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# DIGITIZATION IN SECONDARY-SCHOOL TEACHING

**Abstract: We** present the usage of digitization in secondary-school teaching as well as the results of this approach in teaching. It appears that there is a significant impact of the usage of digitized material in teaching to the greater activity of students, their independence in work and the students' comprehension of the interdisciplinary character of subjects. I find this approach to teaching history, Serbian language and literature and physics very interesting for students, since, besides achieving new knowledge, this approach made the students study new materials by themselves.
**Key words:** digitized teaching materials, website, student motivation, interdisciplinarity

## Introduction

Digitization has enabled easier and quicker preparation, reproduction, distribution and usage of different forms of information (texts, pictures, sound). Therefore, traditional forms like libraries, record and tape libraries, even galleries and cinemas are slowly getting a completely different form. Even education is no longer represented with the traditional role of schools or universities. Since the Internet has no physical limitations for filing and storing books, the quantity of information is immeasurable and it is also available twenty-four hours a day, seven days a week. On-line education provides students with unknown freedom to study on virtually any location, at any speed that could be adapted to their other conditions such as job or family.

In teaching, the usage of computers contributes to a greater interdisciplinarity and students' activity in classes. The interdisciplinarity is more and more important in today's teaching. Breaking the barriers between the subjects we connect them and often obtain better explanation and understanding. Also, the educational process is accomplished in a more efficient, more natural and more integrated way. One of the greatest problems of this way of teaching is the regulation of teaching units and subjects since the curriculum regulates specified schedules and the number of lessons for certain subjects.

This paper is based on my master work that I wrote under supervision of professor Žarko Mijajlović as a requirement for obtaining the master degree at the Faculty of Mathematics of the University of Belgrade. He proposed the theme of the master work and I would like to thank him for numerous advises during the writing of the thesis. During the writing of this paper and master work I used extensively the Internet site http://spomenicikulture.mi.sanu.ac.rs. I would like to thank professor Zoran Ognjanović, the designer and the main author of this site for helpful discussion.

## Digitization in education. Problems of teaching in secondary schools

- The problem is the inactivity of students in the teaching process, as well as the lack of independence in work, and the students' passive role in the process. Students are presented

facts and they are often expected to use mechanical memory ( to learn facts and data by heart). The problem is also a strict distinction in teacher-student relation.

- In the work with students there is no feedback (except via marks). Only via marks students are given information on the level of their knowledge, that is on their progressing/regressing in learning.
- Learning scientific facts remains in the classroom and later has no effect on students' thinking. The example of this thesis is the work in vocational schools where students after leaving secondary vocational school rarely find a job in the field they studied at school.

According to my everyday work with students and my own experience and according to some forms of digitized teaching aids already applied in teaching, I believe that one of the ways of solving these problems is the application of digitized teaching aids in teaching.

## The application of digitization in teaching

In information technology classes students were presented the works of the National Centre for Digitization. In the realization of this project teachers and students of ‘‘Goša’’ Secondary School for Mechanical and Electrical Engineering and the High School in Velika Plana took part.

The mentioned topics represent the contents of the teaching matter for the subjects of history (1st, 2nd, 3rd, 4th year), physics, Serbian language and literature and information technology.

The dynamics of the realization in the very process of teaching depends on the variety of learning conditions. It is designed by teachers themselves, who bear in mind the aims of the programme, the developing abilities of a child and the prior experience and knowledge of students. While planning a teaching unit, a teacher is expected to accomplish the integrated thematic approach.

In the conversation with students in "Goša" Secondary School for Mechanical and Electrical Engineering I realized that the lessons are mostly monotonous and boring and that they are not motivated to learn. Because of that, I offered the students some other sources of learning in information technology classes: Electronic catalogue of static cultural monuments in Serbia [2]

The students were primarily interested in the cultural monuments in their surroundings.


