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DIGITAL EDUCATIONAL RESOURCES IN SERVICE OF INTERACTIVE TEACHING METHODS

DIGITALIZIRANA NASTAVNA SREDSTVA U FUNKCIJI INTERAKTIVNIH NASTAVNIH METODA

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Abstract

New teaching strategies include significant use of computers but the effectiveness of those methods based on the use of computers is low if the inclusion of interactive teaching methods and students' intellectual engagement is ignored. Digital resources are not the ones that affect the learning outcomes but teaching methods that are accompanied by the implementation of various educational technologies. If we just change the media which presents teaching content and thereby keep the same teaching methods as before, the effectiveness of teaching remains the same. Digital resources differ with respect to the potential of creating learning situations. Some digital resources facilitate the implementation of interactive teaching to a greater extent from others. A survey was conducted in Croatia in order to test the effectiveness of one of the strategies involving digital resources. The results indicate that application of appropriate digital resources has a positive effect on learning and acquiring the concepts in physics. The results are an indicator for the research that follows which will examine the teaching method that involves interaction at all stages of teaching process and highlights the use of digital resources as one of the tools for the realization of interactivity and student's intellectual activity enlargement.

Keywords: *interactive teaching methods, student's intellectual engagement, digital resources, effectiveness of digital resources*

Sažetak

Mnoge od novih nastavnih strategija uključuju značajnu uporabu računala no treba naglasiti da je učinkovitost samih metoda baziranih na uporabi računala niska ukoliko se zanemari uključivanje interaktivnih nastavnih metoda kao i intelektualna angažiranost učenika. Nisu digitalni materijali ti koji utječu na krajnje ishode učenja, nego su to nastavne metode koje prate primjenu različitih nastavnih tehnologija. Drugim riječima, promijenimo li samo medije putem kojih prezentiramo nastavne sadržaje, a zadržimo pri tome iste nastavne metode kao i ranije, efikasnost nastave ostaje ista. Digitalni materijali se međusobno razlikuju obzirom na potencijal stvaranja nastavnih situacija. Neki digitalni materijali u većoj mjeri olakšavaju realizaciju interaktivne nastave od drugih. U svrhu ispitivanja učinkovitosti jedne od strategija koja uključuje računalo i digitalne materijale provedeno je testno ispitivanje u Republici Hrvatskoj. Rezultati ispitivanja upućuju na zaključak kako primjena odgovarajućih digitalnih materijala ima pozitivan učinak na učenje i savladavanje koncepata iz fizike. Također, rezultati istraživanja indikator su za istraživanje koje slijedi, a kojim će se ispitati nastavna metoda koja uključuje interaktivnost u svim fazama nastavnog procesa i ističe korištenje digitalnih materijala kao jednog od alata za ostvarivanje interaktivnosti i povećanja učenikove intelektualne aktivnosti.

Ključne riječi: *interaktivne nastavne metode, intelektualna angažiranost učenika, digitalni materijali, učinkovitost digitalnih materijala*

1. Introduction

1. *Uvod*

Contemporary state od science has changed throughout history within three phases [1]: institutionalization, professionalization and socialization. During these phases there has been the introduction of new terms such as natural science and natural scientist instead of philosophy of nature and philosopher of nature as well as redefining the role of teaching science to be a function not only of cultural transmission but also social reconstruction.[2]

Following the above changes in recent decades, a number of studies in the filed of educational contructivism is carried out. Constructivistic ideas about learning and teaching have their starting point in the ideas of Swiss psychologist J. Piaget while the constructivistic view of science is based on the ideas of philosophers of science like Popper, Kuhn, Laktos, Feyerabend. The fundamental is the assumption of Piaget's genetic epistemology that there is an analogy between the development of the logical organization of the corpus of knowledge within a discipline (Physics) and the corresponding development of psychological processes in the development of person. By including the history and philosophy of Physics, the epistemological aspects of Physics can naturally get closer to students.[3] Bigger introduction of history and philosophy of Physics in the classroom contributes to the humanization of teaching science by encouraging social perspective and enhanced interaction between the natural sciences, social changes and technology.

The starting point for the individualization of teaching is based on the fact that students in the class do not make a set of equivalent observer. The modern pedagogy provided the answer to the theoretical settings of the famous educators and psychologists (Jean Piaget, Leo Vygotski, and Roger Schank) who emphasized the individualization of teaching, thus creating the framework for self-regulated learning. Self-regulated learning is self-guiding process by which learners transform their mental abilities into learning skills.[4] In the self-regulated learning the student's task is to become an active participant [5] prepared for the revolutionary conceptual change based on the analogy of a paradigm shift in the philosophy of science [6] i.e. the process of accommodation in the epistemology of Piaget. Conceptual change is a cognitive process in which the emphasis is on the transformation of concepts in the learning process.[7] Famous constructivist Rosalind Driver points out that the learning cycle must necessarily be interactive in every stage.[8] Considering the fact that science in the world science community works on the principle of consensus, that could be an argument for the introduction of more interactive constructivist approach to the teaching process.

