "station" and simulations of mathematical software were used at the third "station". After that, the students independently designed the school classes with the same teaching unit and held a lecture to the students of the other two schools through Skype. Control classes of the same grade in all three schools attended classes in a traditional way. After that, the teachers tested

and compared knowledge of both control and experimental groups. Finally, a survey was conducted among students.

The research involved 86 students of the experimental group and 85 students of the control group. It is also important to note that all teaching classes were open for teachers so 24 teachers attended these classes. Three teachers realized the classes.

The research used methods of analysis and synthesis, as well as a comparative method for theoretical conclusions. A survey and testing were used to collect data. The data collected were statistically processed in MS Excel.

RESULTS AND DISCUSSION

During two school classes, the students of the first experimental group processed the same teaching topic in different ways (the traditional way and the contemporary one). Based on their experience, through discussion, they prepared a new lesson to share their knowledge with peers from another city through a video conference. The video conference was realized through Skype.

Since the acquired knowledge was presented to the peers of another school via a video link, the students had to prepare the lecture for an unknown audience, which made the task more difficult, but it was even more challenging. Moreover, one of the web tools used daily (i.e. Skype) also received an educational dimension.

In the following class, a knowledge test was conducted on the control and experimental groups through a fifteen-minute test. The obtained results are shown in Table 1:

	failing grade	**passing grade**	**good**	**very good**	**excellent**
control group	18%	40%	23%	10%	9%
experimental group	3%	20%	40%	22%	15%

Table 1: Results of the knowledge test

Therefore, the test results indicate that 97% of the students of the experimental groups met the criteria of the basic level of knowledge, 40% met the intermediate level, and 15% met the highest level. It is particularly noteworthy that even 18% of the students of the control group failed to meet the basic level of knowledge. It is also important to emphasize that, in terms of percentage, the number of students of the control group who mastered the satisfactory level is the same as the number of students of the experimental group who mastered the intermediate level. Fifteen percent of the students in the experimental group achieved the highest level of knowledge which is 6% more than in the control group.

The survey, which was conducted among students in the experimental and control groups, showed that a large percentage of students in both groups have access to computers and mobile phones. The results of the survey are presented in Figure 2 which shows that 94-95% of students possess mobile phones, 87-88% of them have computers, and internet access is available to 68-73% of students.

Figure 2: Availability of ICT

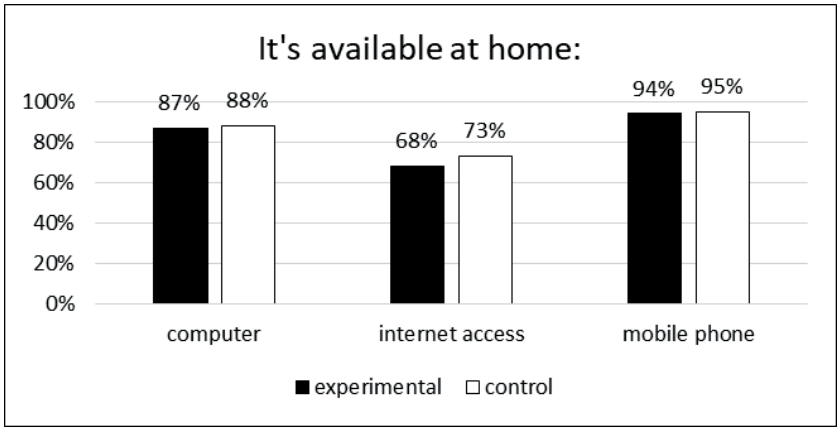
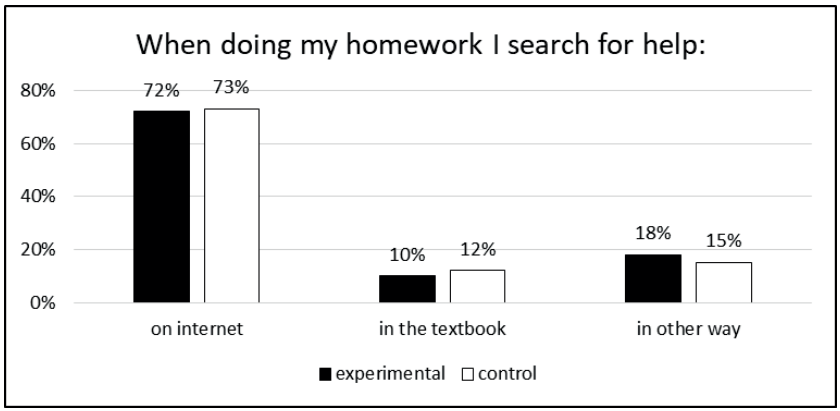


Figure 3 presents the results of the student survey related to homework help. It turned out that students prefer studying by searching the internet, and that they rarely use textbooks.

