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A TEL PLATFORM BLENDING ACADEMIC AND ENTREPRENEURIAL KNOWLEDGE

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***Abstract:** In this paper the main features of BAEKTEL, a platform founded on OER principles, aimed at blending academic and entrepreneurial knowledge, are outlined. The platform is proposed as a solution for both integrating newly emerged knowledge generated by technological development into academic programs, and updating academic knowledge of graduate students working for enterprises. BAEKTEL encompasses tools, learning content and implementation resources. It also features a backend control panel offering to university teachers the possibility to track the progress of their students, and to supervisors of graduate students who started to work in companies to monitor the life-long learning process of their employees. The platform provides an efficient answer to the main criticism that OER are biased towards the so called "big" languages, as it includes a powerful language support system, which enables the publishing of learning materials in various languages.*

***Keywords:** Technology enhanced learning, e-Learning, Open courseware, Open educational resources*

1. INTRODUCTION

It is safe to say that in the majority of engineering disciplines two major sources of knowledge exist. One is the academic knowledge offered by universities and other academic institutions within study programs for future engineers. The other is entrepreneurial knowledge resulting from expertise gained through practical use of rapidly developing technology in solving real world problems. These two sources of knowledge are in general complementary and intertwine in various ways.

The importance of keeping academic curricula up-to-date with current entrepreneurial knowledge has become a critical issue in the majority of engineering disciplines. More and more often knowledge offered by academic programs lags in some of its aspects after expert knowledge available in large enterprises. The integration of newly emerged knowledge generated by technological development into academic programs by renewing the curricula in ever shortening intervals is a solution that is increasingly harder to achieve. Namely, while technology is rapidly developing, changes in academic programs are subject to procedures that are often time-consuming and slow.

On the other hand, academic knowledge that graduate students bring from their universities when they start working for an enterprise becomes partly outdated in time, as new knowledge in the their academic field of expertise emerges. Hence, the now widely recognized need for life-long learning in many disciplines, which presumes the acquiring of new academic knowledge after the academic education has been completed [1].

Advances in information technology and especially web technologies have offered new educational opportunities for solving the aforementioned problems. Even before the emerging of the Semantic Web or Web 3.0, the Web 2.0 had already enabled users to interact with knowledge and information in more active and collaborative ways in a variety of educational formats. As Rhoads et al. point out "a cornucopia of Internet-related educational innovations — including social networking, blogs, wikis, cognitive tutors, virtual learning communities, and learning management systems (LMS) — have enabled further advances in the sharing of educational ideas, materials, and knowledge" [2].

The idea and practice of offering free educational resources in the form of courses through the Internet in the form of MOOCs (massive open online courses), were developed and implemented within the open courseware (OCW) movement. The OCW can be perceived as part of the broader open educational resources (OER) initiative, which defines open educational resources as "digitised materials offered openly and freely to educators, students, and self-learners to use and reuse for teaching, learning, and research." [3]

In this paper we propose a solution both for making emerging entrepreneurial knowledge available to students in academic institutions, and for updating academic

knowledge of graduate students working in enterprises. The approach relies on blending knowledge from the two sources, academic and entrepreneurial, within BAEKTEL, a platform founded on OER principles. Namely, BAEKTEL enables higher education institutions to publish various academic learning resources (video lectures, course planning materials and evaluation tools as well as thematic content), following the OCW concept, on the one hand, and on the other, offers an opportunity for enterprises to present different forms of expert knowledge, such as case studies, expert presentations on specific topics, demonstrations of software implementation in practice and the like.

In Section 2 we describe the goals that are to be achieved by our approach. An insight in the platform illustrated by a conceptual map is given in Section 3, while section 4 offers more details on its language support system. Conclusions are given in Section 5.

