



## Technology support education: Modernisation of mathematics education in Serbia

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12 November 2014

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# About the Republic of Serbia

- Country situated at the crossroads between Central and Southeast Europe
- Area 88.361 km<sup>2</sup>  
(243.610 km<sup>2</sup> - UK comparison)
- Population 9.024.734  
(63.705.000 – UK comparison)
- Capital: Belgrade  
Population 1.166.763  
(8.278.251 – London comparison)



\*Data from Wikipedia.

For comparison of in brackets are given data from the United Kingdom and London.

# Overview of talk

- Objectives of this presentation are to:
  - Show the structure and organization of the education system in Serbia.
  - Explain the single curriculum for all, and mostly to talk about the primary school and the final examination at the end of the eighth grade.
  - Point to efforts and major changes in the education system in Serbia in the past few years, and to emphasise the role of ICT in teaching.
  - Show the aims of the mathematics curriculum and emphasise the ISSUE with homework in Serbian schools . To justify the way of solving the problem by using ICT.
  - Explain the details of the project eZbirka, platform possibilities, and to present results of pilot testing.

# Structure and organization of the education system

Education sector	Age in years	Grade	Tests that are undertaken and in which subjects
<b>Pre-primary education</b>			
Nursery	0-3		
Pre-school	3-6		
Compulsory	6-7		
<b>Compulsory primary education</b>			
Class instruction	7-11	1-4	National Testing in mathematics is conducted at the beginning of the fourth grade.
Subject-based instruction	11-14	5-8	National Testing in mathematics is conducted at the beginning of the sixth and eighth grade. At the end of the eighth grade all pupils have to pass the final examination for mathematics and the Serbian language for enrolment in secondary school.
<b>Secondary education</b>			
General secondary school and Vocational schools	14-18	1-4	Pupils have to pass general Matura after the 4th grade of general secondary education or 3rd grade of vocational education and training.

Structure and organization of the education system (MoESTD, 2009)

# General curriculum for all schools

- The Ministry of Education, Science and Technological Development of the Republic of Serbia issues a single curriculum for all schools.
  - The curriculum includes compulsory and optional subjects, their schedule by grades, weekly and annual number of lessons and other specifics relating to educational processes (MoESTD, 2009).
  - The curriculum defines the contents of each subject, including teaching aims and objectives as well as guidelines on how to attain them.
  - They are mandatory for all schools, without any possibility of choice by the pupils or teachers (Halaz, 2003).
- The cultural role of the school has been lost.
  - There are no organized activities like concerts, book promotions, exhibitions, charity actions or nature protection events.

# Primary education

- Primary education has a function to provide pupils with basic knowledge across all areas, to prepare the young people for their further education (MoESTD, 2009).
  - During the first part (from the age of 7 to the age of 11 years), all main subjects are taught by one teacher. Pupils have 4 lessons per day, which might be learning to read/write both Cyrillic and Latin letters, mathematics, English, history, geography, music, and art.
  - In the second part of the primary education (from the age of 11 to the age of 14 years) pupils gain a wider knowledge. For each subject they have one qualified teacher.
- The teaching takes place in 3,429 schools .

# Final examination

- At the end of the primary education all pupils have to pass the final examination for mathematics and the Serbian language for enrolment in secondary school.
- Ranking for enrolment in secondary schools is based on the number of points from these two final examinations and the average score during the second part of primary school (the maximum of points is 100).
  - All marks in primary school, from the sixth, seventh and eighth grades, contribute a maximum of 60 points, and
  - the final examination provides up to 40 points (20 points each for the Serbian language and mathematics tests)

(The Institute for Education Quality and Evaluation, 2014)

# Subject teacher education

- Serbia is one of the few countries where no faculty of education or education sciences exists for teacher training in education policy, comparative education, education administration and management, etc.
- Subject teachers are educated at faculties for their respective academic discipline, involving a broad range of possibilities:
  - enrolling in a department for teacher education at the faculty for the respective academic discipline (e.g. Department for Biology Professors at the Biology Faculty at Belgrade University),
  - through selecting a teacher education track later in the course of one's study (e.g. the Chemistry Teacher Track at the Chemical Faculty at Belgrade University),
  - or just adding a set of teacher courses (Pedagogy or Education Psychology) to the academic curriculum as an optional subject .

