PROCEEDING
The Fifth International Conference on e-Learning

eLearning
5th Conference on e-Learning 2014

CONTENT

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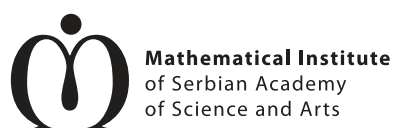
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The annual conference eLearning 2014 is an international forum for researchers, developers and educators to discuss about technology, innovation and best practices in e-learning, distance education and new learning opportunities. This year, the conference will pay special attention to Technical Concepts such as Learning Management Systems (LMS), Virtual Learning Environments (VLEs) and mobile learning technology, Instructional Design, including design and development of online courses, simulation and gamification of learning, and Pedagogical and Psychological Aspects of e-Learning.

The Scope of the Conference

The scope of the conference includes the following topics:

Tehnical Concepts

Learning Management Systems (LMS)
Virtual Learning Environments (VLEs)
Mobile learning technology
Personal Learning Environments
Infrastructure of E-Learning Environments
Authoring tools
Social networks and Web 2.0 technologies
Security and Data Protection
Learning objects
Standards and Interoperability
Semantic Web
Learning Analytics
Mobile Learning Analytics
Learning Networks

Instructional Design

Design and development of online courses
Adaptability
Experiential Learning
Simulation
Gasification of learning
Content Development
Organizational strategy
E-Portfolios
Curriculum development
Quality assurance in e-Learning
Assessment in e-learning
Effective Learning Strategies

Pedagogical and Psychological Aspects of e-Learning

Pedagogical models and strategies
Pedagogical and Psychological Requirements for e-Learning Systems
Learning/Teaching Methodologies and Assessment
Learning Theories, Teaching Methods and E-Learning
Implementing Pedagogical Methods in e-Learning Systems
Didactical Issues of e-Learning
Personalized e-Learning
Motivation and e-Learning
E-Teacher Skills and Competences
Educating the Educators
Brain, Lifestyle&Cognition
Information Skills

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Language
The official languages of the eLearning-2014 is English. English will be used for all printed matters, presentations and discussion.

OPEN LEARNING FOR IMPROVING SCHOOL EDUCATION, LIFELONG LEARNING AND SOCIETAL IMPACT

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Abstract: *This paper presents the Open Learning theory with the aim at modernizing and opening up education for fitting to the given situation and for a long-term and sustainable improvement across all sectors in learning, education and training, all communities, educational and training systems and societies in Europe and worldwide.*

Keywords: *Open Learning, quality, innovations, learning history, quality development, school education, lifelong learning, digital age, E-Learning*

1. WHY OPEN LEARNING?

In this paper, the theory and design of Open Learning will be introduced.

The Open Learning theory answers the question how to improve the quality in learning, education and training on the background of the given digital age and revolution and how to integrate learning innovation for modernizing education.

Open Learning is the theoretical and generic framework and long-term vision for the modernization of Learning, Education and Training (LET) and for the required changes in all educational sectors, from kindergarten to lifelong learning. Open Learning combines learning innovations and learning quality to achieve a balanced and appropriate solution adapted to the given learning objectives, needs and situations.

An innovative and structural change in particular within the school education is required due to the general and global challenges by the digital age.

2. CHALLENGES BY THE DIGITAL AGE

Learning innovations and learning quality are important and reflected topics for a very long time from the beginning of discussions and theories about learning processes: In Europe, Plato's Allegory of the Cave is one of the earliest examples. Their debate continued during the introduction of the first universities in the Middle Age and of the school systems in the 18th century. During the last years and the upcoming so called "digital age", many discussions took place (also in the fields of school and higher education, learning for work and at workplaces as well as non-formal and informal learning) due to the two main changes covering all sectors, branches and levels of the society: first, globalisation and second, establishment of the worldwide internet.

These two factors are leading to global markets, worldwide networking, communication and competition, as well as to the digitalisation of services and systems with the introduction of internet-based services, hardware and software within all parts of our lives. They were and are still changing all societies and in particular the learning, education and training in schools, universities, at work and online.

The European Union has identified the challenges and opportunities by these global changes and published several communications and framework for the future European society and its learning, education and training: Based on the Lisbon Declaration, the former vision of the Information Society called i2020 and the established Bologna Process [1], the European Commission and Council have reviewed and analysed the impact of the globalisation, the internet and the information technologies in general leading to current new communications and policies: The Digital Age for Europe, EUROPE 2020 and Education and Training 2020 are reflecting these movements with special emphasis on the potentials for the European citizens and communities [2], [3] and [4]. Most recently the European Commission launched the communication on Opening Up Education for supporting the introduction and use of Technology-Enhanced Learning (TEL) and Open Educational Resources (OER) as well as the Grand Coalition initiative for competences and skills development through lifelong learning related to the world of work and all citizens in the European societies.

3. MYTHS OF LEARNING INNOVATIONS

In the international discussions about the future learning, education and training from theory, research and politics but also from press, individuals and social communities, the main focus is currently on the technological innovations and their opportunities. Theories and experts are claiming brand new and extraordinary chances, sometimes promising new learning eras and paradigmas: E. g., the theories of connectivism by Siemens [5] or of Social Learning by Hart [6]. Even the arrival of fundamental new ways of learning are promised under the label of learning 2.0 / 3.0 in analogy to the terms web 2.0 / 3.0 (cf. [7], [8], and for an overview [9]). Finally new concepts and descriptions of our world as a 'flat world' are leading to predictions that 'to learn how to learn' will become the most important asset for all workers due to all the changes and faster innovation (cf. [10]): It is claimed to be a new movement and progress however it is clear

and evident in pedagogy since several hundreds of years (if not longer) that 'to learn how to learn' is most important for learning processes and progress and for the development of personality and competences (cf. [11], [12], [13] and [14]).

From this perspective, it seems that learning innovations are the only path and road map for a better future education and training: The underlying (and often hidden) argument is that through them we are earning many new chances to learn, without them we are not fitting to the changing times of globalisation and worlwide internet as well as to the new digital generation, the so labelled "digital natives" (Prensky [15], cf. for a general criticism of this term [16]). We call this discussion the (learning) innovation strand.

On the other hand, there is a long-term discussion with huge tradition (since the beginning of our culture) about the learning quality (cf. for an overview [17]). We call this debate the (learning) history strand even if some of the topics like quality management for education and training are less than 100 years old.

Surprisingly, both discussion strands, the new innovation and the old history, are not interconnected and not reflecting each other. It seems that the supporters of learning innovations do not want to refer to theories of the past and that the authors of learning history do not want to recognise global changes vice versa. That leads us to an important question that requires urgently attention and an answer in our changing times: What is the relation between learning innovations and learning quality?

4. IS LEARNING CHANGING?

Our answer is based on three hypotheses of the current learning situation (for their detailed discussion and arguments cf. [18]):
1. Learning history should not and cannot be ignored.
2. Learning innovations are mainly technology-driven.
3. Learning is not completely changing.

First of all, it has to be stated clearly that the worldwide changes by globalisation and internet for all through world wide web and social media and communities do not justify to withdraw or ignore all theories from the past. Modern innovation theories ignoring this treasure of expertise from the history are losing a well-proven underground for basing their argumentation (even if contradictory) that is providing a huge variety of different concepts (e.g. cf. for extremes the theories of cognitive development by Piaget [12] and the systems theories by Luhmann [19] and [20] and Maturana/Varela [21]).

Second, the currently claimed learning innovations based on the effects of new internet opportunities, services and social media are only dealing with technological changes and chances: Of course we can realize diverse learning scenarios and (digital) communities, services and systems today that were not available several years ago like MOOCs, social communities, blogging (cf. [9], [6] and [22]). But technological inventions and changes are offering only new options and pre-conditions. They still require an appropriate learning design and setting with an attractive and motivating learning environment: For those (and other) reasons we call together with Daniel [22] MOOCs as the 'educational buzzword of 2012'. Therefore we direct our focus on the learning quality beyond MOOCs: Learning quality was, is and will be the key for learning success and outcomes (cf. [23]).

Finally learning is not completely different and changing only due to the globalisation, new technologies and network opportunities. The new technologies and global changes are providing challenges and chances to establish new ways to base, present and integrate learning processes within education and training and learning groups including new options for self-regulated learning. But these new modes and types of access and interactions in learning processes do not change completely the way how people learn. The style how to use, consume and reflect learning opportunities and materials may change through increasing speed and multi-tasking and lower attention but that is only increasing the requirements for learning designers, educators and teachers.

5. LEARNING QUALITY IS KEY

What is most important for the success of learning processes is the learning quality. Learning opportunities have to meet the need of the learners and to provide the appropriate quality to fulfil their requirements. That can sometimes mean a simple learning course with teacher-centered education and sometimes a complex sophisticated learning environment with learner-oriented group work enriched facilitated by an educator as moderator, tutor or enabler and with new learning technologies and innovations including social media and communities. That means that learning quality cannot pre-defined but have to be adapted to the given situation and learners. In this sense, learning history and learning innovations are two different approaches and points of view that are interdependent and cannot be reflected solely but have to be analysed in conjunction for achieving the best and appropriate learning opportunity and success. Next to them, standards are building the third source for planning and designing the best learning opportunity and quality (cf. [18] and [24]). This overall objective for the continuous improvement of learning quality can be called quality development: Quality development has to combine the relevant and appropriate approaches, concepts and elements from all three dimensions that are basing the learning quality: History (by learning theories and traditions), innovation (by new learning options) and standards (by consensus building on learning).

There could be three alternatives and options in theory: To focus only on the learning innovations only (1.), to focus only on the history of learning traditions and theory (2.) or to arrange the mix between both approaches (3.). As already explained above, it is not possible to argue that the only focus on learning innovations can succeed by

jumping out of nothing as it cannot be argued and proven how such a jump can take place by ignoring the learning experiences and theories. On the other hand, future learning opportunities have to reflect the changes in society and chances by innovations and would also fail by ignoring them. The following figure tries to represent this need to combine learning innovations and learning traditions and theories:
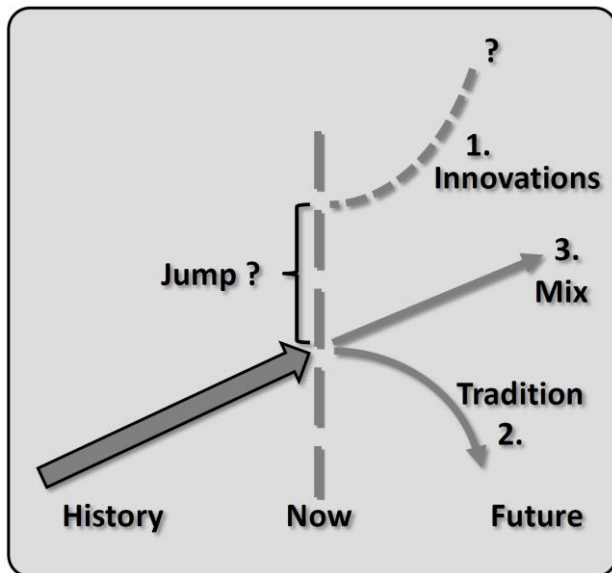
Image 1: Learning history and innovations

Therefore only the mix of learning innovations and history based on learning experiences and theories from the past is promising and convincing as. Thus, we can say and summarize: Quality development is the crucial task for learning, education and training.

The question is now: How can quality development be addressed and improved in learning, education and training in our times of the digital age? The concept of Open Learning tries to provide a theoretical framework for the improvement of the learning quality through the integration of learning innovations leading to opening up the education.

6. THE THEORY OF OPEN LEARNING

Open Learning tries to provide an answer on the given challenges of globalization for the modernization of learning, education and training. Open Learning combines the two major dimensions to meet the current requirements and the right balance between learning innovations and tradition achieving high quality in learning:
1. Suitable and open learning styles and designs
2. Suitable and open learning scenarios and environment

Open Learning introduces the open movement into all educational sectors: Under the umbrella of the term "Open Education" many different approaches are currently summarized. The use of Open Educational Resources (OER) and the design of Open Educational Practices (OEP) are often promoted for all educational

sectors based on the definition by UNESCO [25]. As a theoretical and generic framework and long-term vision for the modernization of Learning, Education and Training (LET) and for the required changes in all educational sectors, from kindergarten to lifelong learning, Open Learning has always to be adapted to the specific situation, target group, learning objectives and needs.

Technology-enhanced learning can play a key role in the future improvement of learning quality in education, training and societies: Not only formal, but also non-formal and informal learning can be facilitated by technology-enhanced learning, e. g., through social learning for working smarter and social workplaces (cf. [6] and [26], for general criticism cf. [27]). In addition the support and tracking options offered by the used technologies can provide substantial basis for data collections, measurements and evaluations of all learning and working activities to assess changes in the performance and assigned competences.

7. OPEN LEARNING IN PRACTICE

In the following we will provide a first adaptation of Open Learning for the school education as well as an introduction into the key European Initiative Open Discovery Space.

Adaptation of Open Learning for school education

Open Learning can be adapted as Open School Learning for the school sector as the combination of:
1. Open Education (innovative education with technologies)
2. Creative Classrooms (collaboration with moderation)

Open School Learning introduces the concept of Open Education within schools by improving the variety of learning styles, amongst others through the use of e-Learning and Open Educational Resources. Open School Learning establishes the vision of Creative Classrooms where teachers are continuously changing their roles according to the scenarios and students are cooperating, amongst others through developing a network of communities across Europe.

Currently, one major project funded by the European Commission is focusing such a broad and sustainable introduction of Open School Learning and technology-enhanced and competence-based learning within school education across whole Europe.

Open Discovery Space for Open Learning in schools

Open Discovery Space (www.opendiscoveryspace.eu) with its focus on the school sector and teachers as main target group addresses more than 2,000 schools and offering training for over 10,000 teachers in all 27 EU member states: Open Discovery Space (ODS) introduces innovative learning designs and scenarios into K-12

schools through the support by technology enhanced learning and social communities.

Open Discovery Space (ODS) focuses on the required modernisation of school education, based on the combination of Open Education and Creative Classrooms through the concept of Open School Learning. Open School Learning introduces and uses innovative scenarios, open educational practices and resources and can be realized through de-centralized and technology-enhanced communities. ODS cooperates since 2012 in a first of its kind effort with all school stakeholders to create a pan-European e-learning environment to promote more flexible and creative ways of learning. The project follows a unique approach to learning at school: supporting the development of self-esteem, an increased "sense of belonging", and an improved perception of one's own capacity to solve problems. In this approach, ODS addresses teachers as main target group and develops regional hubs, instruments and online services, which facilitate and improve Open School Learning and contribute to the "construction of the surrounding community" [28].

The ODS project focuses the establishment of de-centralized regional communities through the introduction of technology-enhanced learning within the national European school systems including the provision of a portal for Open Educational Resources and the development of learning scenarios and services for the long-term improvement of school education by innovative pedagogical planning and learning. The Inspiring Science Education (www.inspiringscience.eu) project will benefit from these developments and transfer all achieved results in the fields of science education for further support and innovations for and by teachers.

7. THE FUTURE OF LEARNING

The introduction of Open Learning requires a complete change and paradigm shift of learning in the future: The paradigm shift from input to outcome orientation in learning is moving the focus from knowledge (as learning input), which can more and more quickly become outdated, to competences (as learning outcomes), including abilities to transfer and act successfully in an unknown situation. Today we have to learn during our entire lifetimes to fulfil lifelong learning in order to be prepared for future jobs and tasks that do not yet exist, which are still unknown and cannot even be thought about (cf. [27], [10] and [29]).
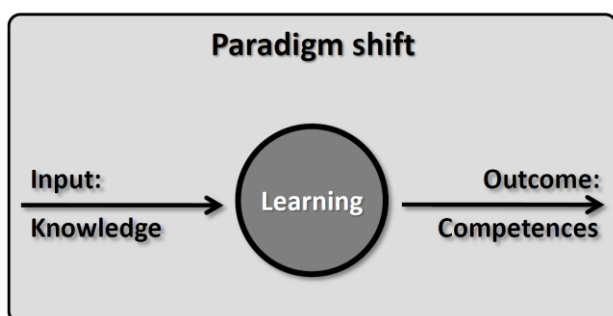
Image 2: Paradigm shift in learning

However the term "competence" is defined in many different ways: The historical development lines of the term "competence" in different science disciplines demonstrate the variety and complexity of meanings and views on the term. In psychology, White has used the term "competence" very early (in the year 1959) to designate skills developed by self-organization and required for performance [cf. 30]. In semantics and only a few years later in 1962, Chomsky defined competence as the self-organized ability to construct and understand a potentially unlimited amount of sentences using a limited set of vocabulary and thus, to manage speech acts as a competent speaker [cf. 31]. And based on these concepts, two different schools of thought were developed in different directions: the first line continued the Chomsky's ideas by broadening them to a human being's acting in general; the second line used the term for societal criticism and combined it along with "coping", in particular with the generation of social situations.

Today, the concept of competence (which is traditionally combined with successful acting in unknown situations in the Central European tradition) offers a theoretical basis for the development of strategies, methods and means for solving the current tasks (cf. [32]). In addition, the needs for personal and organizational development have to be identified, and training and change management methods have to be introduced (cf. [29]).

Thus, initiatives are taking place at the European (cf. [3], [33] and [34]) and international level (cf. [35] and [36]) to harmonize the whole competence field on the basis of the requirements from all stakeholders, educational systems and societies. This paradigm shift towards competence-oriented learning, education and training is not only needed for facing current and future challenges but also for the broad introduction of Open Learning.

8. THE VISION OF OPEN LEARNING

Efforts towards Open Learning through innovations like online cooperation, MOOCs and technology-enhanced learning have achieved broad awareness and agreement through the support of new policies such as Opening up Education launched by the European Commission. Nevertheless, investment in education and training is decreasing in many countries despite general recognition of its importance. Innovation and e-Learning can foster new ways of learning, however many contributions currently focus exclusively on technological opportunities. But it is evident that educational change through Open Learning and refined pedagogies is extremely important to achieve the highest learning quality possible.

ICORE, the International Community for Open Research and Open Education (www.ICORE-online.org) was established with this objective in 2013 and launched at the international LINQ Conference in Rome in order to promote open education and its connections with open research. ICORE is collaborating with leading European and international organizations motivated by a common

vision, joining efforts for future strategies and activities which facilitate innovative learning in schools, universities, societies and at work.

ICORE promotes, supports and enhances Open Research and Open Education worldwide. Main objectives of ICORE are the recognition, progress and application of Open Research and Open Education: ICORE wants to bridge both worlds of Open Research and Open Education. The goal is the mutual re-usage of their results and outcomes, e. g. through the usage of digital resources from Open Research in Open Education.

Hopefully ICORE and all other stakeholders joining and interested in opening up learning, education and training will facilitate the required changes and realize Open Learning for improving school education, lifelong learning and societal impact. A first step was the discussion and approval of the "Declaration of Crete" (cf. [37]) that is requesting the re-establishment of openness as default what could facilitate and improve the introduction of Open Learning worldwide.

9. CONCLUSION

Learning innovation and learning quality are very often addressed separately and solely. But in fact they are interdependent and have to be reflected both for achieving the best learning quality: The best appropriate learning quality remains the core objective in learning, education and training and can be achieved by combining the three dimensions learning history, learning innovations and learning standards. Learning innovations can increase the learning quality but require a basis provided by the learning experiences and theories from the past. On the other hand learning traditions have to be enriched by innovations, in particular facing the current worldwide challenges of globalisation and worldwide internet establishment. Together with the third dimension, the learning standards, learning history and learning innovations are building the basis and potential inputs for planning and design learning opportunities. A suitable mix of history from learning experiences and theories and current innovations combined with international consensus on learning standards is required.

The Open Learning concept was introduced to fulfil these challenges and requirements: It has been roughly adapted to the school education as Open School Learning. In general Open Learning can ensure to meet the learners' needs and to provide the best and appropriate learning opportunities and learning quality fitting to the given situation and for a long-term and sustainable improvement. In the future it has to be demonstrated that Open Learning can also be adapted across all sectors in learning, education and training, all communities, educational and training systems and societies in Europe and worldwide.

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TECHNOLOGY AIDED EDUCATION OF STUDENTS WITH DISABILITIES: A CASE STUDY FOR STUDENTS WITH CEREBRAL PALSY

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Abstract: Differences among individual students can have significant impact on learning performances. In case of students with disabilities learning process can require different approaches in order to overcome physical and social barriers and maximize student's potential. In this paper, we discuss educational challenges of students with special needs by a case study of students with cerebral palsy. Also, it is discussed what kind of technological improvements can be helpful in overcoming the issue mention – from assistive technology devices and software to new learning paradigm which change the way of developing, organizing and presentation of learning materials.

Keywords: E-Learning, Personalized learning, Accessibility, Disability, Cerebral palsy, Assistive technology

1. INTRODUCTION

It is well known that differences among individuals have significant impact on learning performances. More often than not, people with various kinds of disabilities are unable to pursue their educational (and later professional) goals in full capacity as a consequence of environmental and social restrictions. Fortunately, in recent years there have been significant improvements in this area. Three fundamental components stand out as necessary prerequisites of such breakthrough:

- Legal acts,
- Technological improvements,
- Adaptive (student-oriented) learning.

By guaranteeing rights of disabled people, preventing discrimination and suggesting standards which organizations have to fulfill, legal acts regarding the accessible education are expression of maturity of a society and one of the main indicators of human rights. Although various countries have different criteria and, as a consequence, different legislation, the modern trend is positive in terms that more and more countries recognized the existing issues and updating laws in order to meet equal opportunity standards. For more information on accessibility legislation, one can refer to [1] [2] [3] [4] [5] [6] [7].

Learning process in general can benefit from recent technological developments, but it is of crucial importance for education of disabled students. Technological improvements often can be helpful in overcoming environmental and physical barriers which prevent disabled student to participate in educational activities in full capacity. Technology can impact the way learning material is created, how it is organized, method in which it is presented and when it is delivered to students. Learning from any place at any time, multimedia learning content, content, games, simulations, augmented reality, location-based and contextual learning [8] have become important parts of learning experience.

Finally, modern trend in education are learning materials developed, organized and presented in such way that each student can plan learning activities according to his or her individual abilities and interests [9] [10] [11]. Although all students have benefit of such approach, it is especially valuable for students with disabilities.

In this paper, we discuss educational challenges of students with special needs by a case study of students with cerebral palsy. The reason for this is twofold. Firstly, Belgrade Metropolitan University (BMU) has certain experience with students who have cerebral palsy. Secondly, cerebral palsy is a disease which can lead to various kinds of disabilities as it is explained later in the paper. Therefore, conclusions resulted from analysis of such case can be useful in many other situations completely unrelated to cerebral palsy. We present challenges which students with cerebral palsy have to face during their education and propose certain improvements in order to make educational process more accessible.

The rest of the paper is organized as follows. In Section 2 we present various types of disabilities caused by cerebral palsy. In Section 3, we present educational challenges resulting from such disabilities. Short survey was conducted among students with cerebral palsy in order to better understand their problems and needs. In Section 4, several examples of assistive technology are presented. In Section 5, we present current situation on BMU regarding

this issue. And finally, in Section 6, we provide short conclusion.