2. THE MAIN GOALS OF BAEKTEL

The acronym BAEKTEL stands for "Blending Academic and Entrepreneurial Knowledge within Technology Enhanced Learning". The term "technology-enhanced learning" or TEL pertains to activities aimed at improving the quality and outcomes of learning where technology plays a significant supportive role, thus encompassing the OER/OCW initiative. Goodyear and Retalis argue that designing usable, effective interactive TEL environments, such as BAEKTEL, in an efficient affordable way "is a demanding task, which requires creativity and a significant amount of expertise. Designing for effective learning is a complex problem involving the design of learning tasks, learning resources and divisions of labor that enable each learner to learn effectively." [4] There is no doubt that TEL, defined as above, and OCW, as one of its implementations, have a great potential to enhance the quality of education today.

The interest of European high education institutions in OER and OCW has been rapidly growing in the last decade, since MIT first launched the OCW-movement in 2001. The number of online courses published has grown exponentially, and the Open consortium Europe, led by the Delft University of Technology has been formed. Its core members, Delft University of Technology, Universidad Politécnica Madrid, Universitat de Barcelona, Katholieke Universiteit Leuven and Université de Lyon are presently offering over 14,000 courses online In recent years over fifty European partners from Austria, Belgium, Cyprus, Denmark, France, The Netherlands, Poland, Spain and United Kingdom joined the movement. The movement is especially strong in Spain with almost 40 universities offering free online courses [5].

Starting from the Open consortium Europe viewpoint that OCW represents an essential component of the development of virtual mobility one objective of BAEKTEL is to foster active learning and better motivation in the academic environment through implementation of new technologies in the teaching process. It is also meant to enhance cooperation among higher education institutions and increase transparency by making available an insight in the academic content universities are offering, which will help future students to select the university that best suits their needs. Finally, it enables students to follow a program, or part of a program, delivered at another university from their home campus and thus better prepare themselves in case they are considering to continue their studies abroad.

Another goal of BAEKTEL is to be an efficient tool for facilitating and enhancing partnerships between universities and enterprises through blending of academic and entrepreneurial knowledge by means of OER. This enables life-long learners from enterprises to access state of the art education and high quality courses for their continuing development in a way that is more flexible to combine with professional activities than traditional life-long learning programs. On the other hand it offers to students an insight into expert knowledge gained within enterprises.

The BAEKTEL platform makes OER materials freely available to anyone, anytime via the internet. BAEKTEL thus provides educational support for a variety of users at all levels, from preparations of university admission exams, additional student education, workplace education and life-long learning, integration of creative research potential with industry and academic institutions, for the purpose of achieving better quality and accessibility of education through new technologies. At that, OER learners from universities and enterprises are able to watch the lectures at their own pace and to better prepare themselves for class or work activities.

In brief, BAEKTEL enables OER learners from both universities and industry courses to fill in the gaps in their knowledge and become familiar with new knowledge and technology.

3. OVERVIEW OF BAEKTEL PLATFORM

The BAEKTEL platform basically consist of three groups of components as depicted by a conceptual map in Fig. 1, namely:

- *Tools* - software to support the development, use, reuse and delivery of learning content, including content and learning management systems, as well as content development tools;
- *Learning content* - learning resources, both academic and entrepreneurial, and reference resources, where language resources hold the most important place;
- *Implementation resources* - intellectual property licenses to promote open publishing of materials, and best practice design principles.