(Cerović, 2004)



# Improving the quality of teaching and learning

- The education system in Serbia is undergoing major changes.
  - Driven by a strong commitment to EU integration, the authorities have announced and launched numerous reforms in an effort to move the education system from the traditional to new approaches.
- National documents in Serbia emphasize that ICT should become an integral part of teaching practices in all subjects.
  - In the planned measures, there has been included the statement *"train all teachers to use ICT in teaching or its preparation"*.
- Teachers are encouraged to use computers in all forms and types of learning activities.
  - But there is a lack of knowledge about adequate methods, materials and teaching practices.

(National Education Council ,2011, 2013; MoESTD, 2012; MoTTT, 2010)

# ICT in schools in Serbia

- Over the past few years, through many projects, efforts have been made in order to modernize schools and ICT systems.
  - *"Modernization of the vocational school system in Serbia"* (2002) with modern IT equipment worth 1.5 mil euros was installed in 87 schools
  - *"Digital School"* (2010) provided fully-equipped computer classrooms in 2,808 elementary schools
- To foster the learning potentials with ICT teacher support in developing teaching strategies and availability of ICT tools.
  - *"Creative School"* - involved approximately 5,500 teachers
  - MoTTT public call to fund programmes to support activities in the field of ICT application in teaching practice (*Platform Zbirka in supporting effective teaching*).

(MoEaS , 2002; Marić et al., 2014)

# Mathematics curriculum at age 11 to 14 years

- Mathematics is an important subject for personality and skills development among pupils and an integral part for their further education (The Institute for the Advancement of Education, 2014).

Subject	Number of weekly teaching periods			
	(11 years)	(12 years)	(13 years)	(14 years)
Mathematics	4	4	4	4
Serbian Language	5	4	4	4
Foreign Language	2	2	2	2
Art	2	1	1	1
Music	2	1	1	1
History	1	2	2	2
Geography	1	2	2	2
Physics	-	2	2	2
Biology	2	2	2	2
Chemistry	-	-	2	2
Technical Education	2	2	2	2
Physical Education	2	2	2	2
<b>Total weekly periods</b>	<b>23</b>	<b>24</b>	<b>26</b>	<b>26</b>

# The aim of the mathematics curriculum

- The aim of the mathematics curriculum in the primary school is
  - for pupils to apply elementary mathematics knowledge needed for understanding phenomena and rules in nature and in society itself.
  - to prepare them for the application of the adapted knowledge when it comes to solving various tasks from everyday life.
- Mathematics as a subject is intended to
  - represent the base for successful mathematics learning and education in general which will follow.
  - development of mental skills, forming a scientific view onto the world and development of pupil personality as a whole

(The Institute for the Advancement of Education, 2014)

# Mathematics at the end of primary school

- After the eight-year cycle of elementary education pupils are tested at the national level, sitting the final examination.
  - Mathematical knowledge is assessed by a test of 20 questions which cover five subject areas, chosen from three achievement levels: basic, intermediate and advanced.
- Pupils are expected to be able to
  - handle decimal numbers and fractions and perform the calculations.
  - compare numbers and solve linear equations and systems of equations.
  - observe the dependence between variables in algebraic expressions.
  - be familiar with elements and properties of geometric objects.
  - understand concepts of coinciding figures and observe their symmetry.
  - read charts and process the data collected by presenting them graphically or in tables.
  - use numeric expressions in real situations.