2. DISABILITIES CAUSED BY CEREBRAL PALSY

Cerebral palsy is "an umbrella term covering a group of non-progressive, but often changing, motor impairment syndromes secondary to lesions or anomalies of the brain arising in the early stages of development"[12]. Causes of cerebral palsy in most cases are caused by combination of contributing conditions. Adolescent pregnancy, low socio-economic status and poor health are associated with increased risk of cerebral palsy in children. In as many as 25 percent of affected cases, no definite cause of aetiological factor can be pin-pointed.

As a disease, cerebral palsy can lead to various disabilities – vision related, hearing related, speech related, motor related, and cognitive-related. In particular, those disabilities are:

- **Motor disabilities** - very often when we are talking about cerebral palsy, there are focusing on disorders of movement and posture. Cerebral palsy affects people in different ways and can affect body movement, muscle control, muscle coordination, muscle tone, reflex, posture and balance.
- **Visual dysfunction** - the most common is strabismus: nystagmus, visual field cuts, refractive errors and other oculomoux defects are frequently found. There can be inability to interpret visual symbols, inability to identify letters.
- **Visual-perceptual and visual-motor dysfunction** - many children have problems with matching shapes, distinguishing shapes that appear similar, seeing a drawing as separate from its surrounding background and differentiating between varying directions of lines or forms (example: distinguishing "b" from "d").
- **Auditive dysfunctions** (hearing impairment) are also frequently found at children with cerebral palsy.
- **Other sensory dysfunctions** – problems with two point discrimination, sense of position, sharp-dull discrimination, pain, light touch, and temperature sense.
- **Communication disorders** - communication problem is more handicapping people with cerebral palsy than inability to walk. There are speech defect which is relate with reduced control of facial and respiratory muscles, or the muscles of the toque or lips. Language dysfunction is a frequent problem in communication disorders in children with cerebral palsy and children with central processing deficits need an educational approach suited to extend their knowledge of concepts as well as their use of meaningful communication. Emotional and behavioural problems are very important and that is because children with severe cerebral palsy grow up in a life situation that is very different from that of other children.
- **Cognitive dysfunction** - one of the most commonly associated deficits of cerebral palsy. Children with greatest physical handicaps also have the poorest mental functioning, and there seems to be systematic relationship between the extent of the brain damage and the development of intelligence at the group level of research.

Each one of these disabilities can present a serious obstacle for full participation in regular educational activities.

3. EDUCATIONAL CHALLENGES

In Serbia, Cerebral Palsy Associations estimate that more than 6000 people have cerebral palsy. One of the biggest problems that arises with cerebral palsy is the transition to school, and then to adulthood. Education is very important in this process and it is the key that opens the door to all our future opportunities. Every parent of a child with cerebral palsy must be put considerable through into his child`s education. In order to be fully included in educational process and to reduce barriers to learning, parents of a child with cerebral palsy work closely with educators in the special education program to optimise their child's potential for lifelong learning. For children with cerebral palsy, finding the right school environment is often difficult. Depending on the type of cerebral palsy and the degree of severity, the current trend is to enrol a student into one of the "mainstream" schools and place the disabled child into regular classes with non-disabled children. Although some people with cerebral palsy are able to participate in school educational activities with minimal or no help, many of them during the process need assistant and special attention. It is the reason why people with cerebral palsy often need special education. In it essence, special education can be understand under the paradigm of adaptive learning. Definition of special education by The National Dissemination Center for Children with Disabilities [13] is:

"Special education is instruction that is specially designed to meet the unique needs of a child with a disability. This means education that is developed to address that child's specific needs in order to achieve his or her highest learning potential. Since each child is unique, it is difficult to give a sweeping example of special education. It is individualized for each child. It can consist of early intervention programs to identify specific needs related to physical abilities and educational challenges, evaluations, adaptive techniques and tools to enhance those abilities, transition plans and guidance throughout the process."

Many children with cerebral palsy frequently develop learning disabilities. A child with a learning disability can have average or above average level of intelligence, but has difficulty processing certain types of information. In addition to possibly having a learning disability, many children with cerebral palsy are limited in their ability to communicate. Because of this, they are sometimes

considered to have much less intellectual ability than they actually do, as teachers may not be able to tell whether or not the child understands the lesson if they are unable to speak. Due to this, such students are unnecessarily placed into special education programs, many of which focus much of the time in school on different therapies, to the detriment of academic progress. Because of this common misconception of intelligence levels and cognitive ability it is very important for teachers to be educated about the issue so they can respond adequately in such situations.

For the purpose of this paper, in order to more closely investigate this issue, a group of people with cerebral palsy has been interview. Fifteen students participated in the interview, all of which are either from BMU or from Cerebral palsy Association of Serbia at city of Niš. The questionnaire was composed from the following questions.

1.) **Do you have needs for assistive technology hardware?**
Most students responded that they have needs for such hardware. Smaller number of students answered that they are accustomed at normal hardware (as keyboard and mouse), mostly that students with mild form of cerebral palsy.

2.) **Do you use assistive technology hardware in your everyday work?**
Most students responded that occasionally they use such equipment. However, financial issues were mentioned as a usual obstacle in obtaining such equipment. Although, the issue of lack of such devices at the university was raised.

3.) **Do you have understanding from teachers in situations when you need additional help?**
Each student answered that teachers are helpful and cooperative.

4.) **Do you have problem with tiredness after walking or sitting in unsuitable position? Does it affect your concentration?**
Every student answered affirmative to this question.

5.) **How long can you stay at college due to the physical difficulties? Do you have problem with sitting at the desk for several hours?**
Most students tell that they have problem after sitting 2 or more hours. It was overwhelming reason for skipping lectures.

6.) **Do you prefer coming to university building for classes or distance learning from home (e-learning)?**
Most interviewed students have significant motor problems and they prefer for learning from home.

7.) **How would you describe environmental conditions at the university?**
Most students expressed need for environmental adaptation. Adapted furniture, curb ramps and elevators are mentioned as potential upgrades.

8.) **Are you capable of finishing usual tasks like exams and homework in the established timeframes?**
Each student answered that usually more time is required. Extent to which additional time is needed vary mostly as a result of degree of motor disability because it slows down writing and typing.

9.) **Would it be helpful to split an exam into several smaller chunks which can be completed in shorter period?**
Each student answered affirmative to this question.

4. ASSISTIVE TECHNOLOGY

Assistive technology "*includes assistive, adaptive, and rehabilitative devices for people with disabilities and also includes the process used in selecting, locating, and using them.*" [14] It is key component in modern education which enables people with disabilities to perform tasks that they had great difficulty accomplishing and, therefore, allows them to participate in various educational activities. Assistive technology products useful for students with cerebral palsy:

▪ **Alternative keyboards** — Alternative keyboards use different designs to attempt to change the user's posture. Usually, such keyboards have larger or smaller than standard keys, alternative key configurations, adaptive key configurations and keyboards for use with one hand. Examples of such keyboards are presented in Figure 1 and Figure 2.

Image 1: Clevy Keyboard II - English Lower Case [15]

Image 2: A keyboard which allows various layouts. [16]

- **Special mouse devices**, adapted for humans with special needs. Several examples are shown in Figure 3.

(a) (b) (c)
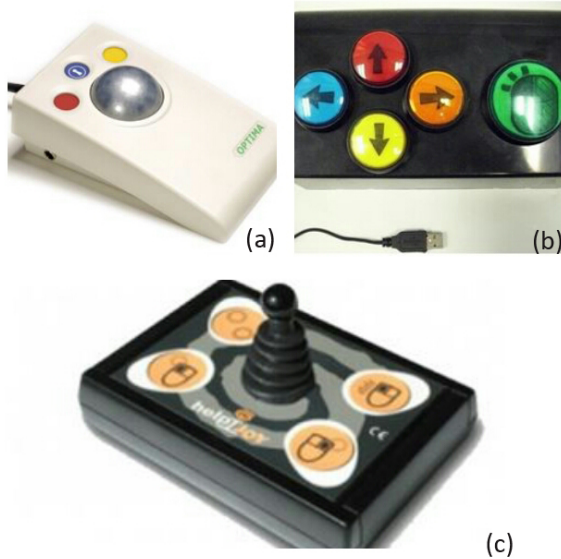
Image 3: Several special mouse devices. [15]

- **Mouse emulators** — used to control the cursor on the screen without use of hands. Devices used include ultrasound, infrared beams, eye movements, nerve signals, or brain waves. In Figure 4. One such device is presented (tracker pro Electronic pointing device). This device is used to help people who are unable to control a mouse and enables controlling the pointer on a computer screen by head movements. Another example of mouse emulator is Sip-and-puff systems—activated by inhaling or exhaling (Figure 5).

Image 4: Mouse emulator - Tracker pro. [18]

Image 5: Mouth-controlled mouse emulator. [17]

- **Accessible software** has become more common option included in popular software packages. The well known example is Microsoft Accessibility set of programs. It includes the following useful features:
  o Keyboard options which include filters with correction for erratic motion tremors and slow response time, filters for typing aids, such as word prediction, abbreviation expansion tool and add-in spelling checkers.
  o On-Screen Keyboard - an image of keyboard (standard and modified keyboard) on computer screen which allows user to select keys with touch screen, mouse, trackball, joystick etc.
  o Speech recognition or voice recognition programs - people can give commands and enter data using their voices rather than a mouse or keyboard using a microphone attached to the computer. These programs can be used to create text documents.
  o Screen enlargers or screen magnifiers which work like magnifying glass by enlarging a portion of the screen.
  o Text-to-speech or speech synthesizers suitable for people who suffer from visual impairing and reading disabilities.

5. ACCESIBLE LEARNING AT BELGRADE METROPOLITAN UNIVERSITY

We analyzed current state of accessible learning at BMU. After conducting interview with students, special attention has been given to the following questions:
- Distance learning,
- Personalized learning,
- Examination process and assessment,
- Assistive technology and environmental conditions.

BMU offers distance learning since 2005. Currently, there are about twice as many students enrolled into traditional program than students who chose e-learning.

As previously described, the key to successful integration of students with cerebral palsy into educational system is

adaptive, student-oriented learning which recognizes individual differences among students. At BMU, increasing number of courses based on learning objects paradigm which are adapted to recognize individual differences among students and their needs. Although, personalized learning in its full capacity remains as a goal for future R&D, significant steps are made in this direction.

BMU decided to use learning objects of fine granularity approach because fine granularity of created learning objects enables easier personalization of online lectures [19]. Additionally, BMU lessons support different levels of engagement (so called "ABC structure", see Figure 6) which can be used for further personalization of learning materials [20]. A student may, according to his interests, needs and abilities, choose appropriate level.
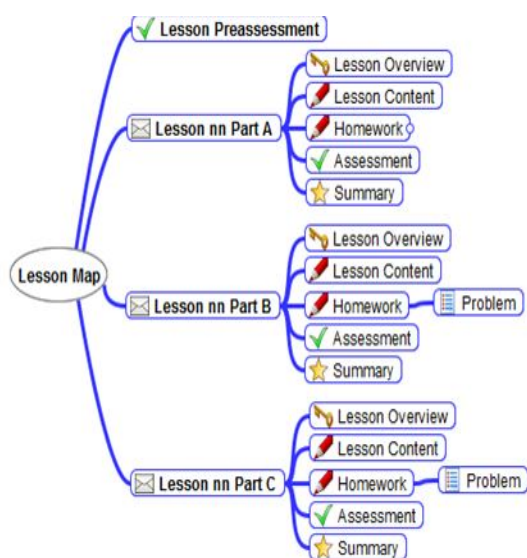
Image 6: Lesson structure at BMU

During preparation of learning material, creators should be aware of possibility that materials could be used by students with various types of disabilities. In [1], authors emphasized the following four steps in the process of transition to accessible e-learning:

- Awareness,
- Analysis and evaluation,
- Implementation,
- Accessibility integration.

Out of these four steps, the most challenging is the *Implementation* step. One of the main reasons for this is that creating accessible learning material is in general demanding process which requires trained technicians and often specialized software tools to accomplish the task. The starting point should be exploring standards which propose guidelines, success criteria and levels of compliance, like WCAG3 [23], WebAIM [24] and Section 508 [25]. For general design tips how to create accessible learning material, one can refer to [1]. In [25], one can find more specific rules and accessibility checklists for particular type of documents (Adobe Acrobat Pro9, Google Docs, Google Presentation, Google

Spreadsheet, Corel Word Perfect X5, Corel Quattro Pro X5, Corel Presentations, Microsoft Powerpoint 2010, Microsoft Word 2010, Microsoft Excel 2010, Video and Multimedia). Additionally, [25] provides comprehensive set of software tools for verification and evaluation of level of accessibility for developed materials.

Assessment of student's work is unavoidable part of any educational system. Continuous evaluation and building student's e-portfolio became preferable over traditional approach to examine students in written form at the end of the course [21]. At BMU the final exam is only part of the final grade. Homework, activity, projects and online tests are also integral part of the final grade. Such approach discourage students from procrastination and stimulates their active engagement. Evaluation in e-learning conditions has its specific issues, especially regarding estimating level of engagement of student in testing activities [22]. It is the reason why at BMU essentially there is no difference in grading policy and procedure between traditional and e-learning students. Additionally, assessment became integral part of each lesson. Each lesson has set of preassessment and postassessment questionnaires. The role of preassessment is to check student's ability to absorb new material, while postassessment checks student's understanding of the presented material. Such approach can be useful for professor's evaluation of student's performances as well as for student's selfassessment. Each of these questionnaires can be in one of the following format:

- True/false answers,
- Choose one correct answer,
- Choose multiple correct answers,
- Connect correct answers.

Multiple choice questions are usually more adequate for student with disabilities and should be used more frequently. For these students, extra time should be reserved if necessary. Additionally, after an exam, students should be offered an evaluation questionnaire. The questionnaire should be composed of the following key points:

- Level of satisfaction by conditions during the exam?
- How much additional time was necessary?
- How much help was necessary from a teacher?
- Which additional equipment (special devices) was necessary?

Such questionnaires would be helpful in collecting data which can be used for further improving quality of the examination procedure.

And finally, use of assistive technology and environmental conditions are areas in which further improvements can be made. However, usual obstacles are financial issues.

6. CONCLUSION

Students with disabilities are usually prevented from full participation in educational system. Significant effort should be invested in order to enable such students to be

actively engaged and maximise their potentials. New technologies reduce physical restrictions, and new learning paradigms enable acquiring knowledge and degree according to individual needs, abilities and interests. At BMU, such paradigms are adopted through new e-learning framework recently introduced.

Finally, there should be noted that significant part of education is social interaction with other colleagues. This is probably even more important in the case of people with disabilities. Therefore, e-learning and its benefits should be combined with elements of traditional schooling to provide full satisfaction alongside quality education for each student.

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DEVELOPMENT AND ENHANCEMENT OF LEARNING OBJECTS FOR ELEARNING SYSTEMS USING LIGHT AGILE METHOD

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Abstract: *The international community is highly interested in developing repository of diverse learning objects that can be exchange and reused for different purposes. Development methods are often very time consuming and costly. There is a need to develop methods that will allow development and enhancements of learning object of high quality and allow flexible, agile and structured approach. The aim of this paper is to present light agile method for development and enhancement of learning objects. This approach is based on the synthesis of software engineering approach and pedagogical principles. This approach is outlined and illustrated on a case study for enhancements of learning objects developed for the Database course.*

Keywords: *reusable learning objects, agile methods*

1. INTRODUCTION

Importance of learning objects (LO) is the subject of many papers and studies related to the introduction and promotion of modern educational system which implements online and/or blended learning. Some researchers believe that the learning objects represent an effective way for the design, develop and deliver learning material that will allow a learner to discover and obtain the learning content that suits their needs. Learning objects present smaller units of learning material, which should be logically independent of other learning objects, even though they may be related to one another in the larger scope of a certain subject. As such, the idea of learning objects is to be flexible and reusable in the eLearning system. If properly developed and implemented, learning objects represent a good candidate to enhance the effectiveness of learning and learner's performance.

In his paper, Boyle argues that learning objects must be developed with potential reuse in mind [1]. In order to delineate principles underlying this LOs characteristic, he established an analogy between principles of software engineering, and pedagogical principles. Cook et.al. explained the approach for development of reusable LOs that is partly based on the software engineering principles of decoupling and cohesion [2], but is also influenced by notions of user-centered and participative design [3]. They consider that LOs should represent a result of discussions between teaching staff, learners and other team members such as the multimedia developer, manager and colleagues from partner institutions, etc.

Boyle et.al. provide a full life-cycle framework that guides LOs designing process, from setting learner's goals within institution and problem identification, all the way to the design and production of all parts of learning object [4]. This method is heavily influenced by 'agile' development methods that rejects heavyweight, bureaucratic approaches to software development such as the Waterfall method. Our research adapts this model, and presents it in the light of the specific examples given for the Database course.

This paper focuses on methods for development and improvement of learning objects. The focus of the paper is a method, which authors refer to as the "light agile" method that presents an iterative and creative process of development and design of reusable learning objects. In this agile and iterative process instructor, reviewer, multimedia developer and students are involved in a part or all stages of full-cycle of design, enhancements and reviews of the quality of the created content. In defining this method, it is considered that the entire process is based on the software engineering principles, which are implemented in LOs development.

The paper is organized as follows: In Section 2 the implementation of software engineering principles in learning objects development is highlighted. Section 3 describes "light agile" methodology for development of learning objects. Section 4 demonstrates the implementation of the described methodology on a case study for enhancements of learning objects developed for the Database course. Section 5 concludes the paper.

2. IMPLEMENTATION OF SOFTWARE ENGINEERING PRINCIPLES IN DEVELOPMENT OF LEARNING OBJECTS

In order to effectively and efficiently develop and redesign LOs content, the appropriate methodology for development of learning objects has to be defined and applied. Similarly as in the development of large software systems, one should determine the sequence of tasks that need to be accomplished, along with the methodology for LOs development. Choice of this methodology should allow the development team to achieve the best route to creating effective learning objects in the context of local opportunities and constraints. The key high-level functions that need to be covered by LOs development methodology are: analysis of learner needs, design, development, delivery and evaluation that are similar to the software development process [4].

When developing modular learning system, where LOs are designed in such way so that they can be reused and repurposed, one may consider implementing certain software engineering principles in their design and development, so that entire process is faster and more effective when compared to traditional writing of learning materials in form of the online textbook. Design and development of LOs can incorporate software engineering principles in two phases:

1.   Development of initial learning content of LOs – cohesion and coupling
2.   Design and enhancements of LOs content and visual presentation – light agile method

In the first phase when the initial content is developed for LO, this development can be based on the development of software modules, produced by applying the principle of modularization. During the process of modularization, software is broken down in smaller units (modules) in order for these units to be maintained more easily. The same principle of modularization can also be applied to the LOs content development, since LOs represent smaller logical units of the learning material. If these units are small and independent enough, their reusability and repurposing can be effectively conducted. Moreover, this approach will allow for redesign and enhancements for each LO to be faster.

In software engineering, each of the software modules produced by modularization has to meet certain characteristics, defined primarily by known principles of cohesion and coupling. As known, coupling is usually contrasted with cohesion. Low coupling is often a sign of a well-structured software system and a good design, and when combined with high cohesion, it supports the general goals of high maintainability. The principles of cohesion and coupling might be also applied in reusable LOs design and evaluation. To be highly cohesive, each learning object should be based on one learning objective and/or clear learning goal. High cohesion of LOs allows increased understanding of their content. Such LOs may

be easier to maintain and reuse. The principle of coupling is also crucial in the design of reusable LOs. The learning object should be "free standing" as much as possible. Tightly coupled LOs tend to exhibit the bad characteristics: a change in one LO usually forces changes in other one, and therefore, such LOs may be harder to reuse and/or evaluate [1].

It should be noted that process of LOs development, like in the software development process, starts with an analysis of the user's needs. In case of development of LO, user is a learner. The learner's needs must be put at the very centre of the design of learning objects. One of the difficulties is that a lot of times assumption has to be made in order for LOs match the cognitive capacities of a learner [4]. This issue is evident in many implementations of eLearning systems that were not successful, in which the reason for failure usually lays in the fact that user's perception and style of learning was not considered enough or at all when the learning material was written and designed for visual presentation.

The second phase of the design and enhancement of LO content is based on the "light agile" method, presented in this paper. This method is based on the modern approach to software development known as 'agile' or rapid application development (RAD) method. Agile process is an adaptive process that accepts the fact that software is difficult to control. The main aim of this method is to minimize the risk of incomplete or bad quality software by ensuring that software engineers focus on smaller units of work (they practice iterative development). This approach is resonant of approaches applied in the purposed "light agile" methodology for LOs development. Since the evaluation process can sometimes be based on the feedback received from the entire semester, and not always short 2-3 week sprints like in the software development, In agile methodology, design and development is an iterative process where the instructor, multimedia developer, reviewers and groups of students are involved in the full life-cycle development, design, enhancements and evaluation of [4].

3. LIGHT AGILE METHODOLOGY FOR DEVELOPMENT OF LEARNING OBJECTS

The goal is to provide a methodology that will allow a flexible approach when developing and enhancing learning objects. The idea is to provide high quality learning objects that are structured, adaptable, and ultimately reusable in different context. In order to reach certain level of reusability it is necessary for this development process to have a balance between structure that is required for learning objects and flexibility, which will allow authors to be more creative, and implement different pedagogical methods, which are necessary for their courses. Group of learning objects is usually developed in order to meet the needs of certain learner, i.e. for a particular course. These learning objects are

developed by course instructors and/or multimedia developers [4]. Course instructors are in charge of developing materials for learning objects along with conceptualizing the design along with proper pedagogical methods, while multimedia developers can serve dual purpose. One to provide their expertise in design and multimedia enhancements of the learning objects, and on the other hand they can prepare learning objects to be entered and published in a certain learning management system (LMS). Even though multimedia developers' main purpose is to enhance visual presentation of learning objects, it is necessary to have the instructor involved in the entire process, so that the emphasis is put on the quality and effectiveness of studying. On the other hand, involvement of course instructors and multimedia developers is an iterative process. More importantly, quality assurance and evaluation can be completed through involvement of the learner in the entire process, so that learning materials are tested with a certain group of students. This is referred to as "use before reuse" [4].

A. Use before reuse

Initially it is assumed that each instructor develops a plan for the course based on the learners needs. We will analyse the course that is prepared for the academic program. In other words, the learners needs in this case need to be aligned with the goals, objectives and outcomes of the academic program of a certain institution. In some instances it is necessary for the course instructor to propose course outline and ideas what pedagogical methods will be used to design learning objects in order to see if this is in line with institutional aims.

Each group of learning objects should be evaluated, not only with academic staff, but primarily with students who will use these materials to study. This evaluation period can take from one week to the entire semester. The feedback about the conducted evaluation from students should be carefully recorded and analyzed. This type of assessment should point out not only the quality of presented material and visual effectiveness, but also whether the proper pedagogical methods were used for their presentation. Evaluation can incorporate several methods:

- Qualitative methods such as surveys, direct observation, and live interviews
- Quantitative methods such as assignment and test scores, performance analysis at the end of the course, frequency of usage of learning materials, etc.

