Advantages and challenges in presenting mathematical content using EDX platform

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ADVANTAGES AND CHALLENGES IN PRESENTING MATHEMATICAL CONTENT USING EDX PLATFORM

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Abstract: *In recent years, rapid improvement of educational and internet technologies has contributed to faster development of Open Educational Resources. OERs have had significant impact on lifelong learning and on the availability of learning content. Despite worldwide trends, in Serbia the idea of implementing OER materials in higher education is still new. This paper presents a pioneer project in this area, creation of OER course "Preparation for entry exam", using the edX platform. The course "Preparation for entry exam" is aimed at presenting course materials to help freshmen prepare for entrance exam. In this paper advantages and challenges in the process of creating such a course will be discussed. Special attention will be paid to presenting mathematical content within open educational platforms. The paper also assesses this course from the pedagogical and didactical points of view.*

Keywords: *OER, edX, course, mathematics*

1. INTRODUCTION

At UNESCO's Forum, in 2002, Open Educational Resources (OERs) have been defined as digitised materials offered freely and openly for educators, students and self-learners to use and reuse for teaching, learning and research [1]. OERs have been used for different topics and they can be in various forms from simple texts, pictures and videos to entire courses.

In this paper we discuss OERs related to Mathematics in Serbian. All over the world there are lot of mathematical OERs and many of them are presented through Massive Online Open Courses (MOOCs). Among MOOCs we can distinguish cMOOCs, which are decentralised, network-based, with non-linear structure, and xMOOCs, where courses are hyper-centralised, content-based, linear, and followed by automated, multiple-choice testing of learners' understanding of the content [2, 3]. xMOOCs have become more popular after expansion of platforms such as edX, Coursera or Udacity, which are suitable for creating and using MOOCs. In this paper we present the xMOOC course "Preparation for entry exam", which was created using the edX platform.

2. BAEKTEL-EDX PLATFORM

Course "Preparation for entry exam" (*Priprema za prijemni ispit* in Serbian) is created within the Open edX platform which is used as the educational platform of choice within the Tempus project BAEKTEL (Blending Academic and Entrepreneurial Knowledge in Technology Enhanced Learning). This project has put together partners from Western Balkans and EU universities from Serbia, Montenegro, Bosnia and Herzegovina, Italy, Slovenia and Romania as well as two partners from industry [5]. The idea of the project was to establish a system for creating, publishing, maintaining and searching of OERs both from academic institutions and enterprises. An important part of this system is the Open edX platform, which was adapted for the needs of BAEKTEL project (edX-BAEKTEL platform). This edX-BAEKTEL platform offers some advantages suitable for creating, publishing and using course such as "Preparation for entry exam". For example, [4]:

1) Improvement of the quality of learning materials through peer review processes and use of modern technology.
2) Innovation in the teaching process, openness and availability with low costs.
3) Short periods for publishing learning material, while serving the needs of particular student populations

such as those with special needs, with the benefits of contextualization.

4) Personalization and localization by optimizing the deployment of institutional staff and budgets, and serving students in local languages.
5) Involving students in the selection and adaptation of OER in order to engage them more actively in the learning process.
6) Encouraging creation of new educational models.
7) Promoting the institution and individuals who are creating OERs.

3. COURSE "PREPARATION FOR ENTRY EXAM"

Course "Preparation for entry exam" is aimed at presenting course material to help freshmen prepare for entrance exam. The course is available within edX-BAEKTEL platform[1] (Image 1). We believe this is a suitable way for making preparation materials accessible to a larger community of potential students. Such a course allows them to access free and open materials anytime from anywhere. The course contains the following sections: *Courseware*, *Course Info*, *Discussions* and *Progress*. *Courseware* contains course learning materials, *Course Info* contains updated course news and information, *Discussion* is the section for mutual communication between enrolled students and there is also a *Progress* section, which allows students to monitor their progress within the course.