Fig. 1: Radovanje Grove (Radovanjski lug)


Fig. 2: Pokajnica Monastery (Manastir Pokajnica)

These are the monasteries and historical monuments from our surroundings(see Fig.1 and Fig.2). This was the first step in getting students acqainted with digitalization and its applica-

tion in teaching. Then we watched the virtual presentation of Kalenić Monastery [1] – a different approach, a walk in real time.

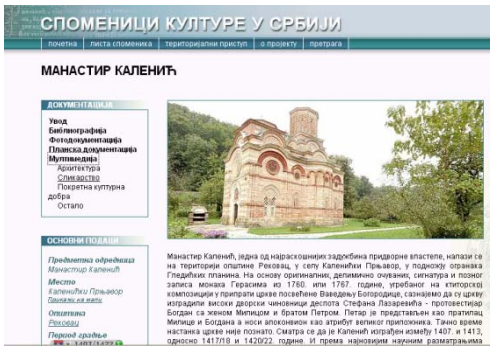



Fig. 3: Kalenić Monatery

Fig. 4: Kalenić Monatery

With this way of data presentation the students:

- got the necessary historical data on cultural monuments in one place,
- studied independently
- showed greater activity and interest in history, geography and information technology classes.

Using this way of presenting data, interdisciplinarity appeared:

- Students were the most interested in how the data were presented. The answer was given in information technology lessons.
- historical data – history ( see Fig. 1, Fig. 2, Fig. 3, Fig. 4 )
- graphic display of a map - geography

The students also had some suggestions:

- Present more cultural monuments like Kalenić Monastery ( Fig. 3, Fig. 4 ) and, if it is possible, insert voice support, too
- Websites like these should be included in compulsory teaching aids.

Željko Đurović, MA, a teacher of history in the High School in Velika Plana, used the Electronic catalogue of static cultural monuments in Serbia website in teaching history in the first, second and third year of high school. The school is well equipped with a computer and a projector in every classroom.

"Even though I belong to the older generation who, unfortunately, use modern teaching methods and aids very rarely, I was immediately attracted by Electronic catalogue of static cultural monuments in Serbia website. Even after the first view I found it really precious and I realized it could contribute to obtaining new knowledge in teaching history. At the same time, it can offer numerous insights in the field of general knowledge."

In the history lessons, the first-year students were introduced the historical and archeological sites of the ancient world in our area. With this way of presenting, the accomplishment was students' better attention in class, greater activity and also their better results.

In the history lessons for the second year Željko Đurović, MA used this website for the topics connected with the national culture in the Middle Ages. The cultural-historical monuments from the period before the Nemanjić reign, during the Nemanjić reign and later are presented very well, as detailed and thoroughly as high school students need, and even more – it is very easy to survey, interesting and without factual and other faults (which, unfortunately, we can often find on the Internet).

In the history lessons for the third year of the socio-linguistic course the website provided the precious data on cultural-historical monuments as well as institutions of education and culture in general.

Students were also presented virtual libraries in information technology classes and later in mathematics and Serbian language and literarure classes. Students were presented the virtual library of the Faculty of Mathematics, where the works of our mathematicians were presented in one place.


Fig. 5: Virtual library of the Faculty of Mathematics

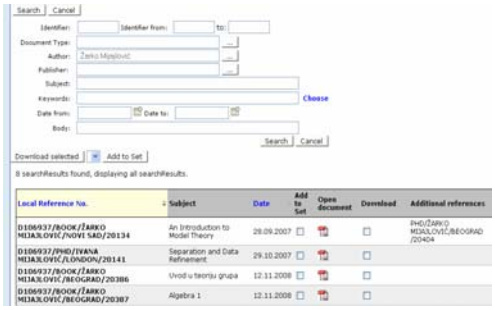



Fig. 6: Virtual library

Using a browser, the students found some interesting books and they solved certain problems on their own ( Fig. 5, Fig. 6 ). They also found some old books where the teaching of mathematics was differently approached. In mathematics lessons the students solved problems using the virtual library. The students who take part in mathematics competition found the problems from the previous competitions and they used them for their preparation for the competition.