This feedback and analysis should give a better input about things that should be changed, adapted and enhanced, throughout the semester. By the end of this phase learning objects are ready to be published and stored in the repository.

B. Enhancements of LO using light agile method

The two main stages in developing the learning objects are developing learning content and developing multimedia content for the learning objects. Once the instructor develops learning content for the learning object, this learning object is forwarded to multimedia developer. It should be noted that there should be an intermediate step involved. Before forwarding the content to the multimedia developer, learning content should be first forwarded to the reviewer, who should give constructive suggestions about improvements of the content as the reviewer should be expert in that particular area for which the learning object is written. However, this step is not necessary since it may increase the cost of the entire process, but this step is recommended before learning object is forwarded to multimedia development, in order to ensure academic quality of the learning object. Once the multimedia developer receives the content for learning object, multimedia is built based on the given specifications. The resulting learning object is given back to the instructor for a review, so that instructor will ensure that learning object has not lost its essence. This iterative process between instructor, reviewer and multimedia developer continues until all specifications and criteria are met. However, multimedia developers cannot serve as independent entities in the process, as they have to work along with specifications and content provided by the instructor, and possibly reviewer. Multimedia developer should develop visual presentation only based on the instructor's specifications, who can provide their ideas as a prototype that needs to be refined. This iterative process allows instructor to be actively involved in development of multimedia. In addition, once the instructor receives a feedback from students, not only that the learning content can be changed, but the entire design of the learning objects, including its multimedia and visual presentation.

Since learning objects present small content, it is typically that one development group, both instructor and multimedia developers are working on several learning projects in parallel. This light agile model is given in Figure 1. This process is more agile and allows for rapid development and redesign of the learning objects. Enhancements and redesign can be done based on the reviewer comments and members of the team, but most importantly learners feedback should be used for continual and further improvements.
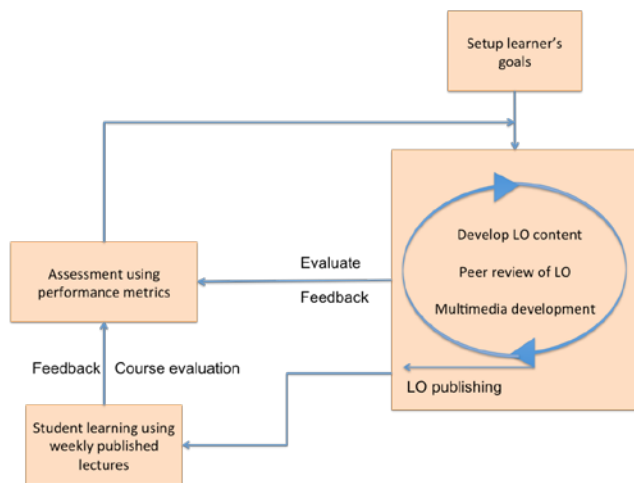
Figure 1. Iterative process of development and enhancement of learning objects

4. ENHANCEMENTS OF LEARNING OBJECTS FOR DATABASE COURSE

In this section, the application of the previously described principles and methods are illustrated by describing design and development of learning objects developed for a Database course. Key concepts of developing structure and logic of reusable and searchable learning objects for the Database course were presented in the previous work [5]. According to this model, learning objects are organized in hierarchical tree representation, all structured around learner's needs for the academic program and tailored towards the course syllabus. Hierarchical organization represents different concepts of the course and is based on the coupling of concepts. Each concept covers several topics. In order to achieve reusability of learning materials, each topic is further divided into smaller learning objects [5].

During the writing and designing of initial content of specified learning objects, the authors realized that the above principles of cohesion and coupling are not fully applied and that learning objects should be enhanced. For example, ontology of the concept "Information Management Concepts and Fundamentals" contain learning object called "Database management system", authors' intention was to describe different types of database system: relational, object and object-relation. In initial material, these 3 topics were included in the same learning object. However, the principle of cohesion indicates that there should be a separate learning object for each Database management system type. An immediate advantage is that the teacher can select the order in which these learning objects are combined; for example, a teacher dealing with experienced student may wish to deal with these in sequence;, while another teacher with a different group of students may choose to combine these learning objects with another learning object that deals with other features of the database. Based on this example, one can conclude that applying

the principle of cohesion in LOs content designing, primarily increases LOs reusability by providing more flexibility in achieving different learner's goals and instructor's aims.

Initial design of the learning objects content by applying the principle of coupling can be shown on the example of the concept "Database Query Language" where SQL statements and their use should be explained on a large number of examples. Each SQL statements (for example statement INSERT, DELETE, UPDATE, SELECT etc.), together with many examples that illustrate their usage, is explained in separate learning objects. It is important to note that in all learning objects for the SQL statement, the same tables were used to illustrate how the statements were used on certain tables in a relational database (i.e. tables EMPLOYEE and COMPANY). This example includes explanation of the use of SQL commands, and the two tables (their attributes, primary and foreign keys). In other words, despite the fact that we must describe the same tables, the description cannot be put in only one learning object, but must be repeated in each of them. Only in this case, learning object that explains one type of SQL statement should not refer specifically to content in objects than describes other type of SQL statement. In such a way, learning objects become decoupled and they can be easily reused and evaluated.

After development of the initial learning content for LOs, the phase of content enhancements and visual presentation is performed using light agile method. In the case of Data base course, at the beginning of this phase, course instructor estimates if the written LOs are in line with the course and with the previously defined learners' goals for the particular academic program. If the LOs are not in line with the aim and goals of the academic program and goals, previously written LOs need to be revised and enhanced. This can be done as a point of view how these LOs fit into a concept of a lecture within this course. Ideally, these LOs are written from the beginning to be good enough as stand alone units, but that may not always be the case. When reviewing LOs for the lesson concepts, additional content should be designed, such as multimedia and different pedagogical methods such as interactive and supporting activities that allow students to interact with the professors and assistants, with other students, assess their understanding of the learning content and express their opinions and their ideas.

During one sprint in the agile method, learning objects were further designed and enhanced. One sprint assumed development and enhancement of all LOs needed for one week's material. The sprint involved a team consisting of course instructor, multimedia developer and students. Due to the high cost, at this stage of LOs enhancements, the reviewer was not included. At the beginning of a sprint, course instructor would forward the group of LOs content to multimedia developer who would build a multimedia presentation based on the instructor's specifications. Multimedia is built during an iterative process between instructor and multimedia developers until both parties

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are satisfied with visual presentation. At the end of a sprint, the group of LOs is published, unless course instructor and multimedia developers assess based on the performance metrics, that the entire design of the learning objects must be redesigned.

After publishing of learning materials, students are provided with access to view it and study from them. In the case of the Data base course, the feedback from students was obtained based on interactive activities that allow them to assess their understanding of the learning content and express their opinions and ideas about what they learned. At the end of the semester, course instructor carefully analyses students' feedback and based on the results decisions are made whether certain LOs need to be further improved.. Thus, the period of full evaluation takes the entire semester. At this point, it is also possible to include reviewer, if the reviewer was not used during the sprints.

5. CONCLUSION

This paper focuses on methods for design and development of reusable learning objects that are based on the software engineering principles. The principles of software engineering can be incorporate in two phases of LOs development: during the initial learning content definition, and later, when LOs content and their visual presentation need enhancement. When course instructor has to develop the initial LOs content for one course, he must break down course material into smaller units. To be reusable, LO has to meet characteristics defined by known software engineering principles of cohesion and coupling. Later, when LOs content should be enhanced, a "light agile" method, also based on the modern approach from software engineering can be applied for a faster and more effective development of LOs. The "light agile" method was illustrated in this paper on a case study for enhancements of learning objects that were developed for the Database course.

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ANDROID "INFO E-STUDENT" MOBILE APPLICATION

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Abstract: The Belgrade Metropolitan University (BMU) has a Web-application titled eStudent, which enables students to get information about their marks, exams, financies, etc. Also, on the other hand, on the BMU Web-site there is a News/info-section, which can be viewed by anyone interested. However, because many students want to access the BMU Web-site via their Andoid devices, the BMU recently decided to develop an Android application which enables Android mobile users to exploit the eStudent and News sections of the BMU Web-site. This paper describes that Android application, titled "Info-eStudent", which on one hand enables the BMU students tu use their Android devices to do all the operations provided by the eStudent Web application. And, the Info-eStudent Android application on the other hand enables anyone interested to access all the information from the News/info section of the BMU Web-site.

Keywords: Android platform, eStudent Web application, News/info-section

1. INTRODUCTION

Android is a mobile operating system (OS), based on the Linux (Kernel), developed initially by Android Inc., and later by Google. Android is currently the world's most popular mobile platform. Also, since 2013, Android devices have been sold more than Windows, iOS, and MacOS devices all together. Android's open-source nature has stimulated a large number of developers to use its open-source code in many projects [1-4].

Mobile devices are more and more popular in the area of e-Learning and LMS (Learning Management Systems). There are more and more mobile applications which are popular among online-learning students. Since Android OS is the most popular mobile platform for mobile phones and tablet computers, there is a strong trend to develop more and more Android mobile applications for online-learning students [5-8].

The Belgrade Metropolitan University (BMU) has a Web application titled "eStudent", which enables the BMU students via Web to get information about their marks, exams scheduling, teachers, financies, and also to do exams registration, and filling-in various questionaries. Also, there is a News/section-section on the BMU Web-site, which provides news/information about the BMU, which can be approached via Web by anyone interested.

However, since many students and others interested want to use mobile Android devices to access the BMU Web-site, the BMU recently developed an Android application, titled "Info-eStudent", which enables Android's owners to use the eStudent-section and the News/info-section from the BMU Web-server.

This paper describes in some relevant details the features and development of Info-eStudent Android application, developed within the BMU LMS. The structure of the paper is: 1)features of the application, 2) integration of this Android application with the BMU LMS, 3) Andriod platform, and 4) GUI is fully illustrated, and also 5) some relevant user-testing results are presented.

2. "INFO E-STUDENT" APPLICATION

The Android "Info-eStudent" mobile application consists of two parts (see Fig. 1):

- The Info-section, which is accessible to anyone interested in viewing the BMU Web-site
- and the eStudent-section, which is accessible only to the BMU students, after an authentification

The Info-section enables viewing news and other Web pages from the BMU Web-site. While the eStudent-section provides all the operations provided otherwise by nonmobile Web-application eStudent.

The Info-section :
this section enables presenting news as a sorted list of titles, sorted according to the date/time of appearance. The news list is shown in the ListView window. Also, any news from the list can be viewed in full (the complete text) in a separate window, and this can be achieved by a single click on any title from the news list.

The eStudent-section:

- Authentification, via checking a student's username and password,
- Presenting relevant information about teachers, regarding various teaching subjects,
- Financial report (presenting all the payments and financial obligations made in the selected year)
- Preseting the list of exams and relevant details for every exam
- Exam registrations
- Presenting every mark for every subject (marks for projects, assignments, etc.)

There are two possible types of users of the Android "Info-eStudent" mobile application (see fig. 2): 1) a BMU student, 2) an "ordinary" user (anyone who has downloaded the Android Info-eStudent application).
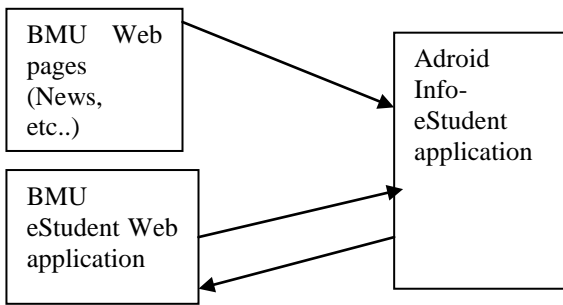
Fig. 1: Android Info-eStudent application

There are several typical scenarios of using the application. For example, the typical scenario for viewing news from the BMU Web-site: openning the Android application, choosing Info-section, viewing the news list, clicking any news from the list,viewing the selected news.

Or, the scenario for a BMU student who wants from eStudent to get information about teachers: openning the Android application, choosing the eStudent-section, authentificating the student, viewing the main menu (dashboard), choosing the "Information about teachers", viewing the list of teachers, grouped against teaching subjects, initiating contacting a choosed teacher via e-mail or Skype. Or, the scenario for a BMU student who wants to register an exam: openning the Android application, choosing the eStudent section, the authentification, viewing the eStudent dashboard, choosing "Exam registering", viewing the list of exams available for the registration, choosing an exam, viewing the available dates and times of the exam, registering.

Regarding the scenario for financies: after viewing the eStudent main menu, choosing "Financial report", viewing the lists of obligations and payments for the current year, choosing any other year to view its financies. In a similar fashion, the scenario for viewing the marks for any teaching subject can be performed: after viewing the eStudent dashboard, choosing "Marks report", viewing the list of teacing subjects, choosing a subject from the list, viewing all the marks for a choosen subject.
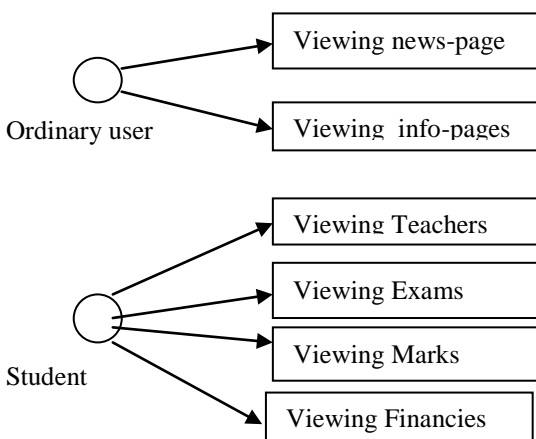
Fig- 2: Use-cases

3. DEVELOPMENT AND INTEGRATION

For using mobile devices in accessing an LMS (Learning Management System), either an open-source LMS or a commercial LMS, all major LMS offer some degree of support [9-14]. This support today varies very much, from simple news/info functionality to full access to an LMS. However, there is a strong trend to increase dramatically using mobile devices in accessing LMS. Although, Android is the most popular, other mobile devices can not be ignored, eg. iOS devices.
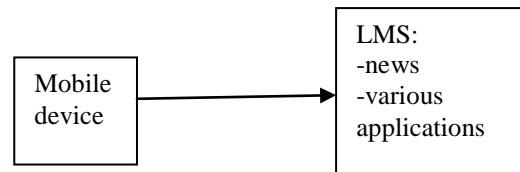
Fig. 3: Mobile device accessing LMS

Integration of the News/info section:
the News/info section of the Android "Info-eStudent" mobile application communicate directly with Web-pages from the BMU Web-site (http:www.metropolitan.edu.rs), by using Internet as their interconnection. As illustrated in Fig. 4., the data from the BMU Web-pages are extracted by the so-called process of "parsing".

Integration of the eStudent section (see Fig. 5):
the eStudent section can be connected with the Android mobile application via an additional Web-component - an interface called API (Automatic Programming Interface). API is an addition to the existing eStudent Web-application, and the API Web-component enables creating XML API data source (specially formatted data) which can be read by the Android mobile application. API is located at the BMU Web-server.

In general, API enables developers of mobile applications (Android, iOS, ..) to connect them with Web-applications. API enables using all the functions defined by API itself. API represents an open point of a Web-application towards the external world, which can be used by other applications, so, it is important to make this point safe against security risks.
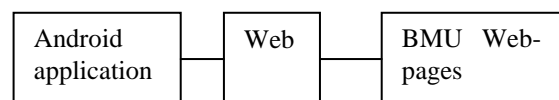
Fig.4: Integration of Android application and BMU Web-site (within the BMU LMS)
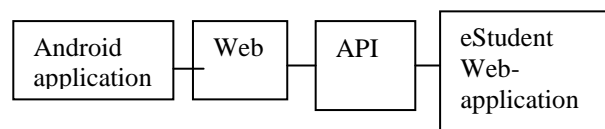
Fig. 5: Integration of Android application and eStudent Web-application (within the BMU LMS)

The "Info-eStudent" Android application was developed using Java programming language. Also, the prototyping development model was used to develop this Android application, which means that several noncomplete versions were developed before the final version. The Android application was divided in several parts, and each part was developed separately. For example, the Android application was firstly developed and tested with the test data (without using API), and API was developed later. Also, the Android application itself was divided into two parts, the one which communicate with API and the rest of the application.

4. ANDROID PLATFORM

The Android platform is based on Java SE (Standard Edition). This enables the full capacity of the Java language to be used, ie. from the programming point of view, when programming a mobile application, almost the everything is the same as you are programming an ordinary Java application (if you use Java SE). For example, you can use the JAR library for parsing XML. However , although the program code is identical in both cases, the virtual Java machine which uses this code is not. Instead of JVM (Java Virtual Machine), which is used in normal applications, the Android platform uses Dalvik Virtual Machine, which is designed for mobile devices.

The Android mobile device software includes:
- Applications
- Application Framework
- Libraries, Google Java Libraries
- Dalvik VM
- Linux 2.6x (Kernel)

Application Framework provides the basic libraries, needed for any project.

Before installing an Android application, it is required from the user to give the permission to use some functions. The programmer needs to specify all the functions which require the permission from the user. For example, it is required to give the permission to an Android application to make phone calls, approach Internet, reads contact list, etc. From the point of view of an Android application user, during installing an Android application, a window appears, as illustrated in Fig. 6. The user can accept to give permissions and then install the application, or to refuse permissions and the installation.

For Android applications development, the standard Java integrated development environment Eclipse can be used, with the addition of ADT (Android Development Tools). ADT includes all the necessary components for development of Android applications, and enables the integration of ADT and Eclipse. During the development and testing an Android application, instead of real mobile

device, an emulator (software simulator) can be used instead (see Fig.7).
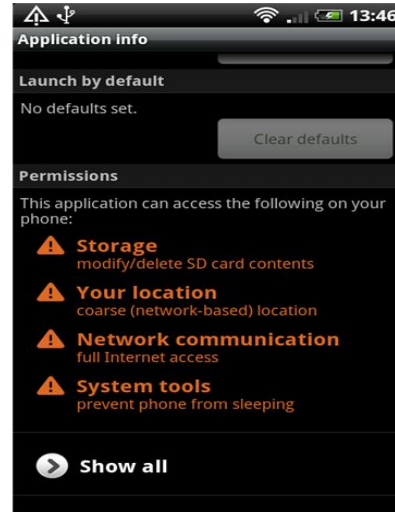
Fig. 6: Android permissions- window

Fig. 7: Android emulator

5. DEMONSTRATING GUI

In this section we illustrate using GUI (Graphical User Interface) of the "Info-eStudent" Android application. The main menu of the application offers two options: "News" and "eStudent". This main menu can be obtained from any window, eg. from the News-list window, as illustrated in Fig. 8.

The main menu of the eStudent section is shown in Fig. 9, and this menu offers: Exam window, Teachers window, Marks window, Financies window. For example, Fig. 10 presents the Teachers window. As we can see, any teacher can be then contacted by e-mail or Skype. Fig. 11 shows the Marks window, and Fig.12 demonstrates choosing a teaching subject. Finally, Fig. 13 presents the Financies window.

Fig. 10: Teachers window

Fig. 8: the main menu and News list

Fig. 11: Marks window

Fig. 12: Choosing a teaching subject

Fig. 9: eStudent menu

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Fig. 13.: Finances window

6. TESTING RESULTS

Testing of the "Info-eStudent" Android application was performed from the customer side, and it included:

- Testing the installation of the application
- Testing GUI (resolution features)
- Testing various functionalities (options) of the application
- Testing the Skype option (contacting teachears via Skype)
- Testing the News/info section

Several Android phones and tablet computers were tested in installing and using the application. Installing is simple and no problems were detected. Testing GUI was performed in order to check the resolution features, ie. are the application windows well designed and visible on smaller Android devices? It was found that the application is working well on both types of devices, Android phones and Android tablets.

After testing the installing process and the GUI resolution features, testing the various functions were performed (Teacher window functions, Finances window functions, Registering exam function, Marks window functions,..). During testing it was found that all the functions of the application were successful, and clicking various options worked well, so all the links and buttons were working correctly.

Also, the Skype option for contacting teachers was tested, and it was proved that it worked well, provided that the choosen teacher is online on Skype. On the other hand, the e-mail option was also working well.

May be, the most important and the most useful function of the application is viewing the marks for various exams and various elements of the total mark (tests, assignments, projects, etc.). It is a very useful option, because it enables viewing the marks simply by pressing two clicks on your Android, which is much faster than using the Web browser, which is necessary if not using the Android application.

7. CONCLUSION

This paper describes the Android "Info-eStudent" mobile application. On one hand, this application consists of the eStudent functionality (giving information about exams, marks, teachers, financies, and enabling exam registration, contacting teachers, filling-in several feedback student questonaries), and on the other hand, it includes the News-info section (viewing Web-pages at the BMU Web-site).

This is the first application developed at the BMU for using Android mobile devices in accessing the BMU LMS. The plan is to increase as soon as possible and as much as possible using mobile devices in accessing the BMU LMS. Not just news-functionality, or eStudent-functionality, but also other functionalities, like accessing learning materials and learning tests, are planned to be introduced soon. The experience obtained during the development and testing the Android "Info-eStudent" application will be very useful and incouraging in developing other mobile applications for the BMU LMS.

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TRENDS AND WAYS OF DEVELOPMENTS IN SOFTWARE METHODOLOGIES AND PROGRAMMING LANGUAGES

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Abstract: Programming languages are developed from mechanical languages to the languages of higher level. Languages which are orientated towards the object give out the totality of the software task, everything is contained in the object which can support one iteration in developing a certain software solution. The agile approach mobilizes flexible software into a unique developing project together with the frequent cooperation of the members of the project team and clients in order to solve the problems of continually opened tasks of developing new software projects. The agile development is supported by means of component development, upgrading it as partial software solutions which rise the quality of the software task as well as the possible options of their solving and the productiveness of the IT project to be accomplished faster and cheaper. Extreme Programming (XP), as a method of `agile development of software`, implies, among the other facts, programming in pairs where all the members have a joint ownership of the code and frequent direct communication with frequent direct communication with clients at the concrete given spot, location of development.

Key words: extreme programming, XP, object, IT projects, objectively orientated programming, agile development of software, components.

1. INTRODUCTION

Programming languages are a set of rules, instructions which have a simple, single meaning meant to be given to computers for solving certain programming tasks. They are recognized directly by the computer hardware and can be divided into three main groups:

- machine language, a simple programming language which is internally used by the computer,
- symbolic language and
- high level language.

Machine and symbolic languages depend on computers. High-level languages are mechanically independent languages which use programming instructions in natural, plain and simple words of English language, whereas the operative system and the architecture of the sole computer remains as a completely independent category.

