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*With this publication, the CD with all papers from the International Conference on Information Technology and Development of Education, ITRO 2017 is also published.*

## **INTRODUCTION**

The Technical Faculty “Mihajlo Pupin”, Zrenjanin, of the University of Novi Sad, the Republic of Serbia organizes VIII<sup>th</sup> International Scientific Professional Conference “Information Technologies and Development of Education 2017” (ITRO 2017). The Conference will be held on 22<sup>nd</sup> June 2017 at the Technical Faculty “Mihajlo Pupin” in Zrenjanin, Serbia.

The Conference “Information Technologies and Development of Education 2017” (ITRO 2017) is organized due to the needs to connect science, profession and education through topics and content concept, first of all concerning the teaching process as base of information society. The tendencies of developed countries are in accordance with the efforts of UNESCO to improve this area related to the needs of life and work in the XXI<sup>st</sup> century. It is necessary to assess the state, detect the problems and perspectives of the development of education by competent professionals and teachers as well as the influence of the development of education on the development of the society as a whole.

The central topic of the meeting is the model of dual education as base for creating good base for the development of industry. Thus, our aim is to gather the representative entities who are able constructively contribute to establishing link between the educational system and industry as follows: Chamber of Commerce of Serbia – Centre for Dual Education, Ministry of Education, Science and Technological Development, Union of Employers of Serbia, ZREPOK – Business Organization of Zrenjanin and Companies that run their business in the region, directors of grammar schools and secondary vocational school, members of the academic communities and other participants who are interested in the topics.

The main topics of the scientific professional conference are:

- Model of dual education
- Teaching based on the concept of entrepreneurship

Other thematic areas of the Conference:

- Theoretical and methodological questions of contemporary Pedagogy
- Digital didactics media
- Contemporary communication in teaching
- Curriculum of contemporary teaching
- Developing teaching
- E-learning
- Management in Education
- Teaching methods of natural and technical subjects
- Information-communication technologies

The Chairman of the Organizing Committee of the ITRO 2017 Prof. Dragana Glušac opened the Conference. The participants were addressed by the vice dean of the Technical Faculty »Mihajlo Pupin«, Prof. Dijana Karuović; provincial secretary for science, higher education and scientific Research prof. Zoran Milošević, and the vice-major of Zrenjanin Mr. Dusko Radisic.

There were total of 143 authors that took part at the Conference from 12 countries, 2 continents: 82 from the Republic of Serbia and 61 from foreign countries such as: Macedonia, Bulgaria, Slovakia, Austria, Cyprus, Albania, Hungary, Spain, Bosnia and Herzegovina, USA, Portugal.

The Proceedings of papers contains 60 papers and it has been published in the English language.

President of the Organizing Committee  
Prof. dr Dragana Glusac

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# A Method for Increasing the Level of Knowledge in Mathematics

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**Abstract** – One of the priorities of the European education and the education in our country is to increase the level of students' knowledge in mathematics. Students are using computers and mobile devices for personal needs, daily. If we can to encourage the students to use these electronic devices and software for: testing, research, visualization and solving real problems, we will receive students who are motivated to learn mathematics, and thus an increased level of their knowledge in mathematics. For this purpose, is constructed a website <http://mathlabyrinth.azurewebsites.net>. The problems placed on the website are in accordance with the subjects that are studying in secondary education and related to everyday situations with which the students are faced every day. These problems require knowledge in mathematics for their solving.

## I. INTRODUCTION

In a recent several researches in our country and wider, it is determined that the students' knowledge in mathematics are decreased and are below the lower sill of knowledge. Because of that, one of the priorities of the European Union and our country in education is to increase the level of mathematics knowledge for the students in all ages. The students use computers, smart phones and other electronic devices more and more for their needs. It is needed to take this opportunity and to include this in the process of education for learning mathematics.

The free software (Geogebra) is using in the process of teaching mathematics, especially when is solving and visualizing constructive problems [1], problems with functions, problems in planimetry and solid geometry. By using of the software Classmarker, are made electronic tests for determining the students' achievements, [2] and which are great accepted by the students.

But, ICT is not enough exploited in the process of teaching mathematics. It is needed more use of ICT using in order to enlarge the level of

knowledge. It is made research about the motivation of students in the high school “Koco Racin” in Veles, Macedonia and about the problems with which the students faced out in the process of solving mathematical problems. In the survey 145 students take a part. The accent in this questionnaire is put on the mathematical problems which refer to real-life problems. The researching is realized in order to determine whether the solving of these tasks will increase the motivation of students to learn mathematics and to determine the difficultness in the process of solving mathematical problems in the school classes and when the students write their homework, [3].