(The Institute for the Advancement of Education, 2014)

# Homework in curriculum

- According to the teaching method instructions, *Guidelines for the implementation of mathematics curriculum for primary schools* issued by MoESTD, regarding homework it says:

*“Homework assignments are an important component of the teaching process. They not only test how much the pupils have mastered certain materials, but they present an introduction of independent work and self-education to pupils. Tasks should be varied, and by the weight should be balanced, in accordance with the knowledge and skills of all pupils”.*

(The Institute for the Advancement of Education, 2014)

# Benefits of homework

- The benefits of homework can be divided into four categories:
  - a current academic benefit,
  - long-term academic benefit,
  - non-academic benefit and
  - parental involvement.
- The most frequent reason for giving homework is the current academic benefit, and the main reason is to increase pupils' time spent learning.
- Positive effects that are directly related to learning are:
  - improved retention of knowledge and
  - better understanding of the subject matter.
- But, the idea of "more is better" is not related to all subjects, at all levels of education and at all levels of pupils' knowledge.

(Cooper, 2007; Epstein et al., 1997)

# Homework in Serbia

- Tasks for homework are present in every mathematics textbook, and they form an integral part of the class.
  - At the outset of every lesson, teachers begin by asking pupils if they had trouble with previous homework - and answers from pupils there are used as feedback about their understanding of the previous teaching.
- A common occurrence in primary schools in Serbia is that most pupils just copy solutions of tasks from their peers prior to the class.
  - Thus, an important part of the educational process loses its meaning and the teachers lose an instrument with which they can better plan the teaching process.
  - To overcome that practice, platform eZbirka is developed to be an aid to teachers in the homework process (Radović et al., 2014)



# eZbirka - support for the effectiveness of teaching

- Creating a publicly available platform eZbirka
- Creating high-quality educational materials in electronic format available on the platform eZbirka
- Professional training of teachers to use the platform eZbirka and information and communication technologies in teaching

The goal was to train teachers in primary and secondary schools for the preparation and maintenance of teaching with the use of modern technological tools



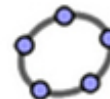
Republic of Serbia  
Ministry of Foreign and Internal Trade  
and Telecommunications



Mathematical  
Society of Serbia



University of Belgrade  
Faculty of Mathematics



GeoGebra Center  
of Belgrade

# Results

- Platform eZbirka has been developed [www.ezbirka.math.rs](http://www.ezbirka.math.rs)
- More than 13,000 mathematics tasks are available, directly related to the curriculum (5th to 8th grade)
- 800 teachers have been trained to use the platform eZbirka and ICT in education <http://ezbirka.math.rs/?action=news>
  - 380 user accounts have been created on the platform eWorkbook (with growing interest of teachers in the region: Bosnia and Herzegovina, Croatia, Hungary, Macedonia)
- 250.000 reviews of teaching materials are on the platform eZbirka from April 2014
  - A survey on teachers' and pupils' attitudes towards the platform.
  - Research about platform eZbirka effectiveness in the education process.

# 5<sup>th</sup> grade

1. 2. 3. 70

еЗбирка

Тестови



игра и за

/п. Једна

Број теста:

Започни решавање теста

7. Кружница и права

8. Кружница и права

9. Геометријски објекти

10. Деловност у скупу

еЗбирка

Име и презиме

Ком

Marko Pavlović

bil

Zoran Ilić

Nisa

Marija Janković

Sve

Lidija Zorić

Baš

The relationship between points and lines and points and planes.

Number of test: 206

1. It is known that two different points define one line. How many lines is determined by:

- a) 3
- o) 5
- b) 7
- r) 12

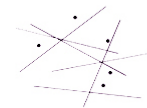


Solution

Solution

2. How many lines is determined by: 240 different points if:

- a) there are not collinear points;
- o) among them there are exactly three collinear points?



Solution

Solution

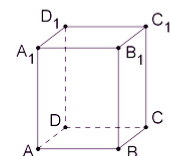
3. How many lines is determined by:  $A, B, C, D$  and  $E$  shown on picture?