According to the way of solving problems, programming languages are divided into two categories and they are the procedural and the objectively oriented ones (OO). The *procedural languages* which have a programming code, assign the computer a set of instructions which may solve the problem and the algorithm, serves as a means of describing **how** to solve the given computing problem. This is the mode of functioning of all known high-level programming languages such as: Fortran, Cobol, Basic, Pascal, C as well as machine dependent languages. Developing and improving programming languages have been implementing new methodologies such as advancing interpreter that independently by its built-in procedures, steps, solves the described problem. This is the feature of the declarative or non-procedural language for the purpose of writing inquiries (query) as it is the case with the natural language SQL. The objectively oriented languages (OO languages) represent a special class where we can observe procedural and non-procedural elements. In procedural languages the actions, ways of realizing procedures and tasks are emphasize where the action proccesses the data by performing the action onto the given data. By the OO approach the programmer tries to wrap, put the data and actions into the tool box (framework) which has the main role in speeding up the development of the software. Small Talk, Java and C# are the best examples of OO languages. The great manufacturers of software today have their own programming packages such as Microsoft`s®[1] set of applications named Visual Studio Net with C#, currently the most popular tool for fast development of an application (Rapid Application Development - RAD). This developmental surrounding contains a series of redefined components, forms and wizards which all together makes strong support to the development of software through all of its phases. The new developing surroundings and OO languages lessen the robustness of the software. They divide the software into partial moduls while the development of the software solutions is based on the objects and interactive units which contain complete functionality for the given programming task implemented in themselves. The defined programming task is repeated several times from one system into the other which forms the mission of standardization of independent software solutions. The development of the ultimate Internet created the utmost need for the written projects to operate in the same way, identicl in different platforms (operative systems). When the OO programming language Java was developed, programmers found solutions and various possibilities of overcoming problems connected with executing software applications

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[1] Microsoft is the protected brand of the Company

in numerous and different platforms. The comlex development of software solutions was met with all sorts of thinking, approaches in upgrading and its realizations, ways of programming and methods of making software, the architecture of the system. Historiclly looking, it evolved from primitive to highly sofisticated and modern developing techniques of creating software solutions as it follows:

- writing programming codes - solving problems by programming them until 1970 is also present nowadays,
- structural methods of developing software: analysis and projecting until 1985,
- development of software based on the models of data, data base and the languages of the fourth generation, since 1980,
- objectively oriented methods of development, since 1980 and
- standards - the UML model of segmental or interactive development of software, since 1998.

2. WAYS OF DEVELOPING SOFTWARE

The traditional model of developing software was popularized as a Waterfall Model. The origin of its name is connected with the article of W. W. Royce which was published in 1970. Royce presented the model of a waterfall claiming that even such a rigid phase system may be developed into a flexible interactive developing process.

It supports all six phases which are developed in the most stable way and undisturbed follow each other, without skipping or shortening the phase tasks: analyses of demands, design projecting, implementation, testing, integration and maintenance. This model of developing software has been used for years and is still applied for its numerous advantages which are not to be neglected:

- better spent time in earlier phases may lead to economical and more efficient work later,
- putting accent onto documentation and authentic code of software products,
- makes progress linearly through discrete and easily understood defined phases since it is rather simple,
- spots control places during the developing process.
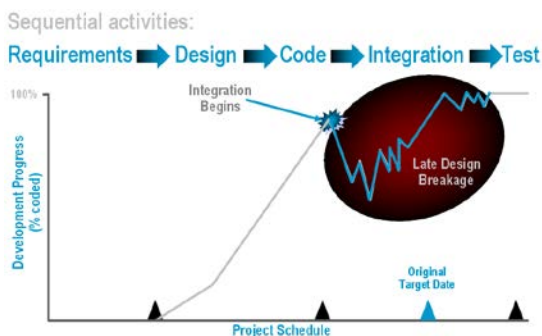
Picture no. 1: Practical implementation of a Waterfall model (literatura [5])

The experience of software teams, project and software solutions tell us that such projects must be open

and ready to accept changes, taking into consideration the fact that clients tend to change their demands. Regarding the fact that OO programming promotes an object from the outer world, as an independent programming unit, where objects are shown and organized in a systematic way making them logically understood and adaptable to potential changes, specific demands, while supporting the analyses of the leveled system. Thus, this model contributes to the following:

- precise formation of the complete future structure of the informatics, computing system,
- formal and logical projecting of the work frame of the future system,
- creating operating tasks by stages according to the objects and the project decisions,
- making the prototype of a new system,
- realistic and versatile evaluation of project decisions in order to choose optimal (economic and productive) solutions and,
- creating files of all the steps during the realization of the new system.

The OO approach to the development of the software solutions bonds the data and the processes into a single logical unit which is defined as a class. In that way a part of the software is isolated from the rest of the system because the changes inside the class have no impact onto the remaining parts of the system, classes in the system itself. The independence of the class provides it with the opportunity to be used in very many ways over and over again in different applied platforms. In OO languages the software is developed by the objective approach and ways of thinking and that means the following connotations:

- there are no classical functions and procedures, just objects,
- tasks are worked out in several smaller, less developed separate steps,
- the work out goes from the top towards downside,
- data have a smaller role, impact compared to the functions,
- fundament, the base of the initial development is made of objects, not by functions and procedures,
- the object is an abstract element in the field of its usage and application.
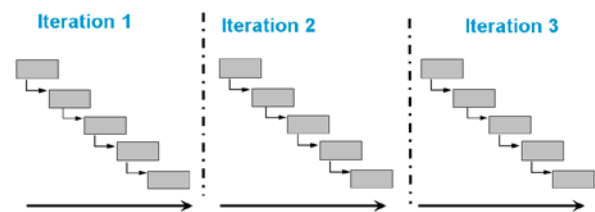
Picture no. 2: Iterative approach in developing software solutions (Literatura [5])

This approach implies the iterative development. The life cycle of the software contains iterations where each iteration has an independent, separate software solution according to the standard phases of its development: analysis, design, programming and testing. The first few phases promptly discover the risks and failures, and each

iteration is developed swiftly and fast from the beginning to its end. In the course of its development each phase is tested several times and integration of other solutions are also possible in numerous software projects.

Different approaches in projecting software systems that promote the leading experts such as: Jacobson, Booch and Rumbaugh unite themselves into one and unique process (Unified Process - UP). As the sponsor of this methodology was the company Rational (well-known software firm which deals with the development of CASE tools) it is not surprising that this process was named Rational Unified Process (RUP) and belongs to the group of easy agile processes. The collaboration of the above mentioned authors resulted in a unified modelling language (Unified Modelling Language - UML) onto which the RUP leans to. UML was developed in 1997 as an approved standard by the Object Management Group – OMG (Literatura [6]). UML is a standard language for specifications, projects, visualizations, constructions and recording projects of the software systems which are developed by the means of OO technology. It is extremely flexible and may be widely used in creating working, operative tasks and it is not necessary for it to serve to the objective oriented technology.

The strategic values of a software are rising in lots of companies, the industry seeks for the techniques which will transform the production of software into an automatic process which will improve the quality of the products and lessen the costs of the final product and help it arrive onto the market faster. Such techniques are developed by using component technologies, visual programming, forms and frameworks. Companies are constantly trying to increase their competences on the market. The solutions which are of special interest are those which refer to: physical distribution, competitiveness, data replication, security, balancing of the overloaded system and the tolerance of errors. UML is designed to answer onto these and similar demands. UML is a technique globally exploited for two main but different developing ways, from the visual software project solution to the programming code, in other words it may be claimed that it forms the initial visual project from the programming code. Projects have a detailed graphic description of the system and it serves as a basis for writing the programming code, while some of them even generate parts of the code. In the prototype developing of the software CASE tools are used for the realization of initial visual project solutions. UML generalizes programming of project solutions in several steps:

- visualization of the system, presenting its outlooks,
- specification of the system, its structure and behavior,
- files and records of the project decisions.

3. NEW DEVELOPMENT METHODOLOGIES

The methodology for developing a software is a complex sum, number of procedures which provide advantages during the development:

- consistent approach lessens the risk of errors,
- complete documentation for the current and future projects is written down,
- quality of the software is regarded high if the solution is agile and susceptible to changes,
- changes of the project teams are also a common practice, experience and knowledge are decisive in choosing the best members,
- visual modelling is easier and so is adapting compared to searching for programming code or changing it.

Nowadays, the agile process which is more and more present is the adaptive one. It was invented in Utah, USA, in 2001. The most important agile methods are: Scrum, XP, Open UP, Crystal, Lean, DSDM and Agile MSF. This process of development is more adaptive, agile and the cooperative work of the team members working on developing software solutions becomes more effective. Agile methods are based onto four main principles:

- people and their relationships are much more important than the process and the tools,
- software functioning comes before recording its documentations, which is not of the greatest importance,
- cooperation with the final consumers is more important than immediate negotiations of working tasks,
- response onto necessary changes and computing tasks are far more important than planning steps and activities.

Generators of application prototype serve for generating the authentic code in OO language. Such a prototype represents a client`s application which by the means of the protocol for the base connection (Open Database Connectivity - ODBC) communicates with the server for the distance, relation database. These tools are especially suitable for a fast development of the system, since they create the user`s interface, state precisely the outlooks of the screen and the format of the user`s reports. Since the class is the main term of the objective development and projecting, class diagrams are mostly used in describing the structure system which is being developed. Characteristics and operations are terms used for describing the class features. UML, as a complex language, contains a great number of diagrams, which in a certain phase of modelling are used. They are also strongly connected with the process of creating a software. The generator of the programming code has a number of generators for various different purposes. SQL generator produces a project and implements its outline for the database. In accordance with the standard syntax, nonprocedural SQL language generates the programming code which contains all the commands for executing the following programming operations:

- creating tables,

- declaring limitations in the form of primary and strange keys,
- declaring limitations and permissions which are in relation to the value of the zero traits,
- declaring limitations in the form of the referential integrity, in the case of its violation, generating the mechanism to returning the database into its consistent state,
- creating triggers and procedures for controlling limitations in relations, if the situation allows the usage of the SQL language in the given problematic case.

The previously described generators of the application prototypes served as an example for software possibilities and they led us to the conclusion that it is extremely productive to develop a generative component which is able to generate the demands of the system, the database and the final users. In the domain of the Visual studio, by the objective approach, the software component was developed for generating applications of which the diagram class is described in few spots of the iterative development.

The main, entrance spot is in the component of the MasterDetailControl. In order to make the memorandum

they are the name of the server and the database. These parameters are sufficient if the Windows authenticity is used. By the means of these parameters, the control board finds the tables of the database and offers the possibility to choose options out of the Master table. From the information scheme we get data on the chosen table such as the names and types of the columns, primary and strange keys, tables, details, etc. The user chooses this data on the bases of defined terms, the values of the fields are generated as well as the labels, connections among the tables, visual and functional description of the fields and such options in connection with the fine adjusting of the way how the model looks like. When it comes to the implementation, everything is in the class of MasterDetailControl. The class DataSet exists as an attribute in the MasterDetail Class and it reads the tables, attributes and all the rest of date from the tables. Everything the user does has an impact onto the data stored and saved in the DataSet. Only after clicking onto the DataSet, it synchronizes the data with the previously saved data. The fields, forms, master and detailed tables are all connected in the corresponding columns in the DataSet and by their editing they are written down, copied into the DataSet automatically. The diagram class MasterDetailControl – the component which generates the cipher reader and other documents such as the
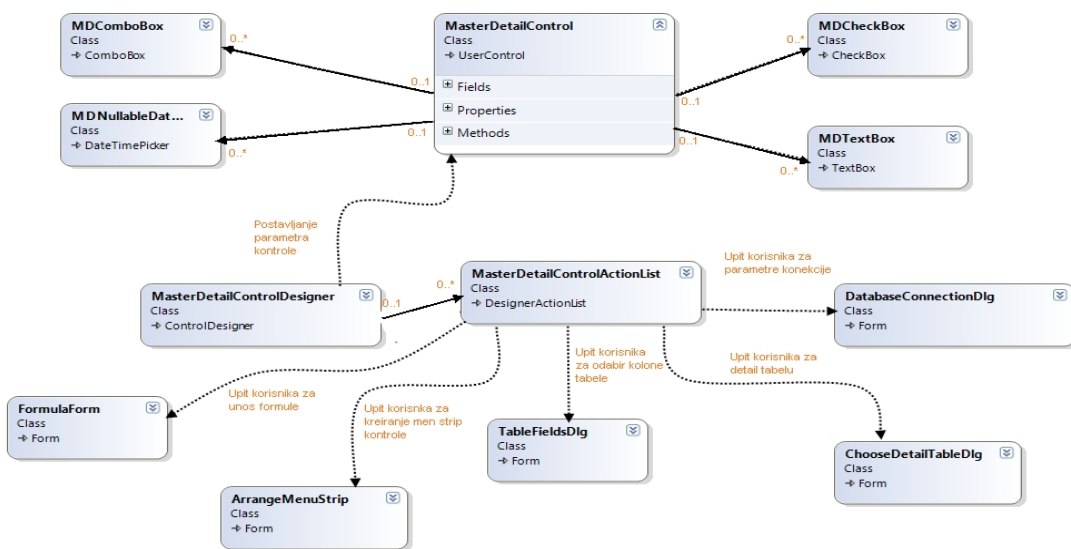
(master/detail) control to generate all of its fields, the parameters for connecting the database is its priority, and

memorandum/items are shown on the following picture:

Picture no. 3: Class Diagram of MasterDetail Control client/server components

4. NEW METHODOLOGIES CREATE REUSABLE VALUES

A different approach to the development of software by the means of agile software methodologies, such as the Extreme Programming (XP), one of a several fast and agile methodologies, gives us the opportunity to adjust swiftly to the changes in the informational demands, during the process of developing the project. Because of all the above mentioned facts, it is more realistic and accessible than the previous ones which insist on defining, stating all the demands at the beginning of developing the project. The constant interaction between

the clients and the members of the developing team leads to a high-quality ending of the work, cutting down the costs, continual management of the demands of the clients and absolute flexibility in developing the system. Extreme Programming is a model of developing a software especially for small and medium-sized developing teams which are constantly exposed to permanent fast and changeable developing activities and demands of the informatics systems. XP offers a great number of formalized solutions which are defined in: programming in pairs, unit testing, refactoring, steady changes according to the new demands, architecture, as well as frequent and repeatedly short iterations which are fully

developed. Such a quick answer onto these rules of the extreme logic in programming is widely supported by the application of the component development of the software, where each component represents a built-in system unit which functions separately but may be also integrated into a complex system of the complete software solution. This solution is safe, agile and adaptive, flexible and may be easily adjusted to the system and clients` demands, reliable and accurate, tested and previously used several times.

Software is goods which does not have amortization. Once it is created, without greater oscillations and on the top-quality hardware platform, may last a long period of time, with the exception of its obsolescence (new operative systems, more perfect, sophisticated and comfortable platforms for developing and maintaining the software, more rational approach to the database, better modern interfaces and reports, etc., in fact, it is relatively questionable and non-objective to discuss what an iternal or obsolete software means). The growth and the development of a software have taken the precedence in the industry of the XXI century by their agile approach to the development and improvement and their only limitations are in the human ambitions. Components, as priorities in developing software systems, are made on a three syllabic architecture. The users` interface is separated from the business logic and the layer of the data. Such a solution enables reusable functions:

- User interface layer – graphical user interface - (GUI),
- Business layer – business logic layer - (BLL):
  - *Process components* – local business functionality,
  - *Business domain components* – functionality of business processes,
  - *Business infrastructure components* – functionality of business domains.
- Technical infrastructure layer – serves to business components - layer which enables access to the data, their physical accommodation onto the server disc of the database (data access layer - DAL).
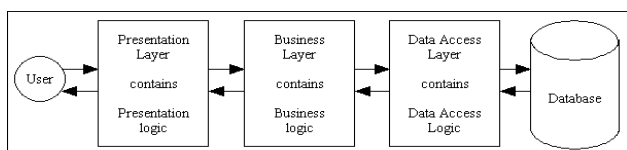
Picture no. 4: Layers of Component Architecture (Literatura [5])

The component architecture is flexible, contains the complete solution, key components and subsystems, mechanisms of its integration and realization, integrated solution, the communication of its mutual processes and the formulae for executing certain tasks. This architecture performs the following tasks:

- divides tasks in the project team,
- maintenance and spotting the possible ways of expanding, spreading,

- estimates the profitability of the reuse or makes it possible for wider use,
- makes choices among thousands of ActiveX and Java components and,
- increasing evolution of the existing software.

In the applications of the Microsoft Windows developing surroundings, control elements or components are defined as programming units which perform incoming and outgoing operations. As a part of the developing project, controls are in the form of a dialogue or a pattern where they serve to all users, members of the project developing team, programmers and may be used in each application of the framework Dot Net. Most of these components are in the library of standard control boards. The library was created for the need of making the users` surroundings apt and persistent to the standards where the control was defined in advance (Predefined controls) or to fit classes of the framework Dot Net. The methodology of making programming systems based on the components (Component-Based Scalable Logical Architecture - CSLA), by the author Rockford Lhotka [Lhot98], has very detailed instructions in the project domain whereas it is more simple and general in the domain of analyzing the demands. It is well oriented according to the Microsoft technologies, with the aim of multiple reuse of the programming components in different work frames and the users` interfaces (client/server architecture, Web platform). Lhotka components are divided into three categories: components for general purposes (standard components), components created for a specific aim for a single application and components made for a specific purpose for just one type of industry.

The created software components, or as we popularly call them R values, are approved my certain number of international component standards, are added to the library of the software components where their formal list, classification and outlooks, features are described in full detail. When the R values are described in this way, they become a part of the licensed list of the other R values which are already in the library of the software components. The users of the software components, on the basis of the detailed, precise description of the R values, its grades, may understand and estimate if such a R value was suitable for them and their needs. The description of a single R value contains technological and informational elements which are presented, clearly shown to the users in a uniform, previously stated schemes. These values are greatly used in creating systems and software goods (applications), or modifications of the existing ones. On the industrial market they are being sold as any other type of goods which has its usage and cost. According to the given description of its components, the buyer is responsible for choosing one in order to use it in an appropriate way. The users choose these components which are easy to be adjustable to their tasks and problems which have to be solved. Making the right choice is not an easy task because of the individual and creative character in the process of developing the system, its surroundings, differences in which the values are being accepted, its

software and especially since there is not a "formal recipe" for choosing the right component.

Each component must have a simple, clear and lucid design of the total developing environment, the controls in the system and all of these must be easily understood by all the members of the project developing system, whereas the component solutions must show a clear picture of the system to each category of the users.

A generative software component was formed in this research and it has a complete model of the demands and the design which generates software applications. Its usage is equalized according to the needs of the final consumers, the architecture of its development is unique, it is easy to be used by all the members of the project developing team. The component executes all the appropriate tasks, while the users` design and its functionality is completely understood to everyone. The quality is proved by its wide-spread and multiple implementations and direct testing of them, while its standard developing architecture lessens major technical, formal and functional risks from the very start.
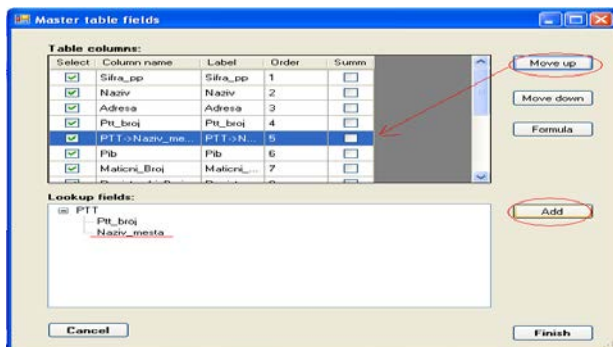
Picture no. 5: Generating master form from the database table

The generative components which perform different functions are perspective software solutions and have a major, leading role in developing projects with the aim to form new applications founded on powerful technical and methodic approach which, at the same time, are adaptive, simple and fast in accessing the development of the applicative software understood and accessible to everyone. The high level of the economic justification of component solutions originates from the possibilities of their multiple application. The OO generative component is a software tool which makes a new applicative software. Creating new applications means lots of new tasks and repeated activities on designing a user`s interface, menu, forms, reports and accesses to the database. Thus, the automation of executing all the mentioned and similar operations is a generative tool for producing a brand new applicative software. Its practical application helps the programming teams to develop different domains in creating automatic ways of developing new applications. In that way business tasks are solved quickly and easily while saving money, time, materials and human resources.

5 CONCLUSION

Agile methods of developing software put a great emphasis onto the communication among the people who make projects, programmers and final consumers, clients. They solve concrete defined tasks and give answers onto the current and frequent changes in the field of informatics and computing demands. In that way the newly created software solution becomes completely adjusted to the needs and expectations of its client. The phases in projecting, developing tasks and solutions together with the documents and recordings, are not priority. They are all formally a less important segment of the final, improved product. Agile methods have a lot of positive features, but there are also inevitable problems as in many other methodological approaches. The agile development by strict rules cannot and should not be formalized since it is unpredictable how the clients and members of the project team will behave. The roles of both sides in this case are extremely emphasized. Clients make great effort, the project documentation and files are also great, sometimes it is not fully defined, precise and clear what clients expect. The legal side of the project and its documentation may not be adequate expressed since the agile contracts are without full, legal formalities. So, there is no way to cover all the legal problems on both sides. But one thing is in common and it is **speed**. Time and mutual trust is of great significance. The problem of functional spots and the budget still represent the cornerstone of the future agreement. The agile team is always expected to adjust itself continually which creates new changes in developing the project, and makes it hard to meet the deadlines. If the project and the team responsible for its development are both agile, one question has the utmost importance: what is the real time needed for finishing the project and what is the real cost of the software? The clients themselves have to be agile and flexible especially when it comes to terms of finishing the project, paying the costs and implementing the software. However, the application of the agile methods in developing software greatly contributes in raising the level of quality and the productiveness of the IT projects.

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LEGAL AND TECHNOLOGICAL CONDITIONS FOR OPEN EDUCATIONAL RESOURCES IN SERBIA

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Abstract: This paper presents an overview of the current situation in Serbia regarding the legal and technological conditions for the development of open educational resources. Apart from an overview of the current situation, it includes SWOT analysis that has identified strengths, weaknesses, opportunities and threats. It also proposes ways to overcome the current difficulties that have been identified in the field of open educational resources.

Keywords: legal conditions, technological conditions, open educational resources

1. INTRODUCTION

Education and digital society are a generator of development and improvement of knowledge in the countries of the European Union. In addition to identifying their own goals and priorities, the countries in the accession process adopt strategic plans, thus confirming the policy and the commitment to realize goals that improve the quality of life and strengthen the economic power of the society.

Strategic choices in the field of ICT still lack the adequate implementation in practice. The necessary digital infrastructure is missing. Further, the necessary legislation that would allow full utilization, access and distribution of data based on the standards and platforms of OD (Open Data) and OER (Open Educational Resources) has yet to be adopted. Regulatory harmonization of intellectual property, e-government, and information security is an additional requirement for the application of OER.

The importance of the development of OER in the process of higher education has been confirmed in practice and the experience of the developed countries through the examples that indicate the need for the application of innovative technologies in order to improve the quality of the educational process.

Along with the identification of strengths and weaknesses and the opportunities and challenges in the implementation of OER, the analysis of the current situation should serve as the foundation for the recommended strategies for the improvement of the implementation in higher education.

The method of achieving progress in the implementation of OER software and standards requires the necessary institutional framework and environment within the academic community that, with the support of and cooperation with other social stakeholders, can assure the realization of the European agenda in this field.