The content management system that BAEKTEL relies on is FMG CMS, an in-house Content Management System (CMS) developed by the University of Belgrade, Faculty of Mining and Geology (FMG) as the core of its blended learning system.
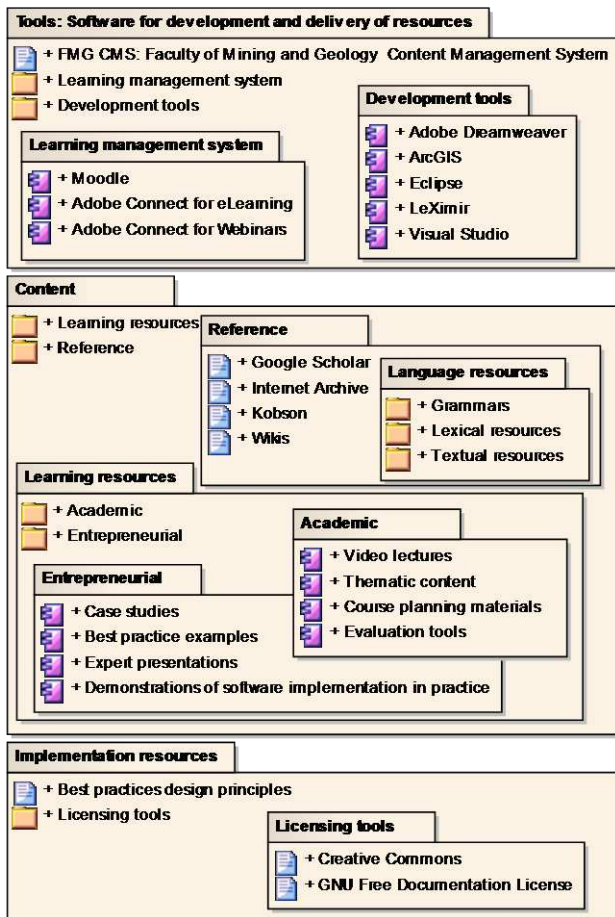
Figure 1: Conceptual map of BAEKTEL

The learning management system comprises of Moodle and Adobe Connect for eLearning and Adobe Connect for webinars.

Moodle (Modular Object-Oriented Dynamic Learning Environment), is a free software e-learning platform, originally developed by Martin Dougiamas, aimed at helping educators create online courses and fostering interaction and collaborative content development. Since it first release in 2002, Moodle has continually evolved and gained popularity. As of September 2013 there were 87,079 registered Moodle sites in 239 countries, featuring 69,982,272 resources, involving 73,722,998 users and 1,300,207 teachers (https://moodle.org/stats/).

Adobe Connect is software used to create general presentations, online training materials, web conferencing, learning modules, and the like. Adobe Connect for eLearning provides a complete solution for rapid training and mobile learning, enabling rapid deployment of training accessible from anywhere, anytime, on virtually any device — leveraging industry-leading content authoring tools, rich learner registration capabilities, and powerful learner management and tracking tools. Adobe Connect for Webinars is an all-in-one solution for digital marketing events, which helps users deliver compelling, immersive events; maximize attendance; and measure results for optimized outcomes (http://wwwimages.adobe.com/www.adobe.com/content/dam/Adobe/en/products/adobeconnect/pdfs/91030579_Connect_Overview_ue.pdf).

Within content development tools are several commercial tools, and LeXimir, a multipurpose tool developed by FMG. Since it pertains to language resources, its function will be outlined in more detail in the following section.

The learning content comprises of academic and entrepreneurial learning resources as well as reference resources, where the most important are language resources, which will also be described in more detail within the following section.

Finally, there are implementation resources, which consist of best practice design principles and licensing tools aimed at facilitating open publishing of materials.

BAEKTEL also features a backend control panel offering the possibility within the academic environment for university teachers to track the progress of their students while using the content, and more importantly to study their learning habits in order to further improve the teaching process. Teachers will also be able to follow how students are mastering specific concepts and assign them to help their peers who have problems in understanding these concepts, thus stimulating "peer to peer knowledge sharing".

The BAEKTEL platform will be used to filter out in early stage the students with tendencies/talent to share knowledge, and motivate them to work as teacher assistants (TA) and also publish their own problem examples as video tutorials. Finally, the platform will provide cost effective practical experience for the students through implementation of software based virtual laboratories (VL) for engineering disciplines.

BAEKTEL backend control panel also provides life-long learning opportunities for graduate students who started to work in companies. Their supervisors, the same as university teachers in the academic environment, will be able to monitor the progress of their employees in keeping pace with new advancements in academic knowledge.