Solution

Solution

4. Determine what is the position of the plane determined by points  $A, C, B_1$  and line determined with  $D_1, B$ .



Solution

Solution

5. There is plane  $\alpha$  and point  $A, B, P, E$  and  $Q$ . Which of the statements is not correct?

- a) points  $A$  и  $B$  belong to the plane  $\alpha$
- o) Line determined with  $P$  и  $B$  and line determined with  $A$  и  $Q$  are skew line.
- b) points  $A, B, Q$  и  $E$  are not coplanar



Solution

Solution

6. It is described a position of line  $c$  in a plane with relation with the two skew line  $a$  и  $b$ . Which of the described lines do not exist?

- a) Line  $c$  is skew with line  $a$  and have together point with line  $b$ .
- o) Line  $c$  have together point with line  $a$  and have together point with line  $b$ .
- b) Line  $c$  is parallel to the line  $a$  and parallel to the line  $b$ .

Solution

Solution

Teacher code:

Comments and remarks to the following classes

Pupil name:

eMail:

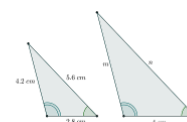
Send homework

# grade

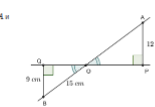
3. 66

ифра: 3)

re  $\triangle ABC$ ,  
 $a = 5$ ,  $b = 6$



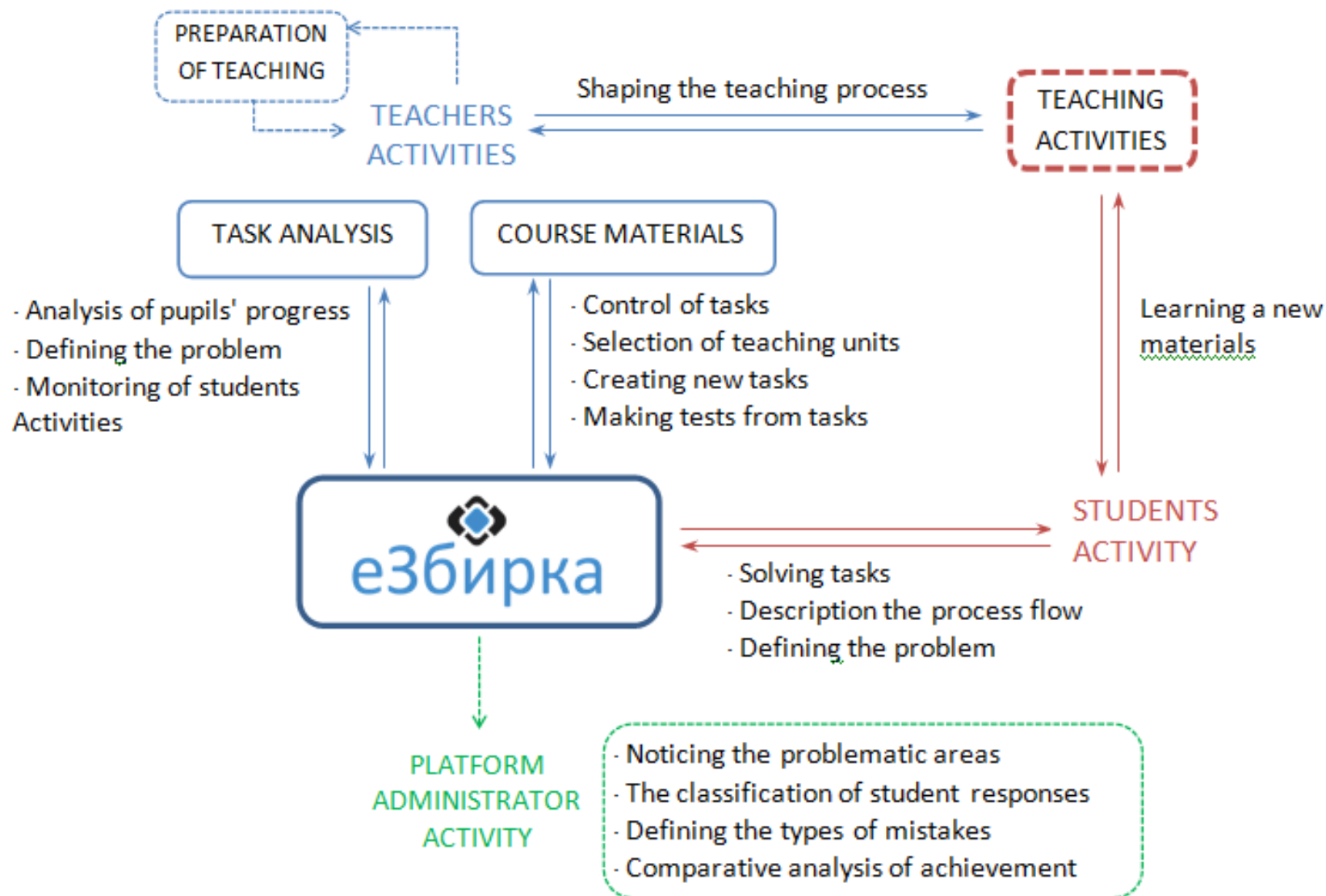
е дужи  $OA$  и



Коментар

Пошаљите решење

# Model of impact on the teaching process by using the platform eZbirka



# Result of pilot testing (1)

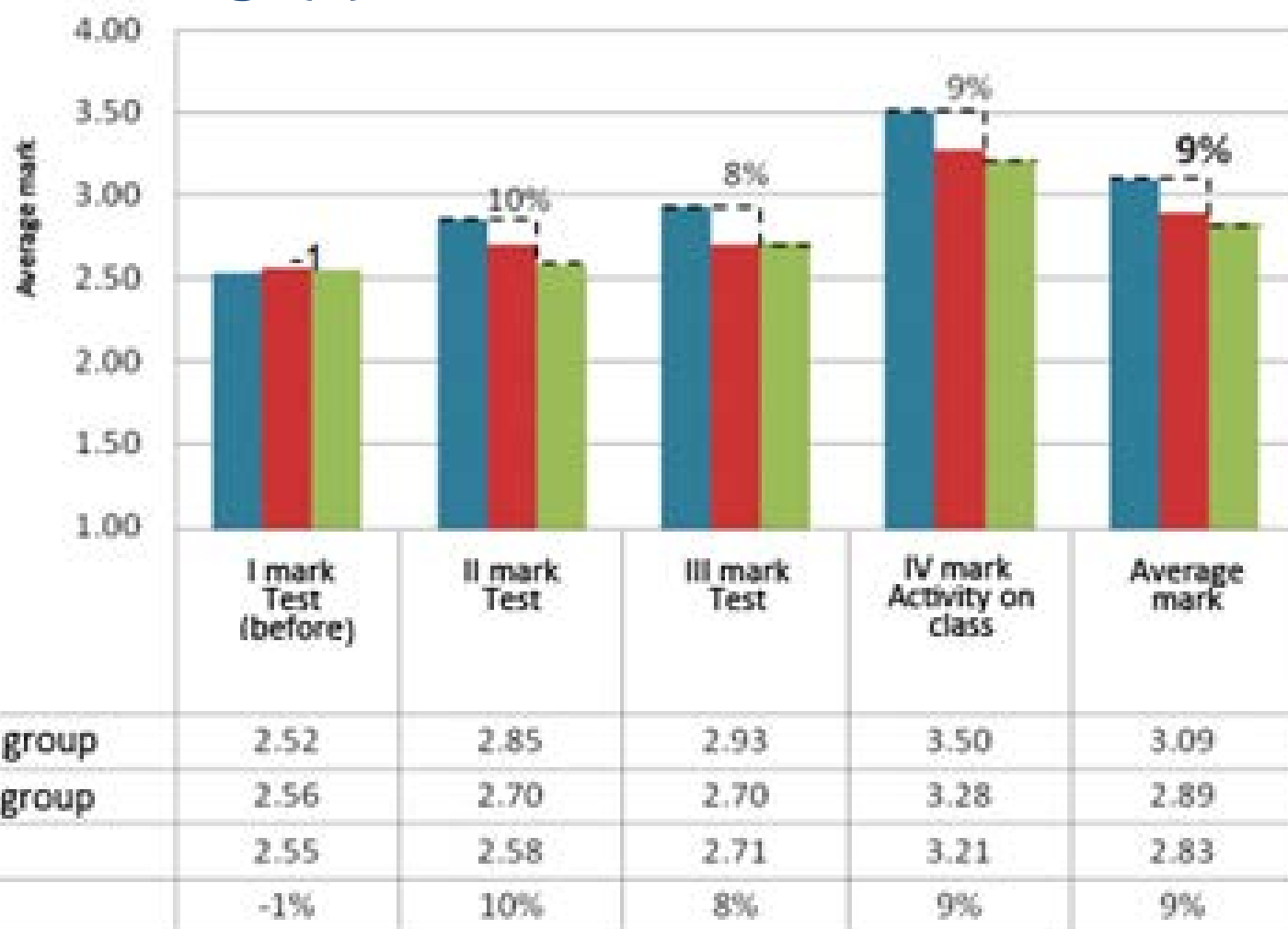
- The results of pilot testing indicate an increasing knowledge for students after using the platform eZbirka (Dramićanin, 2014).
- Pupils (88 of them) were divided into three groups based on homework activity :