2. CURRENT LEGAL CONDITIONS REGARDING OER IN SERBIA

In order to implement and develop OER in Serbia, the legal requirements must be fulfilled at national and institutional level. Apart from the adoption of the existing drafts and enactment of legislation related to open education systems in Serbia, it is necessary to gradually raise awareness about the importance of OER, its possibilities, the method of implementation and development and its usage.

The strategy for development of education in Serbia until 2020 [1] is the starting point for the analysis of legal regulations in the field of OER. The approach to the creation of content of the mentioned strategy is based on the openness of the system of education, while its development is formulated from the perspective of the role it has towards the environment. This strategy overcomes the traditional tendency to have the system of education that is autonomous in relation to the other systems by requiring the system that must be open to all other systems in Serbia. It is this starting point in the strategy for development of education that provides a legal basis for the realization of ideas that are related to OER.

Bearing in mind the successful practice in Europe in terms of implementation of OER, it is necessary to harmonize national regulations in this field. The Law on Higher Education of Serbia [2] governs the alignment with the European system of higher education and the improvement of the academic mobility of teachers and students. It is this principle of the law on higher education in Serbia that provides a starting point for the implementation and development of OER through

alignment with successful European practice and academic mobility in order to share the existing and gain new experiences.

Apart from the mentioned strategy for development of education and the law on higher education, the strategy for development of information society [3], which emphasizes the development of digital educational content as one of the basic goals that should be achieved, is also a significant regulation in this field. The above mentioned strategy refers to the introduction of modern concepts of e-learning and open learning. The basis for the implementation and development of OER was set in accordance with the objectives established by the strategy for development of education.

Examining the existing legal regulations through the mentioned laws and strategies, the conclusions about the needs and demands of the future OER related work are drawn. Existing regulations open up the possibility of development of OER, however, they have yet to be upgraded and harmonized with OER regulations in Europe.

3. CURRENT TECHNOLOGICAL CONDITIONS REGARDING OER IN SERBIA

This chapter highlights the existing platforms that provide foundations for the development of OER. However, before approaching the conditions that are related to the platform, it is necessary to emphasize the need for raising the awareness of the importance of OER in Serbia. To this end, Serbia has already held seminars. In March 2014, the university library *Svetozar Markovic* organized a presentation of the concept of open access to education, open education and massive open online courses (MOOC) [4]. In addition, the methods of accessing high-quality online education have been explained. Such seminars indicate that the promotion of OER is present even at the institutional level, and in accordance with the current legal regulations. Further, a lecture entitled *Digitization and the Knowledge Society* on the subject of free licences, Wikimedia projects, and all aspects of intelectual property in academic papers and projects, has been held at the Mathematical Institute of the Serbian Academy of Sciences and Arts (SASA). Popularization of development, implementation and use of OER in Serbia requires the organization of similar activities at the national and institutional level. Such seminars allow for the improvement of the culture of education, referring to the OER as a new value that should be included in the concept of open education, with the initial goal to build trust in OER [5].

Starting from the basic work requirements for OER, that is the availability of information and communications technology, the Strategy for the Development of Information Society [3] directs towards the maximum utilization of the potential of ICT so as to improve the quality of life. Among others, the Strategy [3] assumes

"open, accessible for all, and good access to the internet," which is a basic requirement for the development and use of OER.

It has been attempted to develop OER in Serbia through already defined practice in other countries, or through their own solutions.

Khan Academy [6] is an example of the non-profit educational website which was developed in 2006 to provide free education "for anyone anywhere." Serbia has started the translation of a video on mathematics, planning to translate the materials on other fields as well. About 400 videos are translated at the moment, and over 150 are synchronized. The mentioned videos are available at http://www.youtube.com/user/KhanAcademySerbian. A part of the translated videos is the product of the cooperation with the LINK group and the Faculty of Philology in Belgrade, while the rest is the result of the work of volunteers and interested individuals. In addition to the translation of educational content, Khan Academy in Serbia is translating the Khan platforms and interactive exercises. The platform is almost fully translated and it is available at http://translate.khanacademy.org. The current work refers to the planning of the translation of exercises. Further, an initiative for mapping of mathematical content in the curricula of individual countries is a significant step for the use of the materials in formal education.

The Belgrade university library *Svetozar Markovic* launched a project on the translation of courses and free learning materials into Serbian [7]. This is also an example of the contribution to the expansion of the existing MOOC practice and the existing platforms for the development and sharing of OER. Further, this example illustrates institutional efforts and the initiative for the development of OER in accordance with the existing legislation.

Apart from the existing solutions within the Khan Academy and the MOOC, their own environment for setting and sharing learning materials has been created . In 2007, within the creative commons project [8] the creative commons national standards were accepted and some examples of good practice in Serbia were given.

In 2005, Wikimedia Serbia was founded with the aim to allow free exchange of knowledge and participation in gathering educational contents [9]. This is a non-profit, independent organization that supports free knowledge and related projects. Wikimedia Serbia is a civic association that is currently implementing several projects. This association has been working on the implementation of Creative Commons licenses in the legal system of Serbia, according to the rules of the international Creative Commons procedure. These licenses are in accordance with national laws and language, and they are also internationally recognized. Wikimedia Serbia is also working on the promotion of Creative Commons licenses with the support of the *Creativity and knowledge-based society* project in which, among others, the discussion on intellectual property and

open forms of intellectual interaction in digital conditions has been opened. Apart from the above mentioned project, Wikimedia Serbia cooperates with various organizations in the organization of seminars and activities that lead to the popularization and education.

Apart from Wikimedia, New Media Center_kuda.org [10], an independent organization that brings together artists, media activists, researchers, and others in the field of information technology also operates in Serbia. This organization deals with the information potential and its influence on the political, economic and cultural relations in the society.

Further, the newly founded Balkan Distance Education Network (BADEN) [11] was created with the aim of hosting resources and information related to open,distance and e-learning. The development plan of this platform also provides the basis for sharing OER.

4. WEAKNESSES, DEFICIENCIES, AND AMBIGUITIES REGARDING THE OER IMPLEMENTATION

Even though e-learning and digitization of learning contents are clearly increasing, there are still significant weaknesses in the implementation and development of OER in the Western Balkans. Weaknesses, deficiencies and ambiguities that arise in the process of the implementation of OER should be anticipated by the OER implementation plan, which is a necessary prerequisite for effective and efficient implementation of OER. The implementation plan includes the following:

• The identification of activities, barriers and potential proposals for their overcoming;
• A detailed description of all activities;
• Allocation of responsibilities and setting time frames.

Along with a defined plan and specific activities, not only have potential problems been identified, but also a way to overcome them. As opposed to the difficulties in the OER implementation, there also exist benefits. This section highlights the difficulties in the OER implementation in the Western Balkans, and the SWOT analysis systematizes the following:

• Strengths, or the features of the implementation that provide advantages and benefits with regard to the other ones;
• Weaknesses, or the features that make the process of implementation more difficult, and that are typical for the Western Balkans;
• Opportunities, or the features that are related to the possibilities that lead to advantages;
• Threats, or the features of the environment that may lead to the problems in the process of implementation.

The following SWOT analysis determines strengths, weaknesses, opportunities and threats through various levels of significance. Table 1 shows abbreviations and the meaning of the SWOT analysis elements, and possible significance quantification [12] that is used in this paper.

Table 1: SWOT analysis and significance quantification[12]

SWOT	Significance quantification
S-Strenghts	Highly significance →+++
W-Weaknesses	Medium significance → ++
O-Opportunities	Low significance → +
T-Threats	No significance → 0

S-Strengths:
• The availability of information about OER implementation, experience and current strategies related to OER; ++
• The decision-making and OER implementation processes involve not only teachers, but also other staff and interested individuals; +
• A large number of educational institutions possess computer equipment and internet connection; +++
• Computer science is a compulsory subject in the curricula for primary and secondary education; ++
• The existence of special programs that are focused on the acquisition of specific ICT skills; +
• Academic institutions are willing to further the implementation of OER through formal and informal education; +
• Low cost of OER production and publishing (the use of free Internet tools and services for creation, storage and disclosure) with high and permanent generated value (once created, the resource has virtually unlimited lifespan); +++
• The existence of strategic development plans and an action plan; ++
• Respectable professional potential of former students at home and abroad; ++
• Intensive cooperation with the international academic community; ++
• The quality of human resources; +++
• The developed system that guarantees quality at all public universities; ++
• The existence of the necessary critical mass of teachers and their associates who are ready for reforms; +
• The awareness of their own responsibility for development. ++

W-Weaknesses:
• A lack of professional internal control in the field of OER implementation and sharing resources; ++
• Unclear job description and individuals' responsibilities for the OER implementation control; ++
• The insufficiently developed system of feedback from the OER users; +++
• The insufficient system of the professional development in the field of OER implementation; +
• OER uses a small number of subjects with insufficient technical equipment; ++
• Insufficient IT contents on the OS platform; +++
• A lack of targeted training for the OER implementation; ++
• Didactic software is not provided in the teaching process; +++

• A lack of defined procurement plans and licensing for the selection and application of didactic software; +++
• A lack of staff and informal training for skill development; ++
• The teaching process mostly focuses on the transfer of information and the "acquisition" of knowledge; +
• A lack of a stable source of research funding; +++
• The insufficient involvement of students in research; ++
• A relatively poor motivation of university staff; +++
• Low investment in the teachers and staff training to use new technologies and techniques; ++
• A lack of quality administrative staff for the support of the international cooperation activities; +++
• Inadequate monitoring of the implementation of laws and policies; +++
• Inadequate infrastructure in the field of ICT; +++
• Insufficient training abroad; ++
• The insufficient number of mutual research projects with the economy; ++
• Inadequate cooperation with the economy; ++
• A large percentage of "brain-drain". +++

O-Opportunities:
• The cooperation with European universities and institutions that successfully implement OER; +++
• The improvement of the professional competence of non-teaching staff in the field of OER; +
• The international IT projects have special significance for the promotion of OER ++
• The affirmation of OER and ideas is realized through academic cooperation +
• Public awareness of the necessity of joining the European academic circles; ++
• The opportunity for active participation in various European projects; +++
• Constant increase in the economic need for lifelong professional development; +
• Linking different scientific fields and initiating interdisciplinary projects; +
• Regular monitoring and support for quality improvement, by raising awareness of quality; ++
• The opportunity that is provided by the technology transfer with the aim of faster knowledge acquisition; ++
• The opportunity for the involvement of our experts from abroad. +

T-Threats:
• A lack of OER related strategy; +++
• The OER implementation process is based on enthusiasm and motivation of individuals or groups, instead of an organized structure that should continuously control the quality of the implementation and development of OER; +++
• A lack of sources of funding for professional development of those who are interested in training in the field of OER implementation; ++
•Economic instability; +
• Insufficient broadband internet access; +++
• A lack of awareness of and resistance to changes in the implementation of new solutions; +
• A lack of awareness of the importance of OER; +++

• Incomplete legislation and poor implementation of the existing one; +++
• Limited employment opportunities for scientific staff; +
• Constant "brain drain"; ++
• Uncontrolled development of higher education institutions in some areas of Bosnia and Herzegovina at the expense of quality; +
• Poor feedback between the economy and universities; ++
• A lack of lifelong learning culture. +++

5. METHODS FOR IMPROVEMENT OF THE OFFERING AND IMPLEMENTATION OF OER

Apart from the above mentioned categories which show weaknesses, difficulties and ambiguities, this chapter suggests potential solutions for overcoming barriers. Here follows a suggestion of corrective measures and actions for the quality improvement:

• Everyone who is employed in the institutions that implement OER in accordance with its business functions should be included in a stage of OER implementation or quality control, while sharing resources and constantly collaborating;
• Develop a methodology for OER implementation evaluation;
• Consistently monitor the anticipated procedures and quality assurance measures;
• Evaluate the effectiveness of the implementation of procedures and quality assurance measures;
• Organize training in the field of OER implementation quality assurance;
• Develop institutional strategies for OER implementation;
• Continuous promotion of the former and current work on the development and use of OER;
• Analyze the institutions' needs in the field of OER within the future activities;
• Allow the comparative analysis in the field of the development and use of OER, by constant exchanges of the staff who work on the development and use of OER at home and abroad;
• Systematically promote the advantages and opportunities of OER;
• Improve collaboration between individuals and institutions that are involved in the development and use of OER;
• The action plan should define a platform that integrates OER solutions, or provides a type of online courses and learning materials;
• The foundation of Open Source Academy at certain universities and ICT centers may lead to the educational and research networks becoming members of international organizations and monitoring standards of Open Source;
• Create an environment for the inclusion of the companies that design didactic software, considerable portion of which should be on the OS platform;
• The action plan should include the creation of a portal for the needs of the distribution of OS software and

exchange of experience in this field for pupils, students and teachers, and a didactic portal for the needs of universities;

• The portal should create a forum where users can post questions, express their opinion on the software and exchange experiences in the use of a specific didactic software.

6. CONCLUSION

The application of OER allows the implementation of technologies that radically improve the process of education and it contributes to the improvement of scientific cooperation. Societies in the process of transition and development of new economies that are based upon knowledge are particularly important for the development of these technologies. The tendency of the Western Balkan countries to direct economic development towards knowledge and innovations in the process of the EU accession requires the use of new technologies and strengthening of the institutional mechanisms for the OER development.

Not only is it necessary to improve legislation for the implementation and development of OER, but the organized awareness of the importance of, necessity for and opportunities of OER should also be built, by linking the educational with the economic systems.

In order to strengthen innovation and encourage the development, the process of education should be directed towards the researches for which OER is an important platform. Young researchers should be particularly encouraged to introduce innovations in knowledge by the use of various forms of education that are based upon web technologies.

The development and improvement of knowledge require greater investment in education and professional development and the encouragement of the implementation of innovative technologies. A special effort should be made so that the expert resources within the academic community could be integrated, thus becoming a core for further expansion and use of OER.

Participation in international projects makes the European achievements familiar, thus raising the possibility for the affirmation and implementation of European values and harmonization of laws and practice.

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TECHNOLOGY ACCEPTANCE MODELS AND LEARNING MANAGEMENT SYSTEMS: CASE STUDY

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Abstract— Paper presents a preview of different technology acceptance models and their application to e-learning, especially to Learning Management System (LMS). Since LMS plays key role in many e-learning implementations, there is a need to collect a feedback from the users – of their attitudes towards the usage of platform, and make an effort in facilitating better technology acceptance. There are several acceptance models, which may be adapted to be used with LMS, by including the pedagogy component. The survey and questionnaire based on adapted TAM (Technology Acceptance Model) were used in order to research LMS acceptance of students from University of Novi Pazar and, results are analyzed and .

Keywords – E-learning, technology acceptance, LMS, Moodle

1. INTRODUCTION

Spread of information technology dictates many transformations of human society on regular basis. It is questionable which area is affected most, since virtually every segment of mankind is shifted via computerization. Education is no exception, on contrary: terms such as lifelong learning and m-learning are generating on almost daily basis. In the same time the raise of MOOC (Massive Open Online Courses) express the vision the university and companies got in online learning.

Institutions also, for their official needs usually implement some sort of learning management system that facilitates access to learning materials, monitoring students, conducting tests, and reusing learning objects and so on [1].

With so much technology involved in our lives, the user acceptance should be treated in a very engaged manner, with specially developed models and methods and systematic approach. There are several general models of technology acceptance. Also, there are models dedicated to e-learning, as it will be presented. Using these models in investigation of user e-learning acceptance, particularly of LMS, might provide us with valuable feedback, pointing the e-learning paradigm in right direction [2].

Paper is aimed at investigation of LMS acceptance among university students. In the following section the term of LMS and its features are briefly presented, and then the technology acceptance models are analyzed. Finally, the research conducted within student population is presented and the results are discussed.

2. LEARNING MANAGENEMT SYSTEM

There are many e-learning tools and applications available online and many of them are free. As a matter of fact, Internet as whole presents a global learning tool, including all educational sites, especially popular services such as YouTube or Facebook. Students are able to build their own learning environment, mixing various media according to their preferences and this approach is known as personal learning environment (PLE)[3]. PLE brings many possibilities to student, as it provides it with full customization. However, in formal education, institution needs mechanisms of access control, progress and results monitoring and communication. The answer lays in LMS, platforms that embed different education activities and resources inside courses: tests, assignments, forums, documents etc. and enable monitor of every student, facilitate communication and collaboration.

There is a somewhat vague classification of LMS related platforms, introducing LCMS ("C" meaning Content) and VLE (Virtual Learning Environment). However, here the LMS is stated as a platform that enables online courses organization using various resources and integrated communication tools, including options for content generation, student monitoring, access control, collaboration and assessment, as well as administrative functions. There are many LMS available on market and there is a common categorization according to the

software model: proprietary LMS and free/open source LMS. Basic LMS features are given in [4].

2.1 Moodle

Moodle stays for Modular Object Oriented Distance Learning Environment and represents the most popular open source LMS with more than 89000 registered installations worldwide in 241 country [5]. Its open source nature and easiness of use made its way to many education institutions.

Moodle content is organized through courses and every course comprises of various activities and resources such as: forums, wiki pages, chat rooms, assignments, files, links, programmed lessons and so on. Teachers got special rights on courses they teach, so they can model the course according to their preferences and in a way that mostly suit the class needs. Every course may be tailored in its own way. However, available resources are the same and their nature mostly dictates the way the course is used by students (and teachers). Also, the organization of the resources on the course level might affect the usage. Additionally, out of the course scope, there is Moodle general environment in which users logs in, gets general information at the platform level, browse courses, edit profile. These are all common activities one student makes in order of using the LMS - particularly Moodle.

Reusable learning objects are educational "cells", smaller course building blocks that can be used in different courses. They are created according to learning objects specifications (SCORM) and Moodle supports several modes of using standardized learning objects. Learning object may contain whole lesson, multimedia, web-page and virtually any possible learning segment. Key for using learning objects is its metadata: information that describes the learning object.

3. TECHNOLOGY ACCEPTANCE MODELS

As stated previously, e-learning embraces various forms of technology usage, spanning from simple PowerPoint presentation, over using specialized sites such as YouTube, to centralized, dedicated complex platform such as Moodle. Every single technology, no matter how simple or complex it is, is susceptible to acceptance analysis.
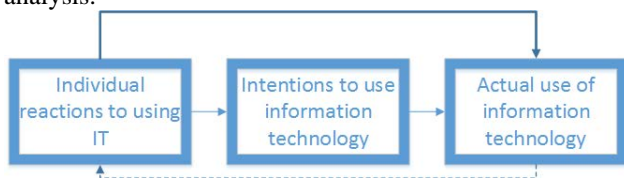
Image 1: Basic concepts of User Acceptance Models

Several models are built in order to describe the relation of user to technology. General concept is given on Image 1.

3.1 Technology Acceptance Model (TAM)

The Technology Acceptance Model is an information systems theory that models users' acceptance and utilization of technology. It is very popular model, made through adaptation of Theory of Reasoned Action (TRA) "specifically tailored for modelling user acceptance of information systems"[6]. The model suggests that when users are presented with a new technology, a number of factors influence their decision about how and when they will use it. Key factors are stated as perceived usefulness and perceived ease of use (Image 2).

Perceived usefulness is defined here as "the degree to which a person believes that using a particular system would enhance his or her job performance.

Perceived ease of use, in contrast, refers to "the degree to which a person believes that using a particular system would be free of effort".
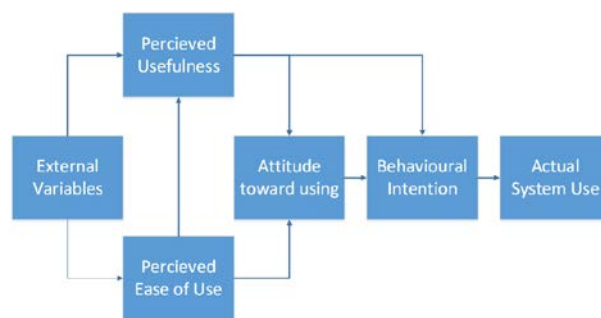
Image 2: TAM concepts

3.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

Venkatesh introduced term of UTAUT, built upon analysis of eight existing theories [7]. The UTAUT's goal is to explain user intentions to use an information system and subsequent usage behavior. The theory holds on four key constructs: 1) performance expectancy, 2) effort expectancy, 3) social influence, and 4) facilitating conditions. The first three direct determines usage intention and behavior, and the fourth the use behavior. Gender, age, experience, and voluntariness of use are posited to moderate the impact of the four key constructs on usage intention and behavior (Image 3).
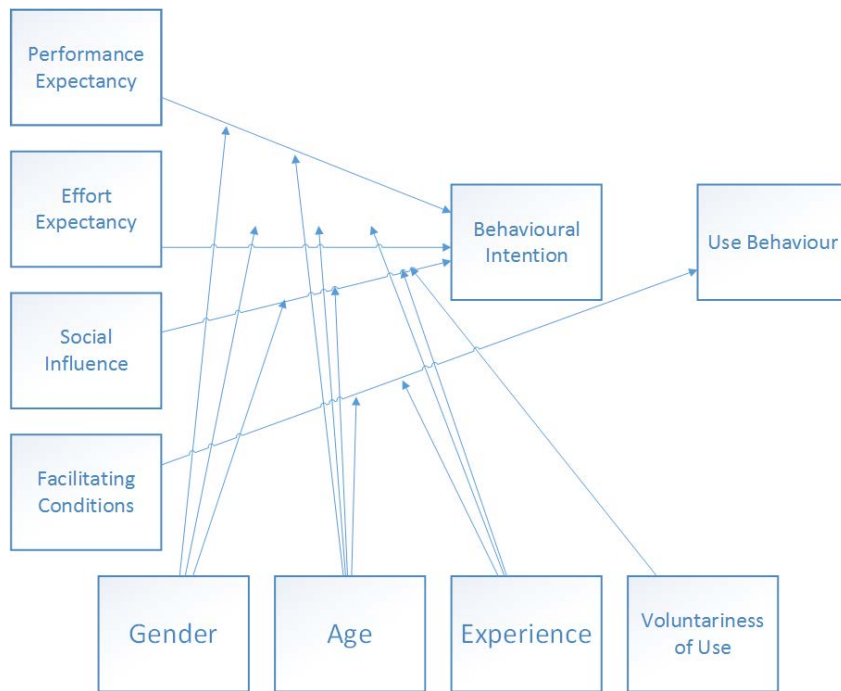
Image 3: UTAUT Research Model

3.3 E-learning Acceptance Model (ELAM)

E-Learning introduces specific issues in matter of user acceptance, such as pedagogy. Therefore, several efforts were made in order of making a specific model UTAUT model has been adapted for technology acceptance research in e-learning, considering both students and teachers, such as[8]. A new model is named E-LAM (E-Learning Acceptance Model)