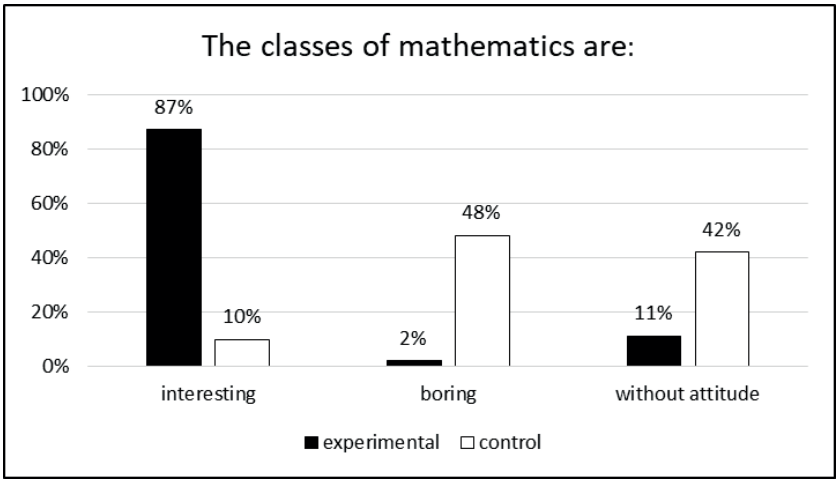


Approximately ¾ of the students search for help on the internet when doing their homework.

Figure 3: Help at doing homework

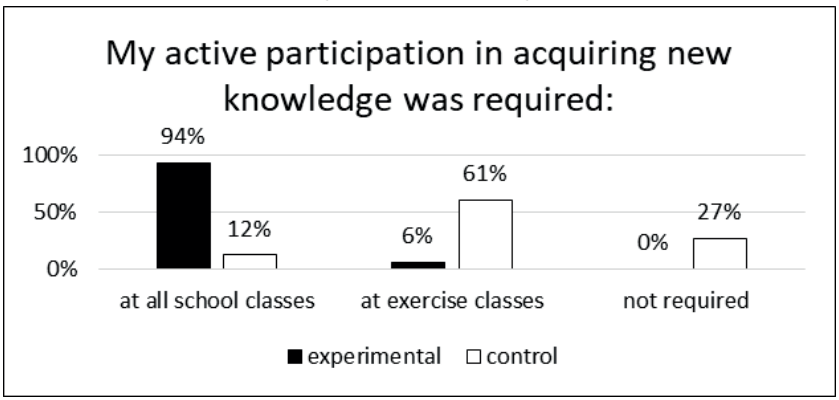
Given that the vast majority of students have access to computers, the internet and mobile phones, they are familiar with the daily presence of ICT. For this reason, the results of the survey in which they expressed their opinion about the previous three mathematics lessons are not unexpected. The results of the survey are shown in Figure 4. Namely, 87% of the students from the experimental group found the lessons interesting. This is not the case with the students who learned the lessons in the traditional way: 48% of them were bored while 42% of them had no specific opinion.

Figure 4: The attitude of the students about the school classes of mathematics



According to the students' assessment, even 94% of the students declared that teaching, which is organized on the principles of active teaching and with the help of ICT, required their engagement during all lessons. The students of the control group actively participated in the practice classes, which was confirmed by 61% of the students, while 27% of them believe that they were not required to actively participate in the teaching process. These results are presented in Figure 5.

Figure 5: Active teaching



Motive is one of the most important factors for the successful process of acquiring knowledge, especially in the subject of Mathematics, which is extremely complex and difficult for students. The results of the survey, presented in Figure 6, show that the introduction of ICT in teaching strengthens the motivation of students. Even 95% of the students from the experimental group declared that this way of teaching motivates them for further work. Only 10% of the students from the control group said that they were motivated to

learn in classes that are conducted in a traditional way, while even 48% of students were not motivated to learn at all.