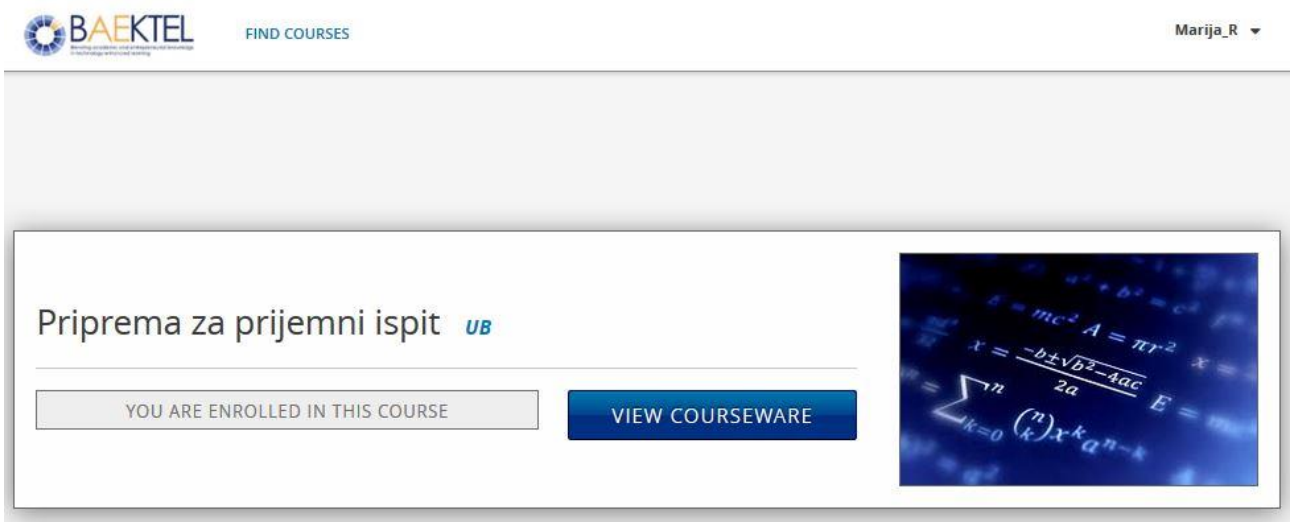

Image 1: Access to course "Preparation for entry exam"

The learning materials are divided in 13 subsections. Every subsection presents one mathematical theme. Subsections contain a theoretical part and a part with exercises. The theoretical part contains basic axioms, theorems and formulae related to a specific mathematical topic. Usually that part of the course is static and it does not require any interaction between user and course. It is the part of the course where students can find necessary knowledge for that topic. Another part of the subsection is the part for exercise, which contains tasks that represent relevant and purposeful examples for the specific mathematical topic. The students are first given the opportunity to try to solve tasks by themselves. Tasks solutions are usually given in the multiple choice form (Image 2). There students can check their solution and then see the detailed, step by step solution process, if needed (Image 3).

[1] Edx- BAEKTEL- Preparation for entry exam http://edx.baektel.eu/courses/course-v1:UB+UB8+2016/courseware/28a75ec7a9a44eedae3231b804e229f4/

Image 2: Multiple choice task at course

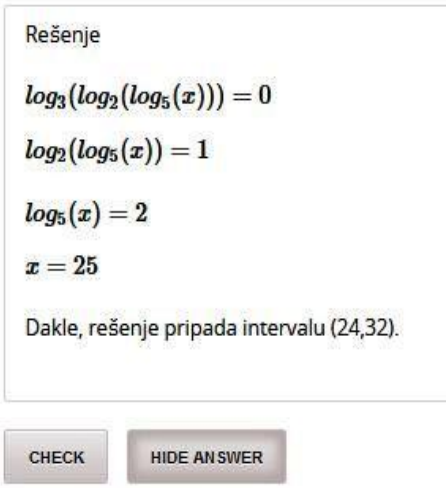

Image 3: Solution of the task

4. PRESENTING MATHEMATICAL CONTENT USING EDX-BAEKTEL PLATFORM

Over the last few years, mathematical content on the web is increasing, which means that production and exploitation of mathematical content using information technology (IT) is in progress [6]. Experts stress the importance of using TPACK framework (Image 4) in creating mathematical content. TPACK has been presented as a system which interconnects and intersects technology, pedagogy, and content knowledge [7]. According to this model technological knowledge has an important place in creating mathematical content. However, creating mathematical content usually requires specific knowledge in using technologies, which poses an additional challenge in creating such content. For example, a creator of materials might be capable of using a specific software successfully in solving some tasks, but would need additional knowledge in integrating that software with other resources and pedagogical requirements [8].