Conceptual framework is given on Image 4.
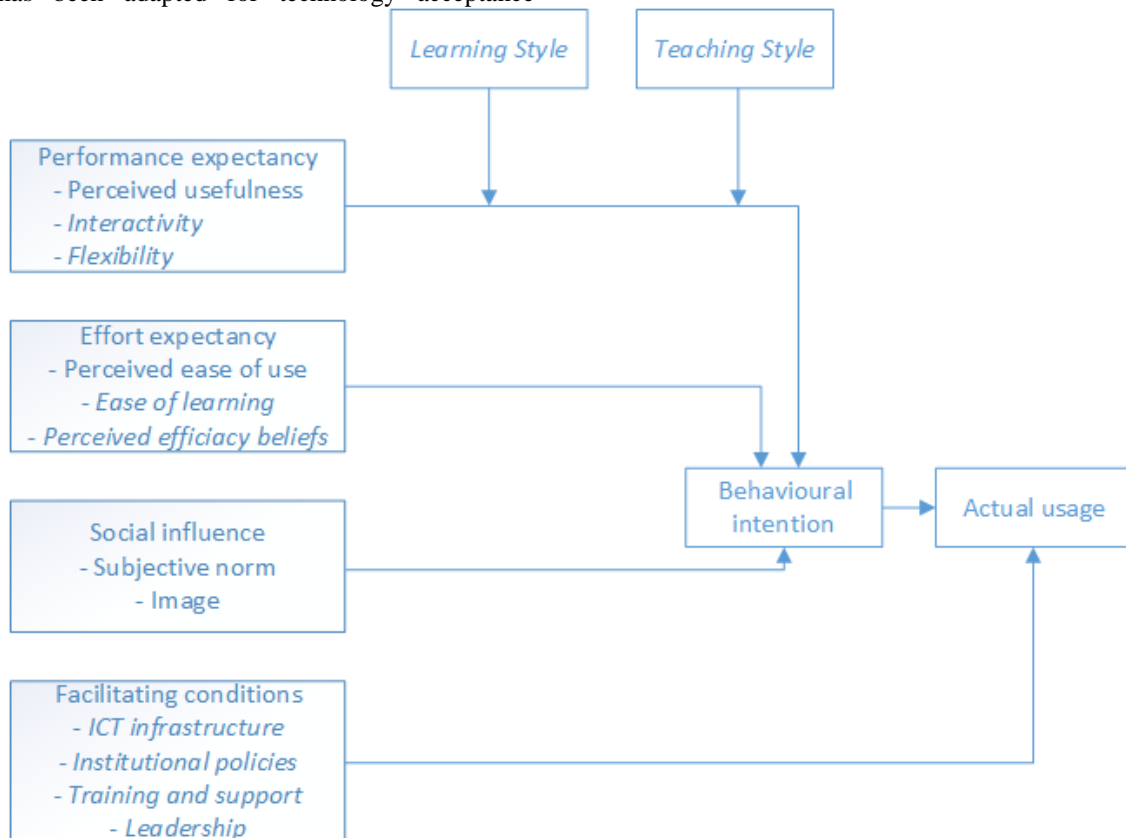
Image 4: ELAM – italic elements are added to original UTAUT

4 THE RESEARCH

The research was non-experimental. The goal was to find out how strong is student's readiness to accept new learning technologies and how much they know about LMS and its usage. Also, a goal was to make an insight into possible differences in acceptance between students who study informatics and the students who study in different fields. A two-part survey was conducted at International University in Novi Pazar. It was based on TAM model with certain adaptations. Population consisted of final year undergraduates of information technology (23 students) and law (8 students). Students had certain experience using Moodle (IT students two courses, Law students one course) . First they filled the closed-questions questionnaire (15 items, based on [9]), and then the 4 item open-ended questionnaire, during their regular classes. Time was limited to 10 minutes per questionnaire. First (main) questionnaire is given in Appendix.

Table 1: Population characteristics.

		IT (%)	Law (%)
Gender	Male	80	60
	Female	20	40
Age	21-22	30	35
	23-24	60	50
	25-26	10	15
Internet experience	None	0	0
	Little	0	5
	Medium	30	70
	Rich	70	25
LMS experience	None	5	40
	Little	25	20
	Medium	45	35
	Rich	25	5
Number of class using LMS (actual school year)	1-2	2	90
	3-8	58	10
	9-21	40	0

The main survey results are given in Appendix.
The second survey part consisted of 4 questions. We quote the most interesting answers.

Are subjects where LMS is used for teaching better?
- I think so, but it depends on design and content harmony.
- No, because a strong knowledge about computers is required prior using LMS.

Do you thing e-learning is more interesting than learning in traditional classrooms?
- It is great to have possibility to learn online, but I think there are to many tasks to be acomplished in this kind of learning.
- I would never trade traditional learning for e-learning because I am a type of person who like listening lectures and be active in classroom

Learning using LMS provides better interactivity with colleagues and teachers.

- I like possibility of contacting teachers and I don't like working in random groups, because the job becomes distributed unfairly at the end.
- There is a problem, still: I cannot meet a colleague in person, to talk and work together.
- Definitely, it reminds me of Facebook.

Learning from home, using digital libraries and attempting tests is LMS advantage.
- I don't believe in online tests. some sort of surveliance should be installed.
- To be honest, I runaway from home to get some rest in class, e-learning would make me stay at home, which is unbearable.

4.1 Survey results analysis

According to the results, the following observations can be made:
- Students do find LMS as general advantage in learning and they are willing to learn more about it.
- Students who are highly involved with IT find using LMS as easy
- There is a substantial difference among acceptance of LMS among IT students and Law students
- Law students in general do not see long-term benefits from LMS, or using it beside their school
- There is a substantial barrier present between students and e-learning (and therefore LMS), caused by lack of traditional and direct methods (classroom communication)
- Elements from social networks are recognized and well accepted in LMS
- Some kind of training would be welcome

5. CONCLUSIONS

Using well known technology acceptance models is a recommended way of getting feedback about e-learning technologies and their usage among students. Existing models can be adapted to embrace additional factors and be finally formulated as a survey.

LMS takes central place in story called e-learning and it highly depends of its acceptance what is going on with e-learning in general. Two categories emerged: technology and pedagogy. It is clear that some sort of training should be made before introducing the LMS in the education system. Although it might be intuitive or similar to Facebook and although students are familiar with Internet applications, still there are novelties and issues that require treatment through trainings and tutorials.

LMS acceptance is coupled with pedagogy and the matter of acceptance does not lay just on certain LMS as itself, but on the pedagogy conducted through the platform: on the course structure and learning materials design. This is matter of instructional design. Teachers (who mostly play instructional designer role) are supposed to be prepared for teaching in learning environment. In that way,

improving the lecturing, the e-learning in general and LMS, as a key part of the package, will be better accepted.

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Appendix

Table 1: Main questionnaire responses

	Responses A – I strongly agree, B – I agree, C – Cannot decide, D – Disagree, E – I strongly disagree									
	IT students					Law students				
	A	B	C	D	E	A	B	C	D	E
I would find Moodle useful for learning.	7	12	4	0	0	4	1	3	0	0
Using Moodle enables me to accomplish tasks more quickly.	3	4	9	5	0	2	0	1	3	2
Using Moodle for learning increases my productivity on classes.	1	3	11	6	2	0	0	2	1	5
If I use Moodle, I will increase my chances of getting knowledge.	17	4	2	0	0	4	1	3	0	0
My interaction with Moodle is clear and understandable.	18	5	0	0	0	0	4	4	0	0
It would be easy for me to become skillful at using the system.	20	2	1	0	0	2	0	0	5	1
Learning to operate Moodle is easy for me.	19	3	0	0	0	0	2	4	0	2
I do not need additional training for using LMS.	5	3	0	12	3	1	0	0	2	5
Using Moodle is a bad idea.	2	0	5	4	12	0	0	7	1	0
Moodle makes learning more interesting.	20	2	1	0	0	2	0	4	2	0
Working with LMS is fun.	15	6	0	2	0	1	0	7	0	0
I often recommend LMS to others.	5	6	9	2	1	1	1	1	5	0
I intend to use LMS in next 6 months.	6	3	13	0	1	0	1	1	0	6
I plan using LMS in the following semester.	19	2	1	0	0	0	0	1	0	7
I already use LMS for my work.	16	4	1	0	2	0	1	0	1	6

M-LEARNING APPLICATION "MALA MATURA"

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Abstract: Bearing in mind the tendency of growing use of mobile devices, and for the purposes of more efficient preparation of elementary school students for taking the final examination (in Serbian the so-called "Mala matura" - little graduation), company LINK group, in cooperation with Information Technology School and Information Technology High School, from Belgrade, developed the mobile application "Mala matura". This paper first summarizes the concept of m-learning, and provides an overview of the possibilities of application of mobile services in e-learning system, and goes on to describe possibilities and way of use of this application for learning using mobile devices.

Keywords: M-learning, Android, Elementary school, High school, Serbian language, Mathematics.

1. INTRODUCTION

Preparation of final examination at the end of elementary school (little graduation, Serbian - "Mala matura") is very stressful and hard for the majority of students. On the other hand, the same students enjoy using mobile devices (such as mobile phone or tablet) in everyday communication or games. It is therefore logical that they should receive the possibility to study and practice, i.e. prepare for such final exam, using those devices. Hence the idea to make a mobile device application for preparing for little graduation. This paper, after offering a brief overview of the possibilities of use of mobile services in learning and education, describes the mobile application "Mala matura", developed in order to make preparation of elementary school students for taking the final examination at the end of elementary school (little graduation), which is also one of the elements involved in ranking for enrollment into high schools. The application was developed by company LINK group, in cooperation with Information Technology School (ITS) and Information Technology High School (ITHS), from Belgrade. Application works under the Android operating system. It is made in Serbian language, and can be used with Latin or Cyrillic alphabet. Use of the application is free and it has over 12,000 users.

2. M-LEARNING

M-learning is based on interaction between mobile devices and learners. M-learning is the acquisition of knowledge or skills through the use of mobile technology anywhere and anytime [1].

M-learning enables one-to-one interaction, time independence, personalization, and extended reach [2]. M-learning may enrich students' learning experiences as it facilitates collaboration and informal interactions between them, builds social capital, and motivates disengaged or at-risk students [1].

Some authors defined m-learning as the intersection of mobile computing and e-learning that includes anytime, anywhere resources; strong search capabilities, rich interaction, powerful support for effective learning, and performance-based assessment [3].

Using mobile devices in learning activities offers some benefits [4]:
- Improved communication and collaborative interaction,
- The provision of more learning opportunities for geographically distant people and groups,
- The encouragement of active learning,
- The enhancement of feedback to learners,
- An emphasis on task,
- The acquisition of content quickly.

Mobile devices are limited by screen size, battery capacity, and network bandwidth [5].

3. M-LEARNING IN EDUCATION

Mobile technologies are one of the fastest growing areas of technology. For educators, they offer an appealing opportunity for learners to transcend teacher-defined

knowledge or approaches by accessing multiple, alternative sources of information [6].

Mobile devices exemplify relatively strong computing capability built in the small sizes, Internet connectivity and the availability of various types and easy-to-use mobile apps. Powerful mobile devices coupled with mobile apps conducive to participation, sharing and communication can make collaboration at distance easier [7].

Mobile devices have added a new dimension and capabilities to situated learning. Some of the mobile functionalities that help in situated learning include [3]:

- Geospatial technologies (GIS, GPS, RFID, Bluetooth),
- Mobile search,
- Use of camera for image capture,
- Social networking.

Enrichment of context-aware technologies has enabled students to learn in an environment that integrates learning resources from both the real world and the digital world [3].

M-learning is becoming an increasingly promising way of delivering instruction in education. This is justified by the current statistics about the prevalence of mobile devices among university students around the world, as well as the emerging m-learning applications in several universities [8]. The portability of mobile devices not only enables students to learn across contexts, but also provides teachers and educators with opportunities to develop new learning models, Image 1 [9].
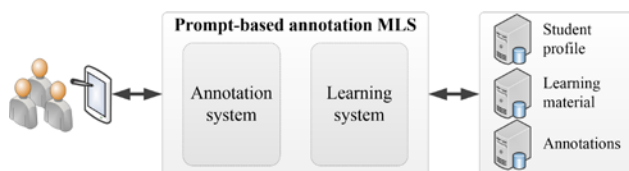

Image 1: Structure of the m-learning system [9]

4. MAIN CHARACTERISTICS OF MOBILE APPLICATION "MALA MATURA"

Following modern tendencies in the information technology field as well as needs in the education system, company LINK group (www.link.co.rs), Information Technology School (ITS, www.its.edu.rs) and Information Technology High School (ITHS, www.iths.edu.rs) created an application called "Mala matura". LINK group is a leading international company that successfully works in professional education and certification from the fields of information technology and modern business. The company operates in Serbia, Bosnia and Herzegovina, Romania, and Ukraine, and through distance learning it brings together students from over 120 countries worldwide. Information Technology School is the first accredited private higher education institution in information technology field in Serbia. Within the school's education processes, teaching is

realized through four study programs: Information Technology, Computer Multimedia, Electronic Business, and Business Systems Management. LINK group, ITS and Comtrade company from Belgrade founded Information Technology High School, which constitutes the first educational institution of this type in Serbia.

The choice for development environment of the "Mala matura" application was the Android operating system. Android is one the latest operating systems for modern mobile devices, proposed by Google and the Open Handset Alliance. Android is based on the Linux kernel and it is available under an open source license. The Java programming language forms the core of the entire Android. All Android applications have the same operating systems rights and privileges and can make use of the majority of the devices' functionalities [10]. Main characteristics of Android platform include automatic application lifecycle management, rich database of useful program libraries and tools for making new applications, high-quality graphic display and sound, compatibility with majority of current and future hardware, support for multimedia data, Bluetooth, Tethering, etc. [11].

Mobile applications are commonly also called mobile apps. These terms are used to describe Internet applications or small bundles of code designed and developed to run on mobile devices. They are intended to enhance features of mobile devices, providing additional functionalities and utilities that increase the devices' utilitarian and entertainment features. There are several kinds of mobile device applications, such as games, Internet applications, widgets, calendars, email utilities, sports information, and so on. This segment of mobile technology has ballooned with the widespread use of smartphones, portable music devices, and other mobile web-capable equipment [10].

Using the application "Mala matura", elementary school students can prepare for taking the final examination free of charge. After creating a user account within the application and logging in, students can choose among the following options (Image 2):

Image 2: "Mala matura" application start screen
- Personal card - Basic information about the student.

- Support - Student can send a message to technical support, retrieve documents and instructions, contact with technical support live, via chat (Image 3).
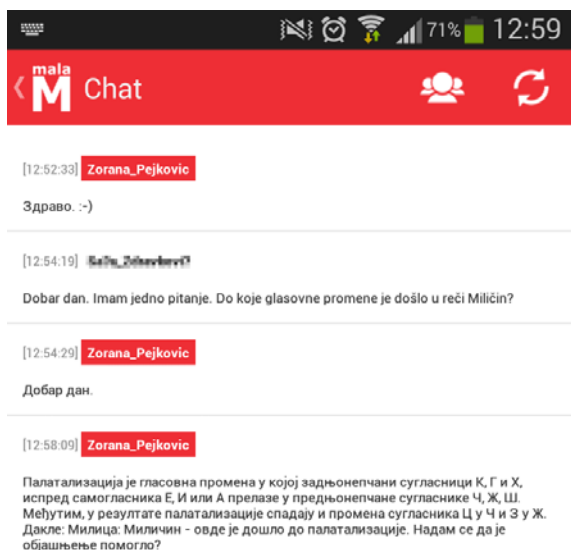
Image 3: Chat room for students

- Instructions - Documents and instructions are available in PDF format, and the student can download them using his mobile device.
- Messages - Student's mailbox, containing received messages, sent messages, drafts and system messages.
- Tasks - Mandatory tests. For every test, a title is displayed, along with the field it belongs to and the recommended date by which the students should complete the test. Test questions are displayed to student one per page.
- Courses - Through their mobile devices, students can attend courses (Image 4) and solving the accompanying tests for assessing the knowledge in Serbian Language and Literature or Mathematics, which cover the entire material covered by little graduation (Image 5).
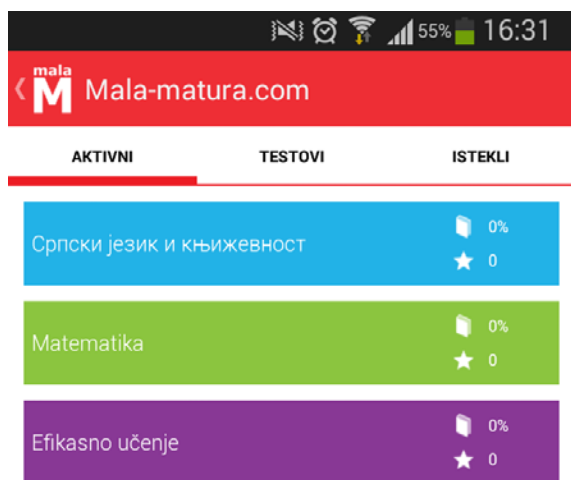
Image 4: Available courses in "Mala matura" application
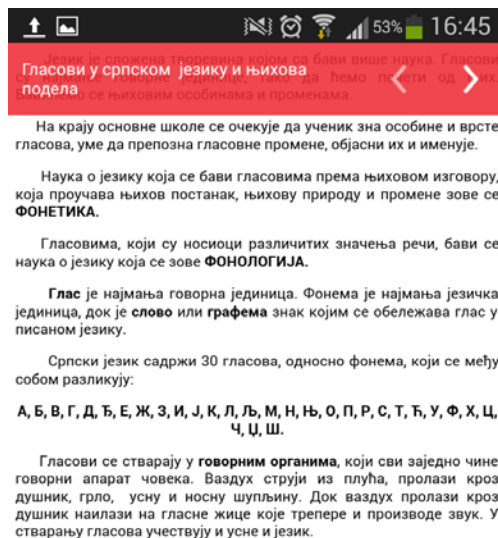
Image 5: Example of Serbian Language and Literature lesson

A part of application "Mala matura" constitutes a simulation of the final exam for elementary school students (Mathematics, Serbian Language and Literature). The final test comprises questions included into the official collection approved by the Ministry of Education, Science and Technological Development of the Republic of Serbia. According to its number of questions, difficulty of questions and the designated time for solving, the test corresponds real conditions in which students take the final exam in their schools (Image 6).
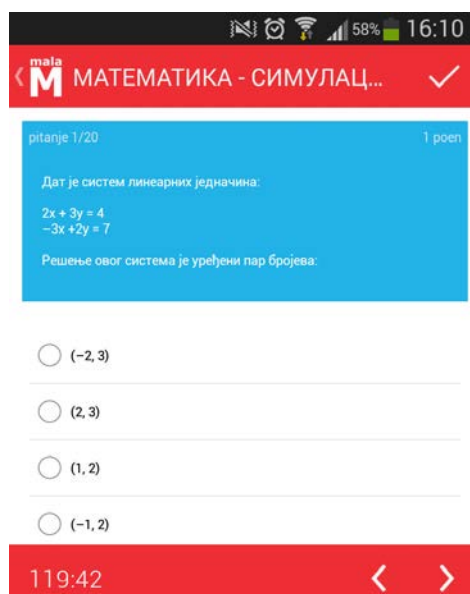
Image 6: Final mathematics test simulation

When the application became available to users at Google Play, in a short time it reached number one as the most popular application in the field of education in Serbia and the region. Application "Mala matura" is currently used by over 12,000 users, and the users awarded it average grade 4.08 on a scale from 0 to 5.

The achieved results of the "Mala matura" application and the positive reviews received from the users of Android platform create the base for further improvement and tracking trends in the field of mobile education. According to the purpose and content, which is in accordance to the regulations of the Ministry of Education, Science and Technological Development of the Republic of Serbia, this is the only application of its kind available to users in Serbia. Moreover, the application is free as well as all the additional services which are a part of it.

Research and analysis of the similar applications on a global level in Google Play led us to the conclusion that there are several applications which could be the subject of comparison. The applications tested and compared are only for one educational field and offer preparation materials and tests for one field only (for example, mathematics, physics, history, biology). The applications are available for download from Google Store but additional payment by users is necessary for the full functionality of the application.

5. CONCLUSION

Increasingly wide use of e-learning with the tendency of increasing use of mobile devices (m-learning) brought about the development of mobile applications. This paper describes one such application, for more efficient preparation of elementary school students for the final exam and preparation for high school enrolment, called "Mala matura", which covers subjects of Serbian Language and Literature, Mathematics, as well as a combined test.

It can be used at any time and from any location. The user can, using his mobile device, download documents and instructions (in PDF format), study, solve problems, asks a teacher a question, use exam simulation, send a message to technical support, contact with technical support live, via chat.

The application has been developed under Android operating system, its use is free of charge, and it has over 12,000 users.

Based on the research conducted, we suggest that the "Mala matura" application can be implemented in the educational systems outside Serbia.

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CREATING AN ENVIRONMENT FOR FREE EDUCATION AND TECHNOLOGY ENHANCED LEARNING

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Abstract: *The purpose of this paper is to present a project aimed at making knowledge publically available through open educational resources (OER). The focus is on open online courses which will be created by educational institutions and best practice examples offered by leading companies, with the purpose to support life-long education and enhancement of academic education with practical knowledge. The goal is to create diverse high quality educational materials in electronic format, which will be publically available. The educational material will follow basic pedagogical-didactic principles, in order to best meet the needs of the potential learners. In accordance with that a review of didactic principles that can contribute to producing OER content of excellence is given. The choice of a convenient platform, as well as the application of appropriate information technologies enable content representation in a suitable, innovative and meaningful way.*

Keywords: *Open educational resources, lifelong-learning, open online courses*

1. INTRODUCTION

Rapid technological advancement, expansion of information technologies, and growth of the internet have resulted in their penetration into all segments of the society. Consequently, substantial changes are underway in the educational domain as well. There is a growing support of the academic public to open educational resources (OER), and a respectable number of OER content is already available. There are many definitions of OER content, one of the most comprehensive being the one suggested by Downes [1], for whom OER can be understood as educational materials that can be freely accessed, changed, reused and shared. They include courses, textbooks, videos, tests, software and tools that can be used in educational purposes. OER materials can thus be found in different forms, from short video clips to complete complex courses.

Besides the strong support to OER in Europe, several recent reports testify to the spreading of OER around the globe, such as the initiative reported by Harsasi [2] about a project in Indonesia, which includes over 275 OER courses. Other examples include OER content implementation in the educational system in Japan, where courses were created in different areas, as well as OER initiatives in China, Korea and Taiwan, where large collections of open educational resources have also been developed [3].

There is an ongoing debate among researches on the mechanisms for fostering the creation of OER materials, who is to be included in this process, and what the advantages and challenges that OER brings are [4][5]. The historical rationale for OER can be found in the Universal Declaration of Human Rights (Article 26), which refers to education as follows: "Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages." However, reporting on OER implementation in Spain and its impact, Gil-Jaurena emphasizes the importance of institutional support to OER content creation [6], whereas a UNSECO report by Schwille et al. [7] sets OER in the global perspective of improving educational policy and practice.