The question "Do you think that solving practical problems can increase the motivation for learning mathematics," 66% of the respondents said that that motivated them to learn math.

13. Дали мислиш дека со решавање на практични/ применливи задачи може да се зголеми мотивираноста за учење математика (146 responses)

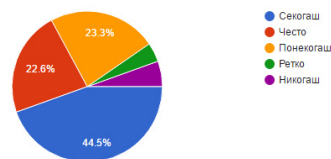


TABLE I.

The question "When you have problems in dealing with your homework, would like to have a website that will give the steps and help to solve the problems," 86% of the asked students said that they want, and only 5% said they do not want to have such help.

17. Кога имам проблем при решавање на домашните работи, тогаш е сакал да имам помош на веб страна која ќе дава чекори и помош за решавање на проблемите  
(145 responses)

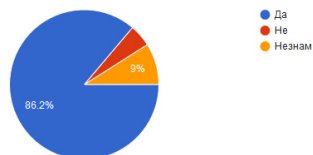


TABLE II.

For that purpose, is constructed the website <http://mathlabyrinth.azurewebsites.net>, [4] on which are presented problems and tasks related to real-life problems, methods and procedure for their solving and visualization. The website is using in the teaching process on classes and when students write their homework.

## II. METHODOLOGY OF THE WEBSITE'S PROBLEMS PREPARATION

Before starting with the website's preparation, it was necessary to choose problems, tasks and process for their solving.

The greater number of the problems which are posted on the website, are derived from the books and collection with tasks. The problems and tasks are grouped in themes, that are studied in the secondary schools in Macedonia (figure 1).

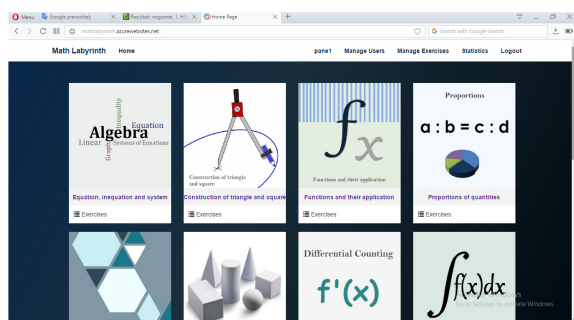


Figure 1. Cover page of the website - Themes

In determining the procedure for solving the tasks, knowing that they will be solved in the classes and in the homes, has been used a procedure based on Pólya represented in the book "How to resolve" [5].

The procedure is based on four principles:

- Understanding the problem;
- Plan for solving;
- Realization of the plan;
- Considering the solving process and the solution of the problem. How we can improve them?

The first principle "Understanding of the problem" is neglected very often, because the teachers think that it is obvious. Even this is not mentioned in many mathematical classes. Although, the students usually have difficulties when they are trying to solve the problem alone, because they don't understand the requirements in the task. In order to correct this point of view, Pólya gives instructions for teachers. The main aim of these instructions is to encourage the students to ask some questions themselves. The questions are in the forms: What is needed to be found? Could you tell yourself the problem with your own words? Could you draw a picture or diagram to help you for problem' understanding? Do you understand all words and terms in the problem?

At the beginning of the task, which will be placed on the website, the teacher will choose a several questions with the appropriate level of difficulty depending on the age of the students. So, they will easily understand the task and they will know how to solve it and what they should to calculate.

The second principle: make a plan: According to Pólya it is mentioned that there are existing many rational ways for problems' solving. Skill of choosing the appropriate strategy is learned by solving of many problems. So, this could be stressed to the students. A partial list of strategies: guess and check, eliminating the possibilities, use symmetry, consider the exceptional cases, use direct thinking, solving equations.

A specific list of strategies: search model, draw a picture, use a formula, be creative, use skills and etc.

When the plan and procedure for solving of the problem are chosen, usually are used free software for visualizing problems and represented a variety of actions to address them. Always is mentioned that this is one of the procedures to solve the problem. Creativity of the students can solve the problem in another way, or much faster.

The third principle: Implementing of the plan.

This step is usually easier than the step when plan is considering and analyzing. In general, all you need is patience and care, given that they have the required skills to continue with the plan that is selected. The author notes for this step: If the plan does not work, discard it and choose another plan. Do not be misled; this is the principle how mathematics is done, even by professionals.

In this part, the teacher is describing in details the steps for calculation of the problem' solution. He encourages the students that with this

procedure, they could solve the problem. But if they try to solve the problem in another way and it is not successful, that they should throw that plan and to try with new.