Besides this virtual library, the students were acquainted with the digital libraries:

- The Digital National Library of Serbia
- The Digital Anthology of Serbian Literarure
- The Digital Library of Čačak

Jelena Zlatkova, the teacher of Serbian language and literature in the High School in Velika Plana also took part in this work. Here is her conclusion: "When the teaching of Serbian language and literature in a secondary school is concerned, the existence of websites like these is very useful especially in classrooms which are technically equipped (a computer classroom with quick Internet). Since students show more and more resistance towards books and they spend most of their free time on the Internet, the electronic editions offer them a possibility to read a book without going to a library. It is also a possibility for them to have an insight in the books which are classified under a term of so-called secondary literature. When shorter texts are concerned, there is a possibility that they read them in class, sitting at computers, which makes the teacher's work much easier. Websites like these are also helpful in making various computer presentations (PowerPoint, PDF…) which are very necessary in modern teaching of language and literature. That could make the lessons more interesting."

On these websites students also found some interesting books, available at home, too.

The advantages of virtual/digital libraries:

- Students can find the necessary literature quickly and in one place. They do not have to look for books, which are often rarely available, and when they find them, some are in a very bad state so that they have problems to read them.
- The books in an electronic form are always available. There are books which are not available for students because libraries do not allow certain books to be taken out of

the library. In this way students can read rare works and thus they get more interested in literature, mathematics and other subjects.

- The possibility of downloading books – Students can download books in a digital form and then they can read them or study their contents at home.
- Easy search – Virtual/digital libraries are quite easy for searching (key word, author etc.)

In cooperation with Aleksandra Ivanović, the teacher of physics in "Goša" Secondary School for Mechanical and Electrical Engineering, the students were also presented the website of The Museum of Nikola Tesla [4], where they saw the digitized archive in which they could learn about the life of our great scientist with a click of a mouse. The students were also very interested in 3D models, where they saw the simulations of the works of Tesla ( Fig. 8).


Fig. 7: Website of The Museum of Nikola Tesla


Fig. 8: Website of The Museum of Nikola Tesla

After the lessons, colleague Aleksandra Ivanović concluded : " The teaching of physics in our secondary school is mainly traditional. The number of lessons realized with methods of active learning is not enough if we have in mind the structure and the conception of the teaching matter. It leads to the inactivity of students and their lack of functional knowledge. The process of moving from a traditional to an active teaching method with the aim of awakening the motivation of students and teachers and therefore improving the quality of education is possible with the introduction of new teaching methods and the usage of new didactic aids based on the usage of visual materials. With the usage of digitized aids in teaching physics it is possible to replace classic teaching aids to a large extent.

On the Internet address www.tesla-museum.org very interesting examples and applications of digitized aids for teaching physics can be found. Their usage enables students to observe the phenomena in three dimensions. The advantage of this form of teaching is that it is very creative and it provides ideas as well as motivation among students to make an animation themselves which is very important if we have in mind that we are a vocational secondary school, the purpose of which is to connect the core of a profession with general knowledge subjects."

After using this website the following can be concluded:

- In this way students got interested in physics so that they independently studied the projects of Nikola Tesla at home, and some students found other interesting websites about physics and thus they improved their knowledge.
- Certain number of students tried to present the models in other programmes which they use at school (SolidWorks), in modeling classes. They also chose one of the projects of Nikola Tesla to do in class as a practical exercise.

- Students also presented the models from this website in forms of flash animations in information technology classes.

This form of digitized teaching has led to a greater engagement of students in physics, information technology, modelling and computer graphics lessons.

## Empiric research

The research hypothesis: The aim of the research is designing models of teaching with the application of digitalization in teaching in secondary schools in order to increase the efficiency of teaching among students.