BAEKTEL accessibility services are supposed to support formal learning description methods, as well as methods for describing cognitive student and teacher workload in TEL. Providing means for easy integration of learning content from different sources was also necessary.

4. THE LANGUAGE SUPPORT SYSTEM

In BAEKTEL, special attention is given to its language support system. This is primarily a consequence of the need to sustain expert terminology in a multilingual environment. Namely, due to the combined effect of globalization and European integration the need for enhancing multilingual business and academic communication is growing. In contrast to more traditional approaches that look at one language at a time, a holistic approach is now being proposed that takes into account all of the languages in the learner's repertoire [6]. Its immediate effect on our approach is reflected in allowing learning materials in various languages within the

BAEKTEL platform. This also provides an efficient answer to the main criticism of OER that they are biased towards the so called "big" languages.

In order to offer support in expert terminology within the multilingual approach, the BAEKTEL platform provides electronic terminological resources, parallel (multilingual) corpora of lessons and texts in written form, and functionalities for searching and browsing of terminological resources and using them for text annotation. The contents of these resources conform to the methodic/didactic quality criteria and contain very rich metadata sets that enable adaptive usage.

The importance of terminological resources supporting expert terminology for specific domains is growing with the rapidly expanding availability of various texts on the web. Besides being indispensable in information an document retrieval systems, these resources have a strong educational impact [7]. Students involved in the study of OCW in a specific domain should get acquainted with the proper terminology related to that domain both in their mother tongue and in other languages. Hence the need to integrate terminological resources in e-format into the BAEKTEL e-learning environment.

Terminological resources can take different forms. *Indexes* are the simplest form, basically just lists of terms, usually arranged in alphabetical order. *Glossaries* are slightly more complex and they can be monolingual, bilingual or multilingual. They are lists of terms with definitions, and in the case they are bilingual or multilingual, corresponding terms are usually linked by appropriate mechanisms. *Taxonomies* feature semantic relations between terms, or rather concepts represented by specific terms. The basic semantic relationship, hypernym/hyponym, connects the broader concept, or the hypernym, with the narrower concept, or the hyponym. Taxonomies thus represent hierarchical classifications of concepts, with terms that describe them, and definitions that explain them in more detail. *Thesauruses* feature a more complex semantic structure with relations such as holonymy/meronymy (part of) and the like, and are most often related to a specific domain. Semantically most complex are *ontologies*, where new knowledge can be derived from already existing segments of knowledge.

The BAEKTEL language support system consists of several software components handling simultaneously several types of language resources: grammars, lexical and textual resources (Fig 2). One of the basic lexical resources is the system of morphological dictionaries of Serbian simple words and compounds in the so-called LADL format [8]. Morphological dictionaries in the same format exist for many other languages, including French, English, Greek, Portuguese, Russian, Thai, Korean, Italian, Spanish, Norwegian, Arabic, German, Polish and Bulgarian.

Another important resource is the Serbian wordnet. A wordnet is composed of synsets, or sets of synonymous words representing a concept, with basic semantic relations between them forming a semantic network. Each