Today, on the traces of constructivism, there is a new culture of learning that has an impact on new forms of teaching that are achieved by using the technology through various aspects of pedagogical arrangements. The teaching material of solid textbooks is converted into educational software tailored to the student. In accordance with constructivist philosophy of learning, in the application of new media, didactic arrangement is more important than the learning content. Digital resources are effective only so far as teachers are able to take advantage of their didactic potential. Digital resources are not the ones that affect the final outcomes of learning, but teaching methods that are accompanied by the implementation of various educational technologies. In other words, if we just change the media through which we present teaching content and thereby keep the same teaching methods as before, the effectiveness of teaching remains the same. Also, if we use teaching methods efficiently, learning will be effective regardless of the educational technologies used in teaching.

In this paper there will presented the results of testing the effectiveness of digital resources in introduction, learning and mastering the physical concepts in the domain of mechanics. The aim of the survey was not a comparative relationship of teaching methods but formatting the teaching method as didactic innovation which allows interactivity in all phases of the teaching process with the use of digital resources and the maximum intellectual engagement of students that affects the self-regulation of students' learning.

2. Integration of digital resources in teaching Physics

2. *Integracija digitalnih materijala u nastavu fizike*

Well designed multimedia resources could significantly affect the increase of motivation for learning and attractiveness of learning content.[9] Modern media and digital resources have extremely high potential when it comes to contribution to the improvement of teaching. . If the basic didactic principles of cognitive learning theory are not taken into account, the use of digital resources in the classroom does not necessarily mean achieving better results. The future of education lies in an interactive teaching approach and therefore in the application of digital resources that encourage interactivity. In addition to creating content for learning based on various types of coding and relate to different sensory modalities, there are: an interactive contact with the learning objects, ability to adapt certain prerequisites for learning, feedback to specific learning activities, research and simulation or online based making sites distributed sections for learning in virtual spaces.[10]

In accordance with constructivist perspective, the learning process is recorded as active, individually controlled, constructive, situationally conditioned social process and its outcome and the flow is affected by many subjective and objective factors.[11] Wondering about the ways of integrating digital resources in teaching Physics and by taking into account the guidelines of modern pedagogy, it came into existence the idea of designing and developing a teaching method that puts emphasis on learning outside the classroom using the interactive digital resources that enable:

- active self-regulated learning in students and achieving conceptual changes
- the role of the teacher as a mentor who assigns content and has access to the student's work through LMS1
- preparation and implementation of lesson in one of the didactic arrangements (e.g. research teaching, project teaching, Physics Suite method or any form that positively affects the development of students' interests and allows active learning, social interaction and allows students to perceive the possibility and importance of applying the theoretical knowledge acquired through digital resources)

Digital resources differ with respect to the potential of creating learning situations that allow us to use teaching methods efficiently. Some digital resources facilitate the implementation of interactive teaching to a greater extent from others. As a starting point for the development and design of this teaching method, it was necessary to examine and determine the effectiveness of various forms of digital resources in compliance with the requirements of interactive constructivist teaching. For this purpose, a web page called "Virtual Classroom"2 is created which contains interactive digital resources (video animation, video presentations, interactive simulations) as well as a description of the integration of these resources into the learning process through didactic framework that shapes the teaching process as a system of three components: learning outside the classroom, classroom learning and teaching.

3. Survey description

3. *Provedba ispitivanja*

The survey was conducted in the school year 2014/2015. in 5 Croatian elementary schools on 168 respondents (students). Schools were equally represented in regional, rural and urban sense. The experimental group and control group were defined in each school. Experimental group includes class in whom a "Virtual Classroom" was implemented while the control group is a class in which there was nothing new regarding the teaching of Physics i.e. processing of teaching unit "Movement and force". The experimental group included a total of 79 students while the control group included 89 students. In order to inspect the effectiveness of "Virtual Classroom", a test for comprehension of the kinematics graphs was developed. The test is created according to the test of Robert J. Beichner3 which is then

1 Learning Management System (LMS)

2 http://virtualnaucionica.weebly.com/

3 Testing student interpretation of kinematics graphs, Robert J. Beichner, Physics Department, North Carolina State University

adapted to the elementary school according to the Croatian National Curriculum Framework.