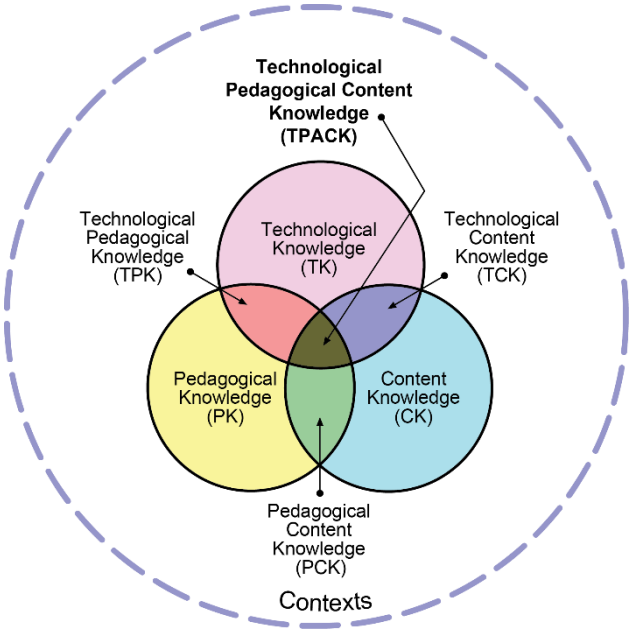

Image 4: TPACK framework (http://tpack.org)

In this section we give a detailed description of the necessary knowledge and skills for creating mathematical content within the edX-BAEKTEL platform.

edX-BAEKTEL platform contains two main components. The first one is a portal aimed for course enrolment and usage of course materials, and the second (edX Studio) is a backend control panel for creating and updating published materials [5]. edX Studio allows creating and combining different type of content, such as text, video, task or discussion. In the course "Preparation for entry exam" we mostly used a combination of text component and task component. The text component contains an editor for writing plain text, with basic editing functions, such as choosing fonts and size of text, adding pictures and links and setting up indentations. Besides the basic editor, the creator of materials can use html view of text. In that case the creator has more opportunities in editing text but it demands creator's basic knowledge of html.

Task component offers a few on board frameworks for different types of tasks. For example, there are possibilities to create multiple choice task, task with text or numerical input, checkbox task or tasks with hints and feedbacks. The platform offers additional advanced options for task design like circuit schematics builder, image mapped input, peer assessment etc. These additional options require some basic programing in Python. All these types of task work with edX tags which annotate the type of content: a question, a response, a possible response and etc. Also there are possibilities for customizing the weight of each problem, number of attempts, feedbacks, randomization of offered answers and time between attempts.

A common situation in creating the course "Preparation for entry exam" was writing mathematical expressions and formulae. Mathematical formulae are written in LaTex form between mathjax tags. Within the edX-BEKTEL platform the usage of mathjax tags is required, which

inform the system that there is a mathematic formula (Image 5). MathJax presents a cross-browser JavaScript library that displays mathematical notation in web browsers using LaTex document preparation system.