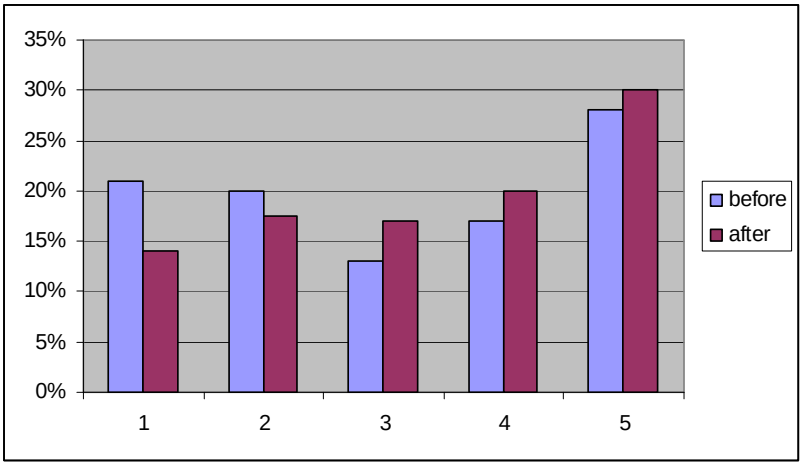
The research starts with the general hypothesis which says: *the application of modern teaching aids has positive effects on increasing the efficiency of teaching in secondary schools.* In the research the model with parallel groups is applied.The independent variables are:

1. traditional teaching and 2. multimedial teaching

The dependent variable is students' efficiency and accomplishment in traditional and multimedial teaching.

According to the test results before and after the usage of the Electronic catalogue of static cultural monuments in Serbia website, the students of the High School in Velika Plana showed different levels of knowledge.

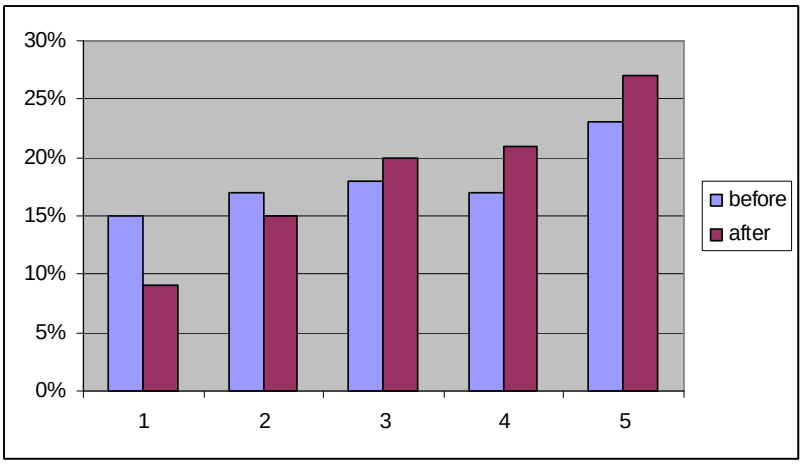
Here are the charts which show the test results (x-axis presents grade from 1 to 5; 1 - not passed, 2 - satisfactory, 5 excellent) of the first-year students before and after the usage of the website in the teaching of history:



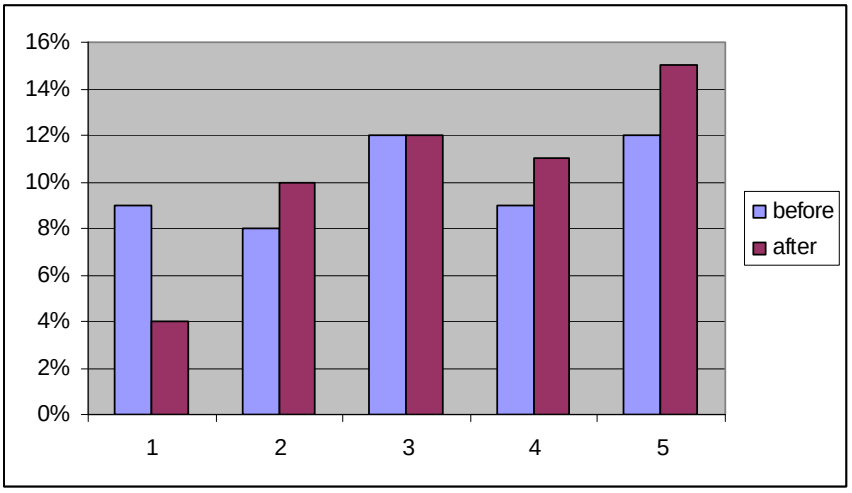

The history teacher Željko Đurović,MA, stated that the first-year students accepted this way of learning very quickly. They could study the necessary matter at home on their own, which led to a greater engagement of students in classes, not only the talented ones, but also the students who had had poorer results in the previous period.

Below are the charts which show the results (x-axis presents grade from 1 to 5; 1 - not passed, 2 - satisfactory, 5 excellent) of the second-year students before and after the usage of the website in the teaching of history:

The students' answers to the question how the usage of the Electronic catalogue of static cultural monuments in Serbia website improved the results of learning were classified in two categories : a) the teaching matter of the educational computer software is well organized b) it is easier memorized with the usage of multimedia.




Here are the charts which show the results of the third-year students before and after the usage of the website in the teaching of history:




As it can be seen from the presented charts, there is a positive change in teaching history after the application of digitalization in classes.

According to the results obtained in the research, it can be concluded that the application of digitized aids in teaching encourages the communication between teachers and students. In some cases it replaces the teacher and it can motivate even the students who were not successful with all the other methods used. It is very important that the usage of computers increases the individual nature of teaching, which improves the quality of teaching. Students are usually thrilled and they accept to learn from the electronic teaching material. They study the material at their own speed and revise and investigate it in their own way.

The main hypothesis is confirmed. The positive effect of the experimental programme is stated. The results of the final investigation draw to a conclusion that the digitization in teaching had a positive effect and it significanly improved the results in doing the assignments in secondary schools.

Using this way of presenting history we came to a conclusion that history as a science is one of the most represented subjects on the Internet. The usage of the modern technical achievements will make students aware that history does not exist only in archives, libraries and so on, but that it is closely connected with the desired image of the modern age. The Internet is an ideal medium for encouragement and motivation of students, for changing the negative image of history as something dull and uninteresting.

## Conclusion

The fast development of information and Internet technology establishes the conditions for using these aids in teaching. In this work the starting point was general and theoretical – the general situation in education, the faults of teaching, using software and digitization in teaching history, the classification and designing of software, the aims and the tasks of the curriculum. The final point is specific and practical – the specific situation in education, the usage of this software in teaching several subjects.

The school I work in, "Goša" Secondary School for Mechanical and Electrical Engineering, is by the nature of the field of work connected with the usage of computers. The students accepted this way of learning and thus they were motivated to make their presentations as seminar works and they did a highly recommendable job. A certain number of students showed interest in choosing the application of digitized materials as a topic for their final-exam work.

All of this led to a conclusion that it should be worked on improving school processes, multimedia software and frequent usage of these methods in schools so that the students could get the experience connected with learning with the help of computers and multimedia software. This kind of teaching would contribute to a more efficient and more motivated teaching process.

With the usage of digitization in teaching the following results are achieved:

- Students show higher level of cooperation in the teaching process and the ones who are less interested during the classic way of teaching achieve better results in this way.
- The necessary knowledge is better acquired because the students are not only passive observers, but they take an active part in the process of learning.
- Students show a greater interest and mental activity, and the information transfer is faster and easier.
- Interactivity
- Students' individualism

The Ministry of Education should be informed about the process of digitization in teaching. A larger number of teachers from elementary and secondary schools should be included through different seminars and educative courses. Of course, it is also necessary to equip the schools for the process of digitization in education.

All the afore-said does not at all mean that the classic form of teaching should be forgotten. But it is an excellent example of how the teaching should be refreshed in all the aspects of teaching and it should be adjusted to modern technologies which inevitably follow education, too.

## References

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