UDK: 004.853:37.037   Professional paper

The effects of digital dialogue in teaching programming

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

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

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

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

1. INTRODUCTION

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

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

This paper presents the display of research that was conducted among the junior vocational

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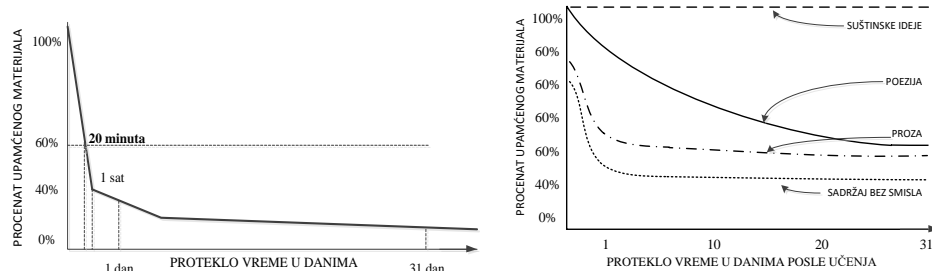

Figure 1 *Ebbinghaus's Forgetting Curve*

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

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

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

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

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

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

2. GENERAL PROPERTIES OF DIGITAL DIALOGUE IN TEACHING

Considerable defects of traditional teaching are still present, even with more and more observable utilization of modern Information and Communication Technologies (ICT) and the practice of hybrid learning: the hindered permanent record of the student presence, attention deficit, lack of interaction and, frequently, the insufficient motivation in subjects. Application of the concept of digital dialogue provides the hybrid learning system with additional advantages - in fact, it elevates the degree of interaction between the subjects and at the same time forms a digital record of the entire teaching process.
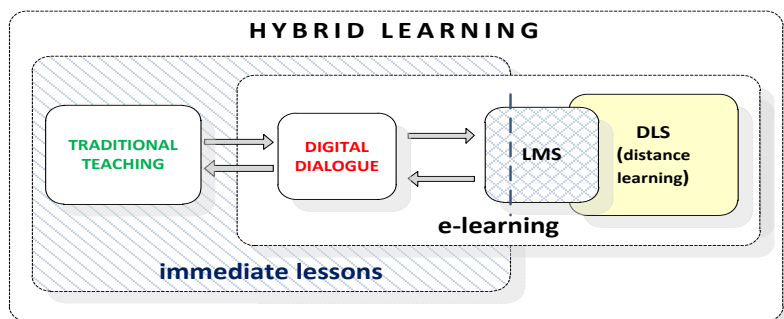
Figure 2 *The position of the digital dialogue in the hybrid learning system*

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

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

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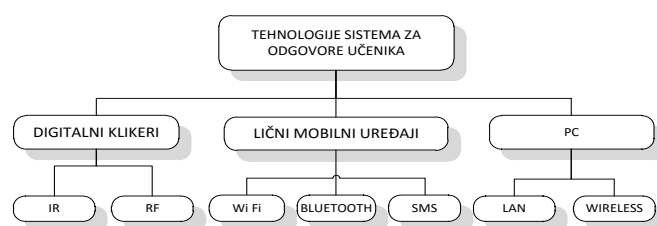

Figure 4 *Student's response system technology in digital dialogue*

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

3. SPECIFICITIES OF TEACHING PROGRAMMING

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

4. TESTING THE EFFECTS OF THE APPLICATION OF DIGITAL DIALOGUE

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

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

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

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

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

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

Table 1 - *Conducted Classes Data*

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

5. RESULTS AND DISCUSSION

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

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

TEST NO.	AVERAGE NO. OF POINTS		DIFFERENCE (NO. OF POINTS)	p		COMMENT
	TE - group	TK - group				
1	62,667	49,852	12,815	0,007	p<0,05	There is a significant difference
2	69,926	54,704	15,222	0,048	p<0,05	There is a significant difference

Based on the results in the table, we can observe that there is a significant difference in the score between the students in the TE and TK group, respectively. Experimental group students have, on average, scored better. Seeing as how the numbers achieved in the test are p= 0,007; p<0,05, meaning p= 0,048; p<0,05, we can accept, with a 95% certainty, the starting hypothesis and we conclude that applying digital dialogue in class has provided a statistically significant support to the students in terms of more effective and sensible remembering the content of direct teaching. In addition, the test has shown that applying digital dialogue can affect the quality of remembering the material and the level of reproducing presented material immediately after the class significantly.