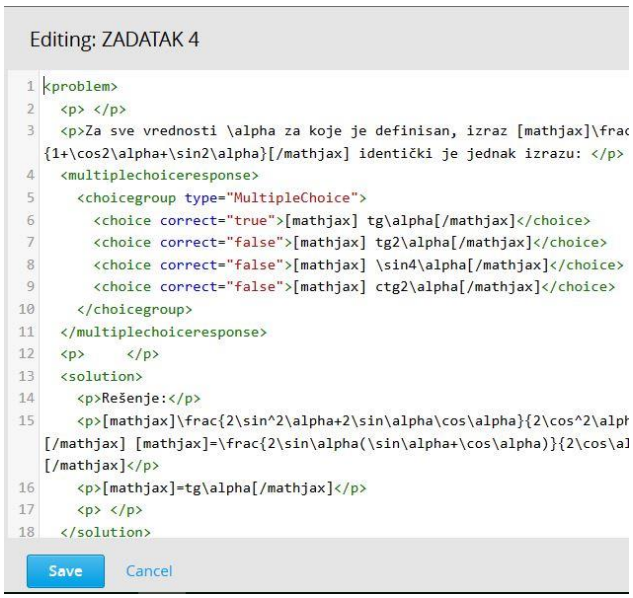

Image 5: Example of tasks editing

According to [5] edX-BAEKTEL platform presents a very good environment for creating courses from a didactical point of view. Some of the didactical principles are present in "Preparation for entry exam". Dividing content in sections, subsections, lessons and units provide a clear structure of course material, which is in line with the didactic principle of systematization and gradualism in the teaching process. Didactical principle of awareness within the teaching process is represented through the tasks, where activity of users and some kind of interaction between users and platform is required, which contributes to the active role of students [9].

The edX-BAEKTEL platform thus offers favourable functionalities, although the interface is not user-friendly with respect to mathematical content writing. Also, for more complex questions deeper technological knowledge is needed. It may be noticed that edX-BAEKTEL platform is a suitable platform in general but for some specific topics, such as mathematics, additional improvement are needed.

5. TERMI RESOURCES IN EDX-BAEKTEL MATHEMATICAL COURSE

The Termi application has recently been launched to serve as a support for the development of terminological dictionaries in various fields. The realization of the application was based on the ASP.NET Framework for C# programming language and MVC design pattern, as well as HTML and JavaScript, whereas SQL Server served as support for the database. The application is located at http://termi.rgf.bg.ac.rs/ and consists of 5 specific units: browse, search, update, bibliography and profiles. Termi currently supports the processing and presentation of terms in Serbian and English, but support for other languages is also planned.

On the Browse page all terms verified by editors can be viewed. The page is visible to all users regardless of whether they are logged in or not. On the left side of the page a hierarchical display of the vocabulary terms is available. Besides its name, each term has its synonyms, abbreviations, description and bibliography. In case that the description of a term contains a Latex fragment, the fragment will be interpreted, which helps in the presentation of mathematical formulae (Image 6).