An important argument in favour of OER development is that, by means of OER, universities do not keep their knowledge locked, but rather make it visible to their fellow educators and researchers from other institutions. Consequently, duplication of research can be avoided, a new working environment can be created among colleagues and integrated into their current work. Beside this, freely available material can be edited and enhanced by colleagues, and thus better educational results can be reached, as opposed to each educator or researcher starting from the very beginning. Moreover, materials of this kind can contribute to the promotion of the educational institution and in this way attract more students. It has been noted that even some kind of rivalry appears between universities, when it comes to number and quality of OER content [8]. Companies, on the other hand, by offering their best practices freely, promote their brand and identity in the competitive entrepreneurial environment.

However, application and development of OER materials faces certain difficulties. Some of the issues are how to secure the quality of OER content, and how to sustain long-term interest for development of OER materials. Thus Koppi and Lavitt [9] state that one of the reasons for the lack of motivation among the teaching staff regarding OER development can be found in absence of institutional valuation. Hence they suggest that appropriate credits should be awarded for contribution to OER development.

Having in mind all the advantages of OER materials, as well as the need to make free educational content available, a number of Western Balkans and EU universities gathered around the idea of creating BAEKTEL project (Blending Academic and Entrepreneurial Knowledge in Technology Enhanced Learning). Universities from Serbia, Montenegro, Bosnia and Herzegovina, Italy, Slovenia and Romania are taking part in this project (www.baektel.eu - Figure 1). The aim of the project is to create OER materials in different areas which will create a connection between university knowledge (theoretical knowledge) and practical (applied) knowledge needed for working in the industry. To that end, educational materials in electronic form will be created, which will be publically available at no cost to the end user. In this task all advantages of information technologies will be used in order to present materials in a meaningful way, by satisfying basic pedagogical-didactic criteria.

Figure 1: BAEKTEL website

In the next section we give an overview of didactic criteria, applied in our approach. Section 3 outlines the main features of the software solution, followed by conclusions.

2. DIDACTIC CRITERIA APPLIED TO OER

Didactic criteria can be understood as principles which determine the flow of teaching and learning, in accordance with aims of upbringing, education and laws of the teaching process.

Observing the aim of the project to create and make available educational content in various teaching areas, and also in different industries, the approach had to enable creating and facilitating materials in different forms. Since teaching subjects can differ a lot, various ways of presenting the content should be possible. The majority of the materials will be in form of online courses, which will be developed in accordance with basic pedagogical-didactic demands. It has also been planned to enable hosting of already existing materials like textbooks, scripts, power point presentations, videos… In order to improve and make materials more interesting to the end users, various types of multimedia as video clips, audio recordings, animations and images will also be used. The idea is to make users active subjects in the process of learning [10], and with that in mind special attention will be given to establishing interactivity through different types of questions and quizzes.

When it comes to creating educational materials, one of the important didactic criteria is **adjusting content to its target group**. Since, the main subject of the project is OER related to higher educational institutions as well as partners from industry, the nature and the needs of the end users are hard to define. Hence, neither the level of education of the end users, nor their age or their motivation for using these means of education is easily predicable. That is why it is important to create courses in such a way that in each moment users are familiar with the aim, sum of knowledge and skills which can be obtained by a given course. To that end, it is necessary to provide a description of the course, as well as of the necessary prerequisites which the user must possess in order to follow the content of the course. With this in mind an indexing web portal with metadata of the OER content will be formed. The model of the metadata will be in compliance with the Dublin Core standard as well as IEEE 1484.12.1-2002 Learning Object Metadata Standard (LOM). In this way it is more likely that users who decide to use a specific content or take a specific course will meet the prerequisites and find the content useful, and thus be satisfied with the specific OER.

It is desirable to combine different ways of teaching content like plain and dynamic text, power point presentations, video clips and animations, etc. in order to adjust the educational content to various needs and learning styles of the end users. In addition to that, courses based on various types of materials can contribute a lot to keeping the educational materials dynamic, which can play an important role when it comes to keeping the end users motivated. Besides the important impact of these materials on increasing the motivation among users, various integrated audio-visual components should also help significantly in reaching a higher level of learning quality and better understanding of presented matter.

Beside the already explained didactic principles which referred to adapting the educational content to the end users, it is also important that educational materials satisfy the didactic **principle of systematization and gradualism in the teaching process**. This principle can partly be accomplished through structuring and organising

the course. It is desirable to create a clear structure of the course through which the user will gradually advance until the closure of the course. It is necessary that all segments which form the structure of the course be combined into a coherent whole. One of the ways to achieve that is to divide the course into sections, sections into units, units into lessons, where the lessons are formed by combining different textual and audio-visual components as depicted in Figure 2.
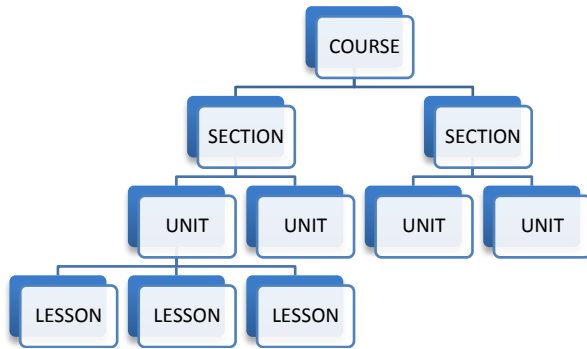

Figure 2: Course structuring

When it comes to the structure of a single lesson, it is recommendable to divide each lesson into three basic parts (Figure 3). In the introductory part of the lesson it is desirable to create motivational examples and tasks that will introduce the content of the lesson to the end user while awakening interest at the same time. The main part of the lesson follows, consisting of the largest part of the planned content, in accordance with the didactic principle of science, which will be elaborated below. Finally, the third part of the lesson should preferably contain a short resume as well as some kind of self-evaluation consisting of short questions and quizzes.

Figure 3: Structure of a lesson

As just mentioned above, the content of the OER materials should be based on the **didactic principle of science**. This principle refers to the orientation of the teaching content towards contemporary scientific development. Given the fact that it is not possible to consider and investigate every view, connection and relation, one of the important demands of the science principle in the teaching process is to make students familiar with the principal features and properties of a subject, as well as the connections and relations between subjects and phenomena. Hence, the idea is to create materials according to the principle of science, which of course implies reliability and verifiability of the given teaching materials.

Also, one of the important didactic principles is **connecting the theory and the practice**. The aim itself of BAEKTEL is in accordance with the mentioned

principle, since it is conceived as one of the means for cooperation and connecting the higher educational institutions with companies from the industry. The idea is for the higher education institutions to enrich, by means of these courses, theoretical knowledge with examples of practical application offered by companies. On the other hand, partner companies will use educational content offered by higher education institutions to enhance and renew the theoretical knowledge of their employees.

Finally, it is also necessary to attune OER materials to the didactic **principle of awareness within the teaching process**. The principle itself refers to effective participation of users in the process of learning, underlining their role as active subjects, as opposed to being passive bystanders in that process.[7] The idea is to enable the users to learn at their own pace, as well as to establish a specific interaction between users and the course creator, as well as interaction between users and the learning platform itself. This segment can be improved by combining many different types of questions according to the aims and the desired outcomes of the course, as well as meaningful animation and interactive applets which will demand direct user interaction.

Also, it is important to implement an evaluation system for OER content. The aim is to obtain user feedback on the quality of OER content, so that it can be constantly improved and further adapted to the end user. This can be achieved by using standard questionnaires as well as gathering and examining anonymous usage data generated by the learning platform.

3. SOFTWARE SOLUTION

Besides having high quality OER content, the way in which it is offered is extremely important for it to reach its full potential. The platform that hosts the content, besides making it easily accessible, acts as a medium that enables the users to interact with it, as well as with each other. Combined, high quality OER content, its users and the platform form a rich user experience. Another important aspect of publishing OER content is making it easily searchable. This way users are able to quickly find the content relevant to their specific needs or get an answer to a specific question.

After examining all of the available open source solutions, and taking into account everything mentioned earlier, it was decided that BAEKTEL platform should consist of two segments: an **indexing web portal** and a **learning platform**.

In order to make the OER content more accessible as well as more discoverable, it is important to provide the users with advanced search features. That is why all the OER content should be properly described with earlier mentioned metadata. For the **indexing web portal** we found that the digital asset management platform ResourceSpace (http://www.resourcespace.org/) offers powerful features for managing metadata of OER content. It is also easily expandable to include advanced search capabilities, so the users are going to be able to search for

desired OER content not only by keywords, author, area, etc… but also by multilingual technical terms. For the search features to function properly, it is important that all required metadata about the OER content are provided.

As mentioned earlier, for a richer user experience, it was important to use the most interactive and the most user friendly learning platform. After examining the most popular learning platforms, we found that edX platform (http://code.edx.org/) created by MIT offers by far the richest and most interactive user experience, compared to the other two most popular open source learning platforms (OpenMOOC and Moodle). Hence a network of edX nodes spread throughout partner countries, together with the ResourceSpace platform form the core of the BAEKTEL framework, as depicted in Figure 4.
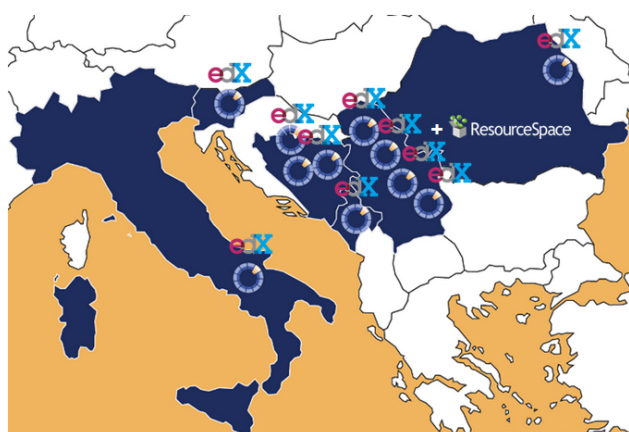

Figure 4: Distribution of BAEKTEL resources

After declaring it open source, edX started to gain rapidly in its popularity. Thanks to its modular design and fast growing community, through the use of third party plugins (software extensions that can be installed on top of the core framework to add new functionalities), new features (such as discussion board, equation editor, code execution simulators, etc.) are being added constantly. With its modern design and simple user interface (Figure 5), edX is easy to learn and simple to use both by content creators and content users. Its backend control panel for authors (edX Studio) makes it easy to combine different types of media and create a course structure that fulfils the previously mentioned didactic principle of systematization and gradualism. It is also possible to create interactive tests, implement self-evaluation and track the progress of users.
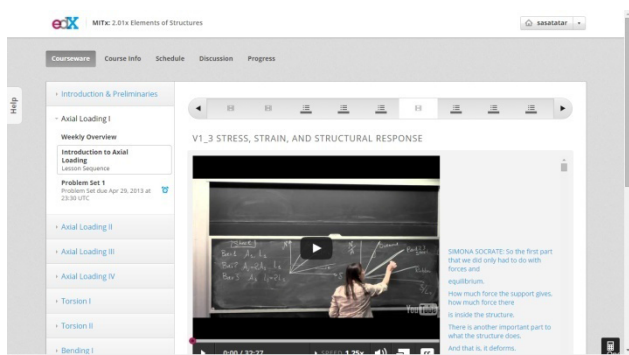

Figure 5: Illustration of an edX course

User feedback together with usage data generated through engaging in the content and interaction with other users offer an invaluable insight on how we learn best and how to further improve the content itself as well as the sheer process of teaching.

4. CONCLUSION

Thanks to rapid technology development the concept of lifelong learning and continuous self-improvement have become crucial in creating well educated and globally competitive work force. It is clear that OER and technology enhanced learning (TEL) will have a huge impact on the way we learn as well as the way we teach.

Our intent is that BAEKTEL plays a significant role in spreading the use of OER and open online courses in WB countries, especially considering that the native languages used there do not belong to the group of "big languages", which makes the impact of existing OER much smaller.

Given that the use of OER is formally not yet recognized in WB countries, our hope is that BAEKTEL will also help form a framework that will foster the development and active use of OER and open online courses at the higher educational institutions.

Other than promoting the use of OER, it is also important to ensure that the created content is of high quality, which is in part to be achieved by imposing the outlined didactic principles.

Finally, by implementing and promoting the use of modern learning platforms such as edX, BAEKTEL should help raise the quality of education, while at the same time, by analysing the usage data, improve the process of teaching in general.

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USING METADATA FOR CONTENT INDEXING WITHIN AN OER NETWORK

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Abstract:*This paper outlines the ICT solution for a metadata portal indexing open educational resources within a network of institutions.The network is aimed at blending academic and entrepreneurial knowledge,by enabling higher education institutions to publish various academic learning resources e.g. video lectures, course planning materials, or thematic content, whereasenterprises can present different forms of expert knowledge, such as case studies, expert presentations on specific topics, demonstrations of software implementation in practice and the like. As these resources need to bediscoverable, accessible and shared by potential learners across the learning environment, it is very important that they are well described and tagged in a standard way in machine readable form by metadata. Only then can they be successfullyused and reused, especially when a large amount of these resources is reached, which makes it hard for the user to locate efficiently those of interest.The metadata set adopted in ourapproachrelies on two standards: Dublin Core and Learning Object Metadata. The aim of metadata and the corresponding metadata portal described in this paper is to provide structured access to information on open educational resources within the network.*

Keywords:*OER, Open educational resources, metadata, TEL, Technology enhanced learning*

1. INTRODUCTION

Due to intense technological development there is a growing need for reinforcing knowledge exchange between academia and industry. At the same time, the Open Educational Resources (OER) movement, aimed at providing teaching, research and learning materials under an open source licence that permits their free use, access, repurposing, reuse and redistribution by others with limited or no restrictions is rapidly gaining popularity [1].Based on these two facts, the BAEKTEL (Blending Academic and Entrepreneurial Knowledge in Technology Enhanced Learning, http://www.baektel.eu) project was initiated with the main goal of building an OER networkofferingeducational materials by higher education (HE) institutions and best practice examples by enterprise experts. The network is conceived as multilingual, which means that resources can be published in different original languages, with adequate support offered for their translation[2].

The conceptual model of the ICT solution for BAEKTEL OER framework envisages a network of nodes offering OER content and a central repository,the BAEKTEL Metadata Portal (BMP), where metadata,providing all important information on the network resources will be stored, thus enabling their centralized search and browse. The initial network consists of six nodes located at different Western Balkans (WB) universities participating in this project, with one of them hosting the BMP.

By means of metadata, or "data that describe other data" within the central BAEKTEL repository, resourceswithin the network become well described and tagged in a standard way in machine readable form.OER metadata include information such asresource title, author, subject, creation date and the like, which facilitates search, but also acquisition, use and reuse of learning objects.

In defining metadata for BAEKTEL resources existing standardization efforts has been taken into consideration. Namely,the IMS Global Learning Consortium (GLC) promotes standardization of learning object metadata vocabularies and federated search processes consistent with several different standards[3]. These standards include Dublin Core, IEEE Learning Object Metadata(LOM) and the Learning Resource Metadata Initiative (LRMI), an extension of schema.org, launched in 2011, as a joint initiative of Google, Yahoo, Microsoft Bing, Yandex and W3C. Schema.org provides a collection of schemas for HTML pages markup in ways recognized by major search providers and used for structured data interoperability [3].The main rationale for the approach fostered by IMS GLC is that the choice of a standardized learning object metadata vocabulary has valuable and beneficialinstitutional and pedagogical implications.

The focus of this paper is on metadata and their management in the context of BAEKTEL OER framework, which is described in more detail in section 2. Section 3 of this paper outlines the key aspects of metadata management, including standards for describing educational resources and the approach to BAEKTEL metadata definition. In section 4a review of the main open source Digital Asset Management (DAM)systems for

metadata managementis given. The model and description of the proposed metadata set are described in Section 5, while section 6 is dedicated to its use case model, followed by conclusions in Section 7.

2. THE BAEKTEL OER FRAMEWORK

The basic structure of the BAEKTEL OER framework isillustrated by the deployment model in Figure 1.The initial framework consist of a network of six nodes at WB universities, namely University of Belgrade (UB), University of Kragujevac (UNIKG), University of Niš (UNI) from Serbia, University of Banja Luka (UBL) and University of Tuzla (UNTZ) from Bosnia and Herzegovina and University Mediterranean (UNIM) from Montenegro. All of them develop and publish their OER independently using edX, an open-source online learning platform offered by a massive open online course (MOOC) non-profitprovider (https://www.edx.org/about-us). In addition to its own OER in edX,UB hostsBMP, the central repository with metadata for all published OER within BAEKTEL network.
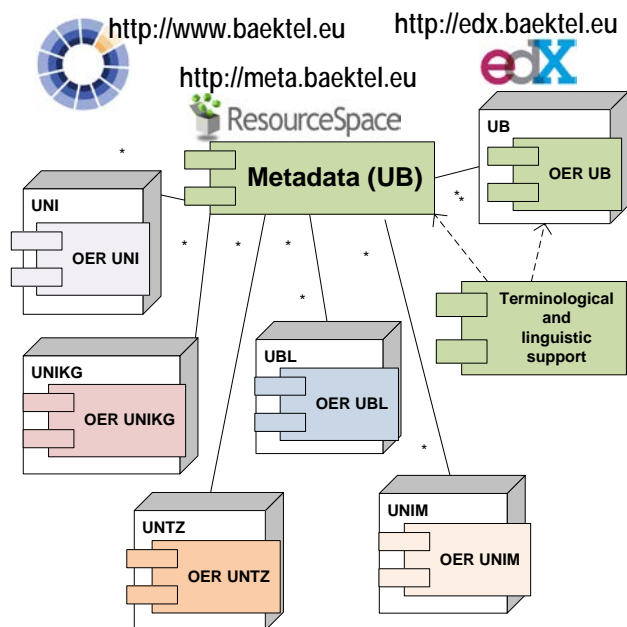

Figure 1: The BAEKTEL framework

BMP features a web application for management, browse and search of metadata, butalso web services for terminological and linguistic support. Since OER content within the network can be published in different languages, the web application and web services support the network multilinguality, but also offer various features related to query expansion, information retrieval, OER indexing, and the like.

The basic aim of the ICT solution for BAEKTEL OER framework is to support a distributed OER system. The framework is not limited to the current six nodes, but allows effortless expansion.More nodes at other institutions, academic or entrepreneurial equally, which might join the BAEKTEL network in the future, can be easily integrated in the current network. In addition, the framework can integrate OER that are not created by institutions within the network, the only condition being that those resources are registered and described in the central metadata repository.