Students within experimental and control groups wrote the same test before the start of the teaching (pretest) of the unit "Movement and force" and after the teaching the same unit (posttest). The survey results are shown in Figure 1.

According to the results it can be concluded that for the experimental group the percentage of solvability for posttest compared to pretest increased for 23.25% while for the control group the increase was 17.30%. Thus, the increment for the experimental group is bigger by 5.95% compared to the control group from which it could be established that the implementation of the "Virtual Classroom" and the application of appropriate digital resources had a positive effect on learning and mastering the concepts in kinematics.

It is important to point out that the implementation of "Virtual Classrooms" encountered several obstacles. It was noted that in the very beginning of the application not all students actively involved in its implementation. In continuation of the implementation it has been observed that more and more students are using digital resources and preparing for the upcoming teaching unit. Also, at the beginning of the implementation, greater activity in class was shown only by excellent students and later on by others. The students pointed out that they like "Virtual Classroom" mostly because of the fact that everything done in class is available in one place (web page). Most students stated that they like Physics less than other subjects but they would like to continue with this type of work in the following teaching units (Waves, Light).

Therefore, we can conclude that the application of digital media does not lead to an increase in the quality of learning and teaching. New media only open space for the development of a new culture of learning and the new organization of learning and teaching. [11]

4. Conclusion

4. *Zaključak*

There are many different interactive teaching methods but their common denominator is exactly intellectual engagement of students. Many of the new teaching strategies include significant use of computers but it should be noted that the effectiveness of those methods based on the use of computers is very low if the inclusion of interactive teaching methods and intellectual engagement of students is ignored. In addition, it is very important to distinguish different types of digital resources. Some digital resources facilitate the implementation of interactive teaching to a greater extent from others. The visualization together with teaching assistance should allow students to observe objects and phenomena in order to reach a clear and accurate knowledge. Well-worked visualization should affect not only the process of acquiring knowledge but also to develop the students' intellectual, sensory and practical skills as well as the ability to express

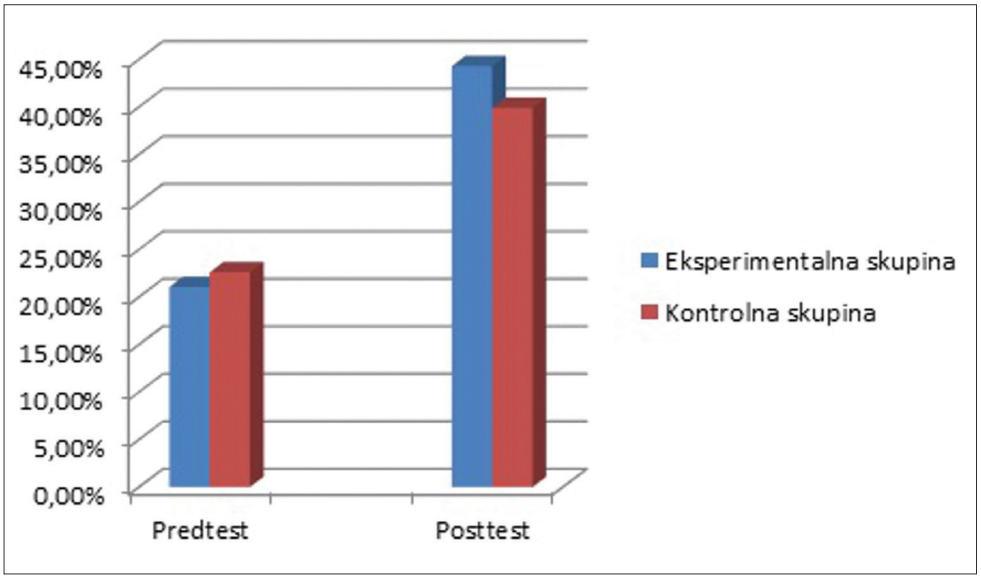

Figure 1
Results of pretest and posttest for comprehension of the kinematics graphs

Slika 1
Prikaz rezultata predtesta i postesta razumijevanja grafički prikaza iz kinematike

themselves. Without visualization of particular problem it is difficult to present a demanding scientific models and systems especially in teaching natural sciences. Furthermore, interactive computer simulation can greatly facilitate the acquisition of knowledge in teaching science but only if its implementation is accompanied by the proper elaboration of models and quality methodology concept. Therefore, during the integration of digital resources in teaching it must be taken into consideration the proper selection of such form of digital resource that will in the certain stage of learning process have the highest efficiency in achieving interactivity and increasing the student's intellectual activities. However, it must be pointed out the importance of developing competencies of teachers for new processes in learning to be supplemented by some other personal, methodical and communicative competencies.[11]

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