synset word or "literal" is denoted by a "literal string" followed by a "sense tag" which represents the specific sense of the literal string in that synset, while an interlingual index (ILI) enables the connection of the same concepts in different languages, a feature that can supports, among others things, the multilinguality of the platform [9].
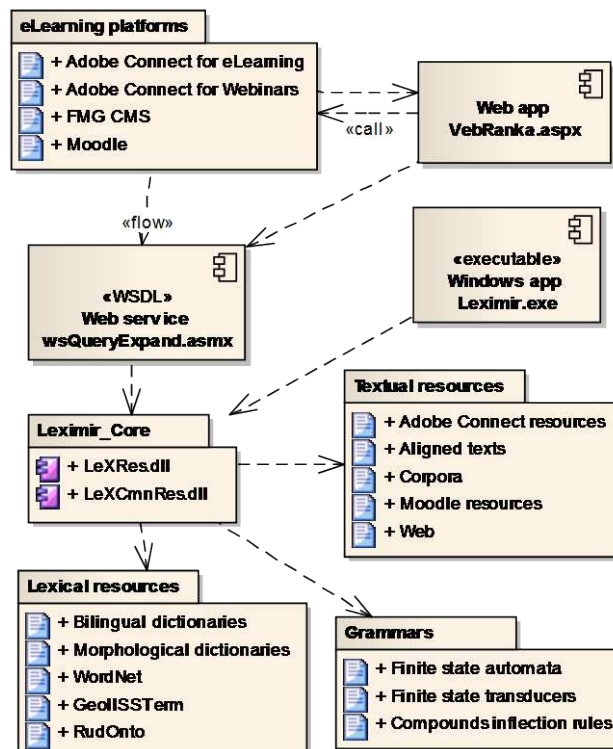

Figure 2: BAEKTEL language support system

An example of terminological resources that BAEKTEL features is GeoISS term, a thesaurus of geological terms with more than 3000 dictionary entries in Serbian and their English equivalents, developed within the GeoISS project and available for search on the web (http://geoliss.mprrpp.gov.rs/term/). Another example is RudOnto, a complex terminological resource also developed at the University of Belgrade Faculty of Mining and Geology and aimed at gradually becoming the reference resource for mining terminology in Serbian in e-format. The current version of RudOnto contains close to 7000 general concepts that are most frequently used in mining engineering practice, with approximately 1600 English equivalents, and occasional translations to other languages. Finally, BAEKTEL terminological resources include small glossaries in Moodle format, which are also already available.

The BAEKTEL language support system also handles aligned texts or bitexts, pairs of semantically equivalent texts in different languages, such as an original text and its translation, that are aligned on a structural level (paragraph, sentence, phrase, etc.). Aligned texts in BAEKTEL enable better understanding of OER and follow the standard format for representing aligned texts, the Translation Memory eXchange format (TMX) that is XML-compliant.

It should finally be mentioned that due to the complex Serbian grammar the language support system also features grammars implemented through finite state automata, finite state transducers and compound inflection rules.

The language resources in the BAEKTEL language support system are managed by a web application (VebRanka), a web service (wsQueryExpand.asmx), an executable Windows application derived from our multipurpose tool LeXimir [10], and a function library (LeXimirCore), a component of LeXimir. The language support system responds to various types of queries issued by the learning platforms. Basically, the web service receives the query from the web application and invokes LeXimirCore, which processes the query. Using the available resources, the system can expand the query morphologically, which is especially important for Serbian, due to its morphological richness. The query can also be expanded to another language thus supporting multilinguality within BAEKTEL.

The BAEKTEL language support system is a very important part of the entire concept implemented through the BAEKTEL platform as it offers and invaluable aid for better understanding of the available OER content.

5. CONCLUSIONS

The BAEKTEL platform outlined in this paper opens a new dimension in the blending of two major sources of engineering knowledge: the academia and the enterprise. It thus contributes to the important task of preparing university students for their future jobs, but also enables them to improve their academic knowledge after graduating by offering them a live-long learning opportunity.

The implementation of BAEKTEL is, however, prone to some risks. One of the most dangerous is the possible lack of interest and willingness among academia and/or enterprise to participate in producing high quality OER content. A similar lack of interest and willingness among students to invest extra work in learning and knowledge sharing is also a threat. Insufficient availability and accessibility of legislation defining the practices and principles regarding the OER content can cause further problems.

Successful implementation of the platform requires the coordination of activities needed for ensuring the agreement of all parties involved on defined policies. Organization and success of public procurement for the equipment and its acquisition is a necessary precondition, and for smooth operation of the platform all communication links and hardware and software infrastructure must operate flawlessly.

In brief, a lot of work still needs to be done before BAEKTEL enters full exploitation to the benefit of future and current university students, as well as university graduates working in enterprises.

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