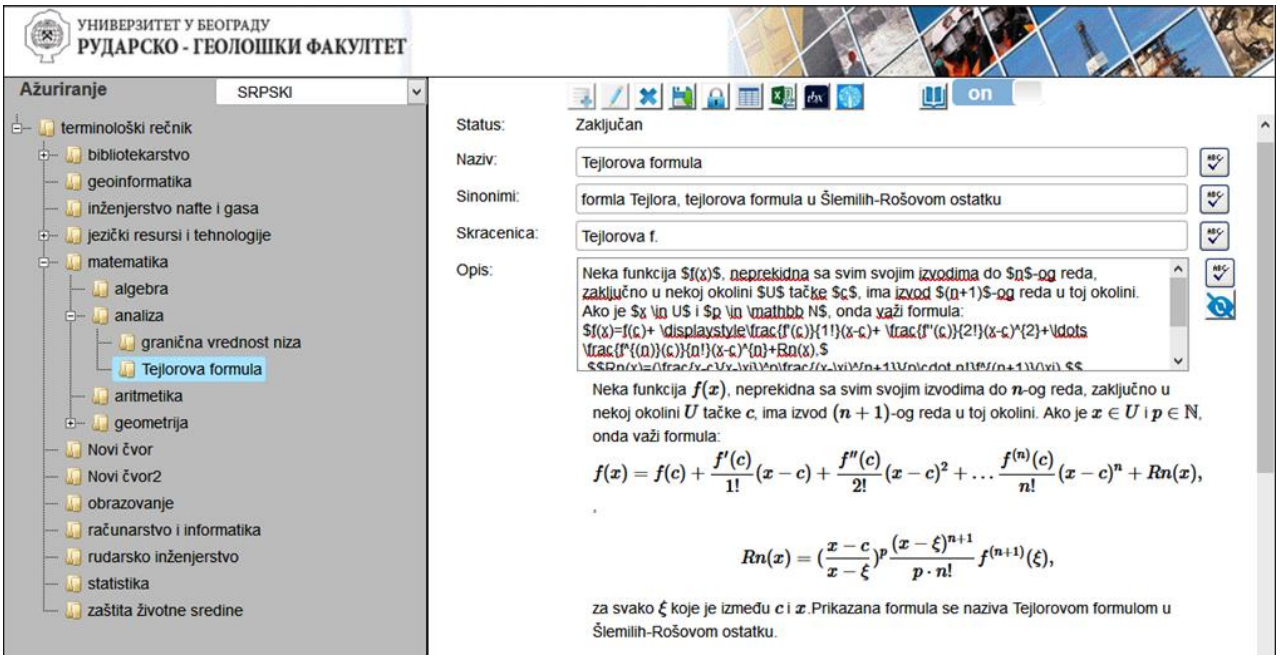

Image 6: Display of mathematical content through Termi editor

Termi is used with the "Preparation for entry exam" course, as it represents a suitable dictionary for mathematical terms. An additional option in Termi is the possibility of creating an export link to a term, which can be embedded in an html page. This provides for establishing a connection between a term within the course and its definition in Termi dictionary. From the user's point of view this addition to mathematical content within the course can be very useful as some kind of reminder for specific or infrequent mathematical terms.

User can open a pop up window with definition from Termi resources by dragging the cursor over the term in the course (Image 7). Also, there is a link which allows the user to see the term in Termi application with additional information, such as synonyms, hyperonyms, hyponyms abbreviations, description and bibliography.

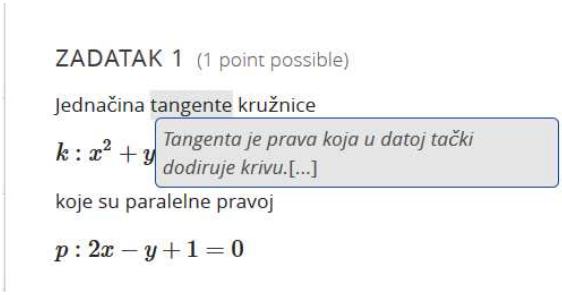

Image 7: Pop up window with definition of term

6. DISCUSSIONS AND SUGGESTIONS

Despite the advantages of OER courses their usage is still at a low level in Serbia. There are not many OER courses in higher education in Serbian and there are almost none suitable for elementary and secondary school. It is interest to nota that the course "Preparation for entry exam" was suggested to more than 300 students, but only 155 students have enrolled. There can be many reasons for that situation, such as unsuccessful promotion of the course and its content, lack of students' habit to use OER courses, lack of interest of students for additional learning materials or students' fear that their work will be evaluated by their future teachers. Also, internet access and minimum of informatics education was required for usage of this course. After ten years of introducing OER, this idea is still not quite adopted, probably because it does not mean just adding a new tool, but rather changing a learning paradigm. But there are still open questions what can be done to improve and promote OER in Serbia and to explore crucial reasons for scarce use of OERs.

Also from a technical point of view, the edX-BAEKTEL platform needs some improvement for creating mathematical OERs. Besides the need for a more user friendly editor and more possibilities in presenting mathematical content, there is also a need for engines which support searching of mathematical content. Currently, there a search engine for searching mathematical content within edX-BAEKTEL course does not exist. A prototype can be WikiMir - mathematics information retrieval system, which is based on keyword, structure and importance of formulae in a document [10]. For such search adequate resources as mathematical term bases are needed. According to [11] there is a great difference between natural languages and mathematical terms. For instance, in Serbian natural language the word "prava" is an adjective but within mathematical terms in Serbian it is a noun. Thus, there is a need for developing a Semantic, Multilingual Termbase for Mathematics (SMGIoM) [11], a semantic term base with strong terminological relations and an explicit and expressive domain ontology. Such a resource would facilitate quick search and analysis of mathematical content. To date, there is no publicly available resource for mathematical content management in Serbian.

7. CONCLUSION

This paper discussed OER materials in Serbian, and the open issue of their acceptance among students. Also we have analysed edX-BAEKTEL platform possibilities for creating and publishing mathematical content. The paper offered an example how different resources can be combined in creating mathematical learning content, such as using the Termi application for mathematical terms. Some challenges in creating mathematical courses within the edX-BAEKTEL platform were pointed out. The lack of engines and resources for deeper analysis and search of mathematical content in Serbian was emphasized. Future work will be based on a more comprehensive research related to awareness of importance of OER materials in Serbian learning environment. In parallel, improvement of lexical resources for mathematical content in Serbian will be continued.

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