Multiple repetition of the tests would definitely provide a clearer picture regarding the lengths the application of digital dialogue can reach, but the tests were not conducted in a laboratory setting, but rather with real students in real classes , according to the official curriculum. A larger number of frequent tests using same classes could endanger successful completion of the curriculum. However, future test results are expected to confirm the results gained so far and undeniably recommend digital dialogue as part on re-engineering hybrid teaching.

6. CONCLUSION

Based on the displayed results we can conclude that the basic goal of the research has been achieved - there was a contribution to overecoming uncertainties regarding the available knowledge of practical possibilities of implementing digital dialogue inot the educational process and its possible application advantages in direct teaching. The test was not concerned with acquiring information regarding the students knowlegde of programming, only with the degree and quality of reproducing key data from the immediately presented lecture. Ergo, it is about the effects of digital dialogue on the students remembering the content of the class more effectively and sensibly. Only osme of the possibilities of the

digital dialogue were used in the experiment, such as short-question answers, voting, commentary, and quiz. Digital dialogue displays its fullest potential while being applied in regular, direct teaching, with large groups of students with using mutliple activities from its arsenal. Seeing as how the time of mobile advancement is still coming, we can say that we are yet to see the period of intensive utilisation of digital dialogue in hybrid learning, because the achievable technical and safety demands for the digital dialogue enable most of high-schools to start application today, within its means, and use the examples of fine practice to contribute to the quality of direct teaching.

REFERENCES

[1] Kárpáti, A., Török, B., Szirmai, A. (2008). *E-Teaching Readiness Of Teachers The Effects Of Personality Traits And Ict Skills On Changes In Teaching Style Of Xperienced Educators*. EDEN Open Classroom. Paris.

[2] Ranđelović, M., Pešić, A. (2012). *Kako praktično prilagoditi računarsku učionicu za različite nastavne programe.* Katalog programa stalnog stručnog usavršavanja nastavnika, vaspitača i stručnih saradnika. Akreditacija broj: 253. ZOUV. Belgrade.

[3] Robins, A., Ronutree, J., Rountree, N. (2003). *Learning and Teaching Programming– A Review and Discussion.* Computer Sience Education. Vol 13, No 2. pp. 137-172.

[4] McDaniel, A., Anderson, J., Derbish, M., Morrisette, N. (2007). Testing the testing effect in the classroom. European Journal of Cognitive Psychology. Volume 19. Issue 4-5. pp. 494-513.

[5] Ranđelović, M., Janev, A., Milošević, D., Paunović, L. (2015). *Digitalni dijalog kao reinženjering u interaktivnoj nastavi.* Nacionalna konferencija sa međunarodnim učešćem - Reinženjering poslovnih procesa u obrazovanju. Čačak. Zbornik radova, 19-36.

[6] Janev, A., Ranđelović, M., Stioimenov, L., Milentijević, I. (2012). *Hardware Solutions Regarding a System for Electronic Testing of Students*, XI International SAUM Conference , Niš.

[7] Ranđelović, M., Janev, A. (2013). *Mobilni telefon i Internet kao edukativna sredstva u takmičenju „Tesla Info Kup“.* Nacionalna konferencija sa međunarodnim učešćem - Reinženjering poslovnih procesa u obrazovanju. Čačak. Zbornik radova, 281-288.

[8] Janev, A., Ranđelović, M. (2013). *Ispitivanja o stepenu korišćenja digitalnih klikera kao uređaja za interaktivno praćenje napredovanja znanja učenika u Makedoniji.* Nacionalna konferencija sa međunarodnim učešćem - Reinženjering poslovnih procesa u obrazovanju. Čačak. Zbornik radova, 188-194.

[9] Saeli, M., Perrenet, J., Jchems, W., Zwaneveld, B. (2011). *Teaching Programming in Secondary School: A Pedagogical Content Knowledge Perspective*. Informatics in Education. Vol. 10, No. 1, 73–88.

[10] Veljović, A. (2010). *Programiranje za menadžere*. Fakultet za inženjerski menadžment, Belgrade.