The first group: used eZbirka in homework activities and describe their problem solving of the task. When they did not know how to solve the problem, then they could write what the obstacle was in solving the tasks. Then, after each unit, the teacher used those comments in order to improve her/his practice and to correct any misunderstandings in the knowledge of students.

The second group also used eZbirka in homework activities, but they wrote only the final solution. The teacher was able to see whether they were doing homework or not, but the teacher could not find the cause of the problem.

The third group: teachers were working with students but without using eZbirka.

## Result of pilot testing (2)



Graphical presentation of the average mark increases for classes that were using the platform eZbirka in different ways (Dramićanin, 2014)

# Pupil survey

- After research, the survey involved pupils from the experimental groups 1 and 2 (56 of them). Based on their responses (Dramićanin, 2014):
  - Pupils have successfully accepted the homework practice on the platform eZbirka and they believe that eZbirka is useful for them (90% of pupils).
  - Pupils appreciate detecting errors and comparing solutions after sending homework to the teacher (78% of pupils).
  - eZbirka helps them to recognize the level of their knowledge (71% of pupils).
  - Pupils appreciate that they all receive different tasks (only 10% of pupils do not agree with this).
  - They would like to do more homework on eZbirka (52% of pupils) than the traditional way of working (18% of pupils appreciate the traditional way of working).

# Teacher survey

- A second survey was conducted to investigate teacher attitude about the effect of platform eZbirka (80 of them) .
  - Teachers believe that the use of the platform eZbirka in educational activities has a positive impact on the motivation of students (98.75% of respondents).
  - Feedback from students after each homework gave them the opportunity to discover misunderstanding in the knowledge in the earliest stages of learning (97.5% of respondents).
  - Teachers point out that the students used the materials and doing quests with a lot of enthusiasm (96.25% of respondents), and this is cited as one of the key successes of the platform.



# Conclusion

- Based on all the evidence, the educational platform eZbirka presents a successful example of adapting electronic material to the needs of modern teaching and to solving a particular problem.
  - In addition to improving the teaching process itself, using the platform provides an opportunity for comparative analysis of students' achievement and misunderstandings.
  - The platform is used also by teachers from outside of Serbia, but those teachers cannot use the organization of teaching materials provided (because their curriculum is different), but they write their own tasks and use the information system.
- All users of the platform eZbirka share the opinion that its integration in learning can improve the quality and efficiency of the entire teaching process.

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Thanks you for your attention

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