Figure 6: Motivation

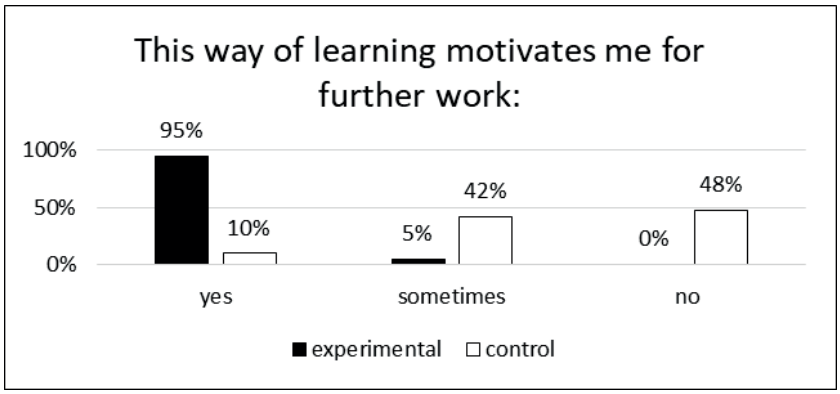
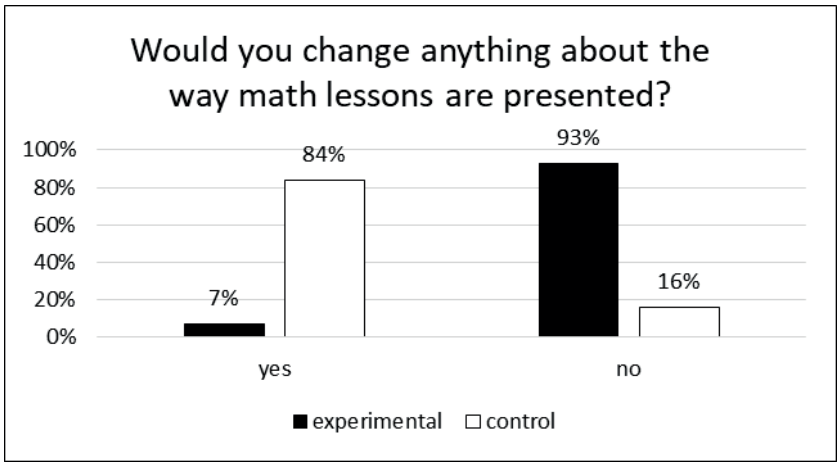


Figure 7 shows the attitude of the students about the teaching method. The students from the experimental group concluded that they would not change anything in the way the class was conducted - 84% said that, while 93% of the students from the control group believe that the way of conducting the class should be changed.

Figure 7: The attitude of students about the teaching method



As expected, both hypotheses were proven by this research. In general, the students who participated in the experimental group found it interesting in the mathematics classes based on active teaching, where all students were involved in learning new content, where teamwork came to the fore and triggered many other abilities of the students, which resulted in a strong motive to research as much as possible for the purpose of self-learning,

but also teaching peers from other schools. As a consequence, better results were achieved on the knowledge test.

These results are confirmed by the theoretical researches of numerous, well-known foreign authors such as Chaney-Cullen and Duffy (1999), Muller and others (2006), Hwanga and others (2007), as well as Forgasz (2006), which, according to the above results, showed the undoubted advantages of applying ICT in teaching regarding the quality of acquired and adopted knowledge, motivation of students to learn and improvement of the entire teaching process in general.

By evaluating their own work and the work of other students, students develop critical thinking. They process the given lesson, adopt new knowledge, make decisions. They work on building common criteria for evaluation, but they also build their own internal criteria. Students learn from each other, they help each other, provide ideas, critically evaluate their own and others' lectures, and thus develop excellent communication and collaboration, the skills necessary for the 21st century. Therefore, the student-student interaction intensifies.

The processing of teaching units via ICT is based on the research work of students, which changes the traditional role of the teacher, i.e. instead of "transmitting" knowledge, the teacher supports, encourages, clarifies, instructs, gives students the freedom to independently build their own knowledge. Students are the creators of their own education, the teacher's role is to provide initial sources of information and a stimulating environment, while students choose the method, way and speed of acquiring the material.

CONCLUSION

Modern teaching of mathematics must follow world trends. The use of information communications technology must become a teaching practice. Traditional teaching is passive, the student is often just an observer while the teacher is the main subject of the teaching process. In ICT teaching both the teacher and student change their roles. While the students are an active participant in the education process, the teacher is the one who helps them by leading them through the teaching process. Such educational technology has produced a positive attitude among students. The introduction of novelties in teaching motivates students and encourages them to take active participation in the process of acquiring knowledge, which results in better achievements and higher motivation for further work. In this way, we have feedback as a definite way to achieve success. Mathematics teaching using ICT motivates students to learn and achieve better results.

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