The fourth principle: Review / Extension

Pólya mentioned that much can be gained by taking time to reflect and look back at what you have done, and what not. It will allow you to predict what strategy should be used to solve problems in the future, if they were applied to the original problem.

Finally, the teacher congratulated for a job well done and encouraged to use these principles and to solve other problems. If the students have a new solution, they should to send it to the teacher and the same can be published and shared with other students.

### III. IMPLEMENTATION OF TASKS

Using these rules, the results of the surveys are made a web page "Mathematical Labyrinth", which contains textual tasks related to real life [4].

For every task posted on the website, the first preparation was made using the principles of Pole and the instructions obtained from the survey. (Figure 2)

□ area/topic/subject – **Differential counting**  
Problem - 9

A sewage channel is supposed to be built along a road by connecting three 1m wide cement blocks. The cross section of the channel is an isosceles trapezium with smaller base and equal to the side. Under what angle in relation to the base should the blocks be set to get largest channel with biggest section (the biggest permeability?)


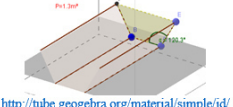
Steps/Stages	Help hints	Answer/solution
How does a sewage channel look like?	(Search for images)	
Make a 3D sketch of a sewage channel	A sketch in GeoGebra with flexible spot	 <a href="http://tube.geogebra.org/material/simple/id/2824831">http://tube.geogebra.org/material/simple/id/2824831</a>
Mark the angle with $\alpha$ (the one with which you can change the walls of the channel)	Make a movable point to change the position of the channel walls.	Observe the position of the walls
What figure did you get?	Straighten up the figure	Prism with a isosceles trapezium

Figure 2. An example of a ready task

By logging into the website as an administrator (teacher) you can set tasks. The main menu contains Math Labyrinth-Home, Manager Users, Manager Exercises and Statistics.

Method of setting tasks.

By selecting the Manager Exercises window, the fields in which the task is to be entered are opened.

In the Exercise Description field, the task test is entered, in the Exercise Name field, the title of the task is entered, and in the Exercise Topic field, the topic from which the task is selected is selected from the drop down menu. (Figure 3)

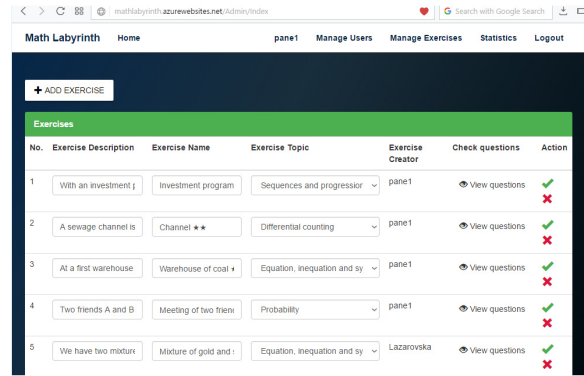


Figure 3. Manager Exercises

By clicking View question, go to the next window where Questions, Help, Answer, and Additional are written. In either field, you can type text or file with the choice of one of the Add / Edit text buttons or Add / Edit file. In the Question field the question is written, in Latex. In Help, some help is added to the question to get to the answer. Answer answers the question, image, or link to an applet associated with the answer. In Additional, additional information about the applet's construction, the construction of the image, or some other additional information that the student can use in solving the tasks will be added. (Figure 4)

In the Orderin Flow field, the row number of the question is selected and finally recorded.

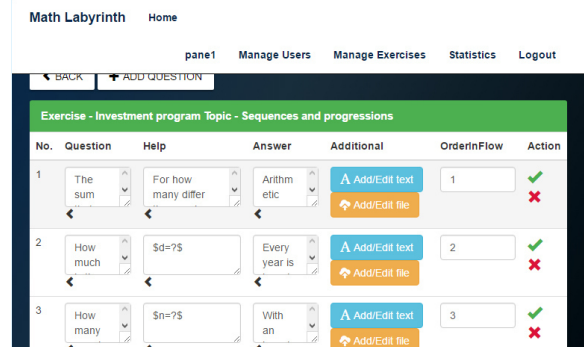


Figure 4. View question

After entering all the questions and the answer we return to the home page and record the entire task again.

In this way, all the tasks on the website are set.

How to use the student web site?



By logging into the website as a student, the assigned tasks can be used. The main menu contains: MathLabyrinth Home and Logout. (Figure 5)

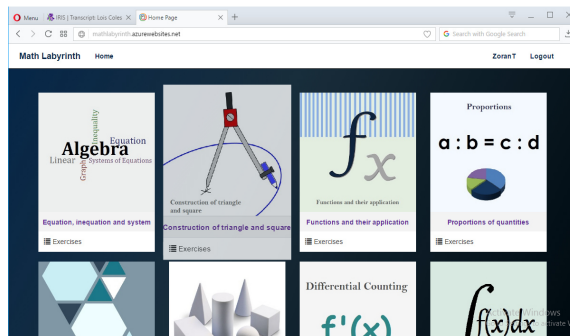


Figure 5. Home - student

All topics are set in Home. By choosing the theme, go to the tasks that are set by that topic. Can read headlines and their contents. If she wants to solve a task and see what her solution is, click on the Play button to start the task, start with the "game" in Math Labyrinth. The resolution steps are set in the form of a maze, so the entire application is called the Mathematical Labyrinth. Clicking on the Play button starts the procedure for solving the task. First, a window opens in which the principles of Pole are written, and then the mode of operation of the task is selected: Test mode - if it only wants to use the questions and help to come to the solution of the task, i.e. Just to test whether a solution or Practice mode can come up - if it wants to use the questions, help, and answers to each question, which will come to the solution of the task. (Figure 6)

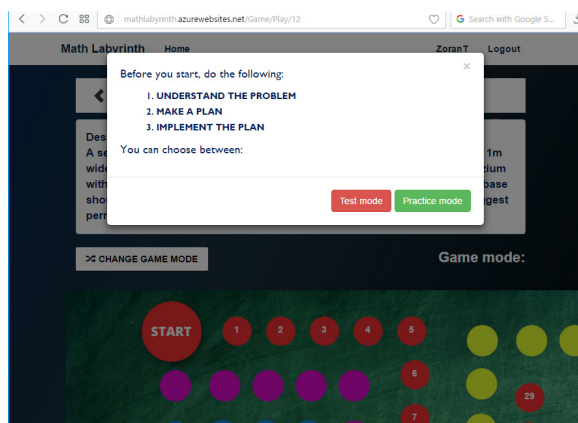


Figure 6. Test mode and Practice mode

By selecting one of the mode to solve the task, a window is displayed showing the maze and by clicking on the number 1 button, the procedure for presenting the task begins. (Figure 7)

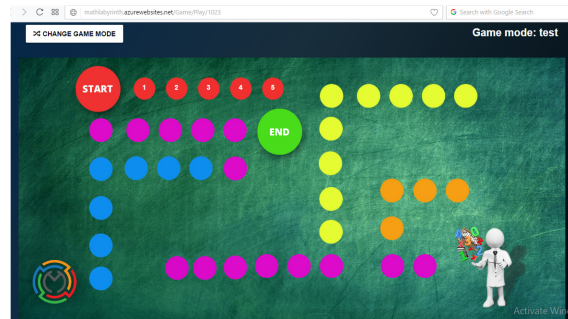


Figure 7. Math Labyrinth

Each step has one question that the student should answer, an image or a link to the applet to which the student should go in order to see the visualization of the task or the decision. (Figure 8)

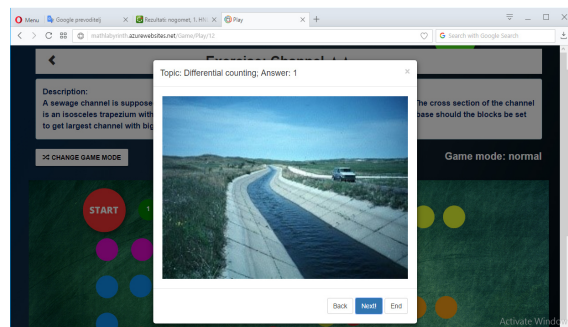


Figure 8. Step in solving the task

By completing the procedure for solving the assignment, the student receives the solution and a window on which a note is congratulated for his persistence. In doing so, it encourages the student to try to independently solve other tasks.

#### IV. APPLICATION OF THE WEB SITE

If we are logged in as Super Admin, in the Statistics tab we can see how many users on the page have registered, how many of them are students, and how many teachers.

During the testing period, this website has had 20 teachers and everyone has a positive opinion about it. About the way of assigning tasks and using the website.

So far, 110 students from the Schools who are involved in the testing of this website have been registered.

The teacher can see which students have used this page so far, how long they have been on the site and what tasks they have fully solved.

All students have positive results so far.

By completing the testing period of the website, another survey will be prepared in order to

determine the student's level of knowledge after using these tasks and the motivation for learning mathematics.

#### V. CONCLUSION

By using the website, using IT in mathematics teaching, when solving tasks and visualizing them, we will increase the motivation of students in mathematics learning.

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