3. METADATA MANAGEMENT

The Schema.org initiative was the result of the exponential growth of data on the web and large intranets, which made the location ofweb pages containing data of interest more and more difficult. A solution to this problem was found in introducing metadata, withthe goal to improve the display of search results, thus making it easier for users to find the right web pages. To that end, content publishers insert machine readable information into the code of web pages, which helps search engines interpret the sense of the text on those pages. One example of such tagging for a page containing a research paper is:

```
<div itemscope itemtype="http://schema.org/ScholarlyArticle">
<h1 itemprop="name">Raster georeferencing</h1>
<p itemprop="author" itemscope itemtype="http://schema.org/Person">
<span itemprop="name">Ranka Stanković</span>,
<span itemprop="affiliation">University of Belgrade–Faculty of Mining
and Geology</span></p>
</div>
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One of the main tasks within the development of the ICT solution for the BAEKTEL metadata portal was to define anappropriate metadata schema, drawing its data elements from one or more namespaces, that is, containers for sets of identifiers. Namely, the BMP schema contains elements taken from standard namespaces with guidelines for metadata creation. In metadata specification, the standard nomenclature was used, enabling learning resources to be described and shared in a common way, and thusenhancingtheir accessibility from other OER portals.

The need for metadata

OER need to be shared, accessible and discoverable by potential users across the learning environment. They should be annotated in such a way that the users can understand what specific learning objectsare about, what is their learning content and prerequisites for their use,without even seeing them [5].

When a large amount of OER is reached, it is even more important that they are well described and tagged in a standard way in machine readable form. In that case, results returned by search engines are more relevant, and both educators and learners can find and compare learning materials that best suit their current needs more efficiently.

OER or the related metadata standards are often stored in the so called Learning Object Repositories (LOR). Different LORs address different needs and therefore have different metadata schemas. Chan & Zeng emphasize thatmuch effort has to be devoted to achieving or improving interoperability among metadata records in order to enable federated searches and facilitate metadata management [6].

The following subsection describes some of the common standards used in educational settings.

Standards for describing educational resources

Koutsomitropoulos et.al [7] point out that, although generic metadata specifications, such as the Dublin Core(DC) [8,9], seem to fulfil the need for documenting web-distributed objects, educational resources demand a more specialized treatment and characterization. They propose a mapping of the IEEE 1484.12.1-2002 LOM Standard elements to DC, as a basis for delivering web services for educational resources. Namely, LOM Standard,provided by the Institute of Electrical and Electronics Engineers, is the leading educational metadata specification[10].The standard groups data elements to describe a learning resource into the following nine categories: general, lifecycle, meta-metadata, technical, educational, rights, relation, annotation and classification. LOM Standard has more than 70 possible elements, andFriesen points out that it is widely used in educational context and applied in several learning object repositories [11].

Along the same lines, the Education Working Group of the Dublin Core Metadata Initiative developed DC terms to describe educational resources. They also proposed a number of LOM elements to be added to enhance the DC record. Several metadata initiatives follow the recommendations provided by the DC Education Working Group.

The International Standards Organization (ISO) sub-committee on Information Technology for Learning, Education and Training (ISO/IEC JTC1 SC36) is also involved in metadata standards for learning resources. They focus on existing standards and technical reports and conducted a survey on the use of LOM. The group published a first draft of a standard towards the end of 2005, but an ISO International Standard for metadata has not yet been released.

As mentioned before, metadata help users find relevant resources and enable them to make informed decisions as to whether or not a particular resource is relevant to their purposes. When metadata are shared with external portals, the visibility of the resources is additionally increased. One such important federated search project is the Global Learning Objects Brokered Exchange (GLOBE) [12], an international consortium that strives towards making shared online learning resources available to educators and students around the world.

The approach to BMP metadata

Focusing on DC and LOM Standard an analysis was performed of the strengths and weaknesses in order to select metadata that will best improve the search and browse functions of the BMP.

LOM, asthe leading, widely used, educational metadata specification is recommended by the Sharable Content Object Reference Model (SCORM), a collection of standards and specifications for web-based e-learning. The major drawback of LOM is that it has too many elements, which makes itoverly complicated. In practice, most communities use just a few elements from the LOM schema. Consequently,the resulting metadata schemasdo not differ muchfrom simpler standards such as DC.

On the other side, DC is compact, well explained and widely used, but it lacks elements for a comprehensive description of learning resources.

The approach to defining metadata within BAEKTEL draws fromtheFAO Learning Object Resources Metadata Application Profile (FAO),which combines DC and LOM Standard [13].In development of the BMP model, compliance withthese standards was obligatory,asthe BMP metadatahadto providefor sharing with otherOER repositories. At the same time, the number of mandatory elements had to be carefully selected,thus preventing metadata from becomingthe bottleneck of the whole system.

4. METADATA PLATFORM

The metadata platform for the BAEKTEL Metadata Portal was selected bearing in mind that the main goal of BMP is to providefacilities to learners for metadata search and direct access to learning resources, such as courses, training materials, guidelines, case studies, best practices and the like,on any media that supports educational material, as well asOER metadata management facilities to OER creators.

As the approach to BMP development was based on adaptation of one of the existing open source software solutions, a review of the main open source Digital Asset Management(DAM) systemswas performed, which set aside three possible platforms: NotreDAM, ResourceSpace and DSpace.

NotreDAM (http://notredam.org/) has an impressive set of features (http://notredam.org/overview/) and looks very promising, but it is still in the development stage, with modest documentation, which is mostly unfinished, and versions operating under specific operating systems. Documentation for the latest version of NotreDAM package is currently under construction, but the instructions for previous versions are also incomplete. It is working properly on Ubuntu 10.04, but for Ubuntu 12.04 it works only partially. The system is developed in Python.

DSpace(http://www.dspace.org/) is a full featured, open-source solution for storing, indexing and retrieving digital resources. It is highly configurable and can support any metadata schema. DSpace is academically oriented to a great extent, with numerous features, but hard to master by 'ordinary' users. It has an unpleasant user interface and the overall user experience is poor.

ResourceSpace(http://www.resourcespace.org/) is an open source DAM system released under a BSD-style license. It requires PHP, MySQL, and the GD Graphics

Library, and works with most web server software and any operating system. Some of its main features are:

- Intelligent search ordering by scoring resources against keywordson basis of user search activity
- Preselected groups of resources
- Resource access level permissions by user group
- Multilingual,allowingthe user to change the languagewith most major languages supported
- Automatic thumbnail creation for resources
- Minimal hosting requirements

After comparing and analysing the three DAM systems, ResourceSpace has been selected as the most suitable platform for the BAEKTEL metadata portal.

5. THE PROPOSED METADATASET

The cross-comparison of themetadata requirements for BMP and analysis of existing standards resulted in the metadata set based on DC with some elements taken from LOM, which describe theresources in a way that facilitates exchange with other OER systems. Figure 2 provides an overview of the elements included in BMP.
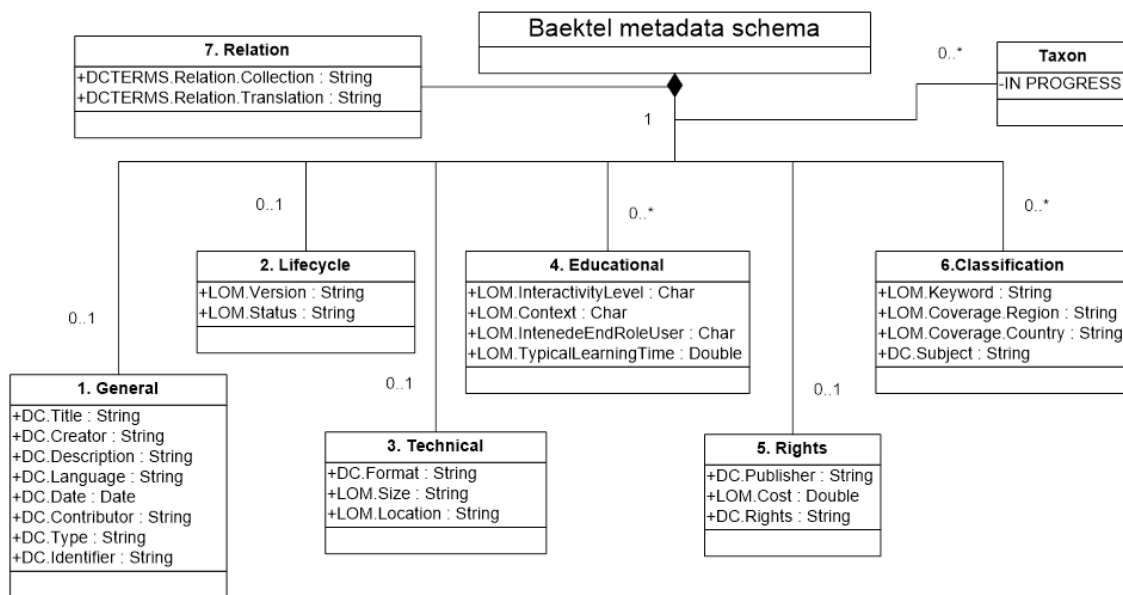

Figure2: Metadata model for BAEKTEL portal

General data are taken from the DC standard. They are: title, creator, description, language of the content of the resource, date when the resource was made available to the public, contributor and type of resource. Also, for each of the resources an identifier is created, as a unique code that provides unambiguous access to the resource.

Title is a name given to the resource. Creator could be a person, group of people or organizations responsible for producing the content of the resource. Description is the abstract, a concise description of resources.Contributor is a person, organization, or service responsible for making contributions to the resource.

Type identifies the nature of the content of the resource, such as"best practice", "case study", "exercise", "guidelines", "lesson", "module", "monitoring"and "evaluation techniques", "policy brief", "portal", "promotional material", or "reference material".

The Lifecycle category describes the history and current state of a learning object. Lifecycle fields, version and status are taken from the LOM Standard. Version indicates the edition of a learning object. Status indicates whether the resource development is completed and ready for publication, for example,"pending submission", "pending review", "active", "waiting to be archived", "archived", or "deleted".

Technical data are format, size of the digital resource in bytes and location (web address).Format is the layout of the resource in terms of how the information contained in the resource is organized. It indicates whetherit is an electronic document, paper only document, slide(s), website, cd-rom/dvd, audio, or video.

Educational data, taken from the LOM standard, suggest the auditorium the resource is intended for, the environment for learning, estimated duration of the course and degree of interactivity.

Interactivity level indicates the degree to which the learner can influence the aspect or behaviour of the resource. Value for this field can be "very low", fora document intended for printing; "low",a video clip with play and pause controls; "medium",a hypertext; "high", a lesson with multiple-choice exercises providing feedback; "very high", a virtual 3-D environment that enables exploring.

Context is the principle environment within which the learning process, that is, the use of the learning object is intended to take place. By selecting the audience and level for the material("school", "higher education", "training", "other"), users conducting searches will be able to narrow in on the appropriate resources.

Intended end user role represents the principal user for whom the resource was designed ("learner", "teacher", "manager", "supervisor").

Typical learning time is the approximate or typical time it takes to work with or through this learning object.

The attributesin the Rightscategory are publisher, rights and cost.Publisher is the individual, group, or organization named in the document as being responsible for that document's publication, distribution, issuing, or release. Rights includes information about various property rights associated with the resource, including intellectual property rights (e.g. creative commons license). Cost indicates whether use of this learning object requires payment.

Classification allows for systematic arrangement and browsing of resources, by grouping them into classes, according to common characteristics.Classification categorycontainsattributes: subject, keywords and coverage. Subject is the topic of the resource, while keywords are used in indexing and information retrieval. Coverage is the spatial characteristics of the intellectual content of the resource,a region and/or countryindicating the jurisdiction under which the resource is relevant.

6. BMP USE CASE MODEL

The BAEKTEL platform makes OER materials freely available to anyone, anytime via the internet. At that, OER learners from universities and enterprises are able to watch the lectures at their own pace in order to better prepare themselves for class or work activities. BAEKTEL accessibility services are supposed to support formal learning description methods, as well as methods for describing cognitive student and teacher workload. Means for easy integration of learning content from different sources have alsobeen provided[14].

In order to ensure the abovementioned functionalities, BAEKTELframework implementsthree user profiles or roles:resourcecreators,course participantsandsystem administrators.

System administrators (Figure3) manage and maintain theBAEKTELMetadata Portal and OER platforms. Administrator managesuser accounts, opensnew accounts for teachers and assignsappropriateprivileges to users.Modification ofthe initialsetof metadata is alsoperformedby the system administrator.
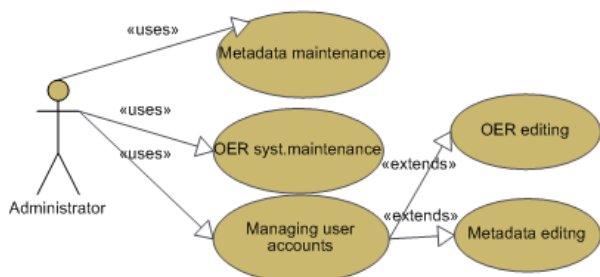

Figure3: Administrator as the user of BAEKTEL

The resource creator (Figure 4)has to own an account with privileges for teacher profile. Sincethe framework iscomposed of differenttypes of software and several repositories, it was desirable to providesingle sign-on (SSO). Single sign-on is a feature of access control of multiple related, but independent software systems. It allows the user to log in once and gain access to all systems within the network without being prompted to log in again at each of them[15].

After setting up a new OER, resource creators are required to fill metadata. They can use the offered terms or add new ones using the custom terminological web application.In the terminological dictionary, a definition is givenfor each term, with its synonyms and translation in English, Russian and other languages[16].If the resource is HTML based, an additional possibility is to link key terms in the text with dictionary entries via web services, thus providing the learner with additional explanations and translations to other languages. Furthermore, textual resources can be tagged, annotated and classifiedusing the bag-of-wordsapproach [17].
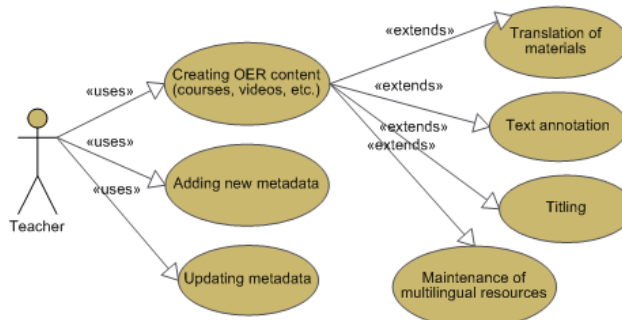
Figure4: Teacher as the user of BAEKTEL

Metadata search and browse is publicly available without log-in, but for accessing OER contentuser registration is required. The learners(Figure 5)will also have the SSO possibility,namely to log-in once and follow all the courses that are offered, regardless of particular physicalOER location.
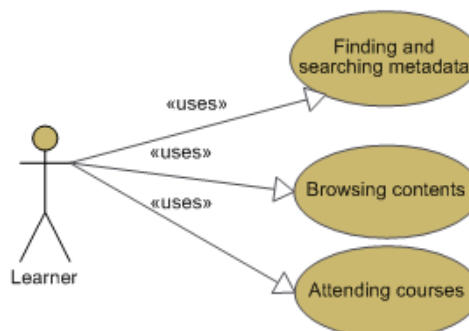
Figure5: Learner as the user of BAEKTEL

7. CONCLUSION

The ICT solution for BAEKTEL metadata portal outlined in this paper enables efficient search and browse of OER content and provides the infrastructure for successful 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.

Given the vast variety of content and the expected growth of the number of resources, as well as different profiles of potential users, indexing of resources that enables their efficient location within the network became a critical issue. To that end a metadata vocabulary and data structure syntax based on DC and LOMwere implemented withinResourceSpace,to offer a flexible and robust mechanism for indexing OER content and enabling the user to easily locate the resources of interest.

However, 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. Namely, the populationof the network with resources is now crucial for bringing the BAEKTEL into full function, thus providing usability to the features outlined in this paper.

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E-LEARNING IN INTERNATIONAL SETTINGS: INSTRUCTOR SUPPORT AS SUCCESS FACTOR

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Abstract: *Many e-Learning-basedoffers, such as international programs and MOOCs have long since overcome the concept of national education and are designed to attract learners distributed throughout the world. In order to cope with the differences between learners, related offers often include opportunities to support the particular learning styles and learning pace beyond the advantages, which the technology itself naturally provides. Examples arethe individual configuration of the learning platformand display of contents and the provision of stylistically diverse and supplementary learning material. Such measures are relatively easy to implement andonce established, do not generate further expenses. Just, is it appropriate to lay the full responsibility for designing a comfortable (and supportive) learning environment into the hands of the learners and do they get along with such a responsibility?We asked university students from three continents regarding their expectations towards instructor-support and found major differences.*

Keywords: *E-Learning, Instructor Support, Learner's Preferences, Educational Culture, Learning Culture Survey*

1. INTRODUCTION

With the Internet as a central platform for education, learners from all over the world can easily be connected in the context of technology-enhanced learning (e-Learning). What on the one hand is a great opportunity, e.g., to foster international exchange and reaching a larger amount of customers, must be understood as a tough challengeon the other hand: Related Internet-based courses do not only need to be comprehensible and manageable for the learners from the different national contexts, but should also meet their culture-specific understanding of what actually is motivating. Motivation generally is a critical condition for productive and successful learning [1]. In the context of technology-enhanced learning, which widely bases on the concept of self-learning, motivation is the most important factor influencing the learners' success [2]: In the traditional face-to-face education, decreasing motivation can be recognized through observation and thus, appropriate interventions can be implemented at an early stage[3]. In scenarios of technology enhanced learning, in contrast, timely recognizing decreasing motivation is extremely difficult because the visual indicators, i.e. mimics and gestures of the learners, are completely missing [4]. Thus, interventions can only follow if the learners explicitly communicate their satisfaction and/or frustration [5]. Depending on their cultural background, learners may rather endure unmet expectations or silently drop out than stating critique or communicating their growing frustration:Particularly in Asian contexts, direct criticism towards instructors or programsis perceived as an expression of lacking respect or at least as impoliteness[6].For learners from such cultural contexts, an open confession of unmet demands would mean an inacceptable violation of fundamentalrules of social behaviour.

Nilsen's[7] central research question inspired our investigation: '*How can lecturers maintain student's initially high motivation?*' Any proactive efforts to increase the learners' motivation during a running program through the providers of educational programs surely are reason-able and helpful. However, due to the special conditions in the context of technology-enhanced learning the learners' initial motivation firstly should be preserved for as long as possible or at least not 'destroyed' [8] by confronting them with unnecessary conflicts. While there is a high number of publications available, which theoretically and experimentally investigate what learners understand as being motivating and which activities raise motivation ([9],[10]), research of influences that lead to decreasing motivation is rare. Nilsen[11] found that the main reasons for students' dropping out were ineffective study strategies, a mismatch between expectations and content in the study-program and a lack of motivation. According to Bekele[12], support services through instructors always play a central role for the level of satisfaction of students in Higher Education (HE).

In his experiments, Nilsen[7] implemented practical work elements and social activities in order to maintain the initial motivation by putting the program into a practical context and fostering social relationships between learners and educators. With such activities, he was able to significantly lower the dropout rate; he neither focused on finding out which (missing) activities might threaten the learners' motivation. Related investigations, however, would be very problematic from an ethical perspective if conducted in the context of experiments. An alternative approach would be the implementation of a questionnaire in which issues are focused that already are known as threatening (or expectedly supportive). FromBekele's [12] results, we assumed that the students' motivation could directly be threatened by not meeting substantial expectations towards instructor-support. In accordance, Paechter et al. [13] found that '*students experience the instructor's support and expertise as especially important for the acquisition of knowledge, skills, and competences, and for course satisfaction*'.

For our study, we focused on the learners' perception of relevance towards particular services that can be providedby the instructor during the educational process. Since it would be very comfortable to transfer related insights to

the national level, one central question for our research was if the learners' expectations regarding the type and intensity of instructor-based services are generalizable at all, and on which level. Cronbachand Snow[14] claim that the learners' understanding of aspects that are motivating for them differs individually. In contrast, Bye et al. [15] found that students had related expectations in common; but those differed with increasing age. Both studies were each limited to a single national context and did not take national differences into consideration.

We started with the basic assumption that learners from different national contexts generally have different educational experiences. We expected that the learners would have such experiences in common because the institutions they visited followed the national demands and regulations regarding curricula and (as far as designed) educational conditions and style. However, according to Garfield [16], 'no [teaching] *method is perfect and will work with all students*'. Given our assumption were right, the students also should have specific expectations in common, how education should take place. As expectations, we understand '*the standards against which a vendor's or service provider's performance should be judged*' [17]. Meeting such expectations is relevant to achieve a high level of student satisfaction [18]; a high level of satisfaction is crucial to keep the students' motivation up [19].

We wanted to achieve a better understanding regarding context-specific differences of such expectations. We chose to investigate university students in the context of face-to-face education.We assumed that a subsequent transfer of the results from the context of traditional face-to-face education to the context of technology-enhanced learning would be legitimate due to two reasons: First, the general model that originally led to the design of technology-enhanced learning based on our experiences which we earlier made in the context of traditional face-to-face education. Second, limiting our investigation on students who already achieved practical experiences within environments of technology-enhanced learning or currently are in the process of making such experiencesrather would reflect their practical experiences and assumed knowledge of opportunities and limitations than providing a picture of their actual needs. It generally is very difficult to decide if the responses from a questionnaire reflect the actual situation of the participants within the investigated context or their wishes regarding how it should be. When dealing with fully unknown contexts, this differentiation is impossible without implementing a lot of additional questions;suchwould have lowered the general acceptance of the questionnaire and thus, massively decreased the response-rate. By focusing on HE students in traditional learning contexts and without regard of their already made experiences with technology-enhanced learning, we considered the respondents of our questionnaire as potential (future) customers for whom related applications are to be developed.

We comparatively investigated the learners' understanding of tasks and responsibilities of lecturers/educators in the context of HE in Ghana, Germany, and South Korea.

2. OPERATIONALIZATION

In order to get an impression of services students might expect their instructors to provide, we conducted a small qualitative survey: We informally interviewed students in Seoul, South Korea on their opinion regarding the tasks and responsibilities of a lecturer. Besides lecturing, their expectations were related to technical support, preselecting contents, support of the organization of learning processes, individual support regarding information research (e.g., by providing books/papers or at least comprehensive literature lists), and evaluation (results, knowledge status, and potential for further development). Their claims for particular instructor services fully are backed up in the common literature [20] [21] [22]. The following five items derived for our questionnaire:

What do you consider being the lecturer's/professor's tasks and responsibilities in the learning process? A lecturer's/ professor's tasks and responsibilities base on ...

1. *giving support according to technical matters, which are relevant for the learning process (e.g. in case of computer problems or installation of software).*
2. *providing well-selected contents and contextual information.*
3. *giving support according to organizing the learning process.*
4. *assisting within the individual student's process of finding information.*
5. *giving feedback on my knowledge base, working results and general professional development.*

First, we wanted to know, if the demands generally differ between the investigated contexts and if the results can be generalized on national level. Second, if a transfer to the national level would be possible, we wanted to understand how different the extent of the claims could be between national contexts. Knowing about such differences would help us decide which level of learner-support would be necessary if students from related contexts were involved within a program; be it in the context of international e-Learning or, e.g., within scenarios of urban education or student exchange. We think that understanding such national differences is crucial in order to install preventive activities that can avoid potential conflicts in whatever kind of intercultural learning scenarios. Related preventive activities can consist of simply informing learners regarding the differences between their actual (nationally biased) experiences and the context in which a particular educational scenario takes place (as preparatory activity). They also can include the implementation of culturally adapted programs (individualized platforms, contents, and/or didactics), in which learners can freely choose the course design, which they consider best fitting.

3. STUDY SETTING

In the first implementation phase of our Learning Culture Survey, we limited our questionnaire to German and South Korean university students. We provided the questionnaire in each national language. In Germany, we conducted a vertical design (in-depth), addressing a high number of students from a low number of universities: We invited the entirety of students from three German universities via the local e-mail distribution systems and

received a total of 1817 fully completed questionnaires.General criteria for the acceptance of responses as valid were the student status, nationality and completeness. For the South Korean context, we chose a horizontal design (broad), which meant involving a high number of universities with each a low number of students: We eventually received 286 fully completed questionnaires from 39 universities. We chose the in-depth design for the German universities because we had the chance to address all students of these universities online and because in terms of transferability, we needed to contrast the responses not just on university but also on faculty-level. Thus, we contrasted the German results on faculty and on university level. We generally chose the countries Germany and South Korea for the initial investigation because both countries are culturally more or less homogenous [23], have a similar technological infrastructure, living standard, a single national language (see limitations), and anyways, are culturally very diverse to each other. In contrast to the German online survey, where the university administrations directly supported us by forwarding our invitations to the local students, we had to implement the survey in its paper form in South Korea due to legal reasons (according to the regulations of the Korean universities, sending mass e-mails via e-mail distribution systems was impossible). As a consequence of the different surveying methods, the response-rates varied; while in Germany, in the online survey, we received fully completed questionnaires from about 4% of the actually addressed students, the non-response rate from the South Korean students, who all were invited in face-to-face situations, was about 50%. In order to reach students from a high number of South-Korean universities, we conducted our paper-based Korean investigation in the subway in Seoul, including all subway lines and following a random path algorithm for the choice of participants.

Later on, with the support of an exchange student, we were able to extend our survey to students at the university of Accra, in Ghana. The questionnaire, also here, was provided in the country's national language (for Ghana, English) and carried outin paper form. The selection process in the case of the Ghanaian sample did not follow a defined algorithm.Instead, students were "randomly" chosen from the campus. We received atotal number of 457 fully completed questionnaires.Ghana has a very limited number of general universities (without field specifications, such as the university for telecommunication) and the university of Accra is said to be the most prominent one in the country. Considering the students' origins, the sample included students from all over the country. Thus, even though Ghana consists of a multitude of different regional and distributed ethnic groups, we think our sampleprovides a good impression on what could be expected if the survey would be conducted on a larger and more regionally focused scale. Further on,after investigating randomly chosen subsets of the full samples from the German context, we found that a larger sample size mainly influences the answer-spectrum. The general answer-patterns (tendencies) actually remained very similar: For this particular investigation, we randomly chose 100 response-clusters with each a size of 30 sample elements of the German overall sample. In 2% of the results, we found accumulations of extreme values, which obviously re-

flected impossible answer-constellations. For the other randomly built response-clusters, the data per item reflected the patterns of the full sample.In order to cope with possible misinterpretations of extreme values due to differently sized samples, the responses from the originally 4-point Likert scale were binarized into positive (answer values 1 & 2) and negative (answer values 3 & 4) responses and calculated as percentage values.

4. STUDY RESULTS AND FINDINGS

In the following Table 1, the "Item #" refers to the initial numbers at each item of the above listed statements. For each country, Ghana, Germany, and South Korea,the mean values (m) and the results in percentage of positive answers (% p.) are displayed per item.

Table 1: Tasks and responsibilities of a lecturer

item #	Ghana		Germany		Korea	
	m.	% (p.)	m.	% (p.)	m.	% (p.)
1	1.88	84.97	2.91	28.23	1.92	81.82
2	1.56	94.77	1.38	97.69	1.77	89.86
3	1.65	92.81	2.39	54.76	1.65	89.86
4	2.01	79.74	2.47	53.11	1.80	86.01
5	1.66	89.54	2.07	71.77	1.59	90.21

The results (Table 1) clearly show that the level of expected support can widely differ between countries. For a better recognition, we display the results (percentage of positive answers) within a net diagram in Image 1. Please note, that even though the resulting patterns help the eyes to easily detect differences, just the points at each of the axes actually are defined.For the interpretation, we consider results between 40 and 60 % as being too close to an equal distribution and thus, we assume these rather express individual preferences than a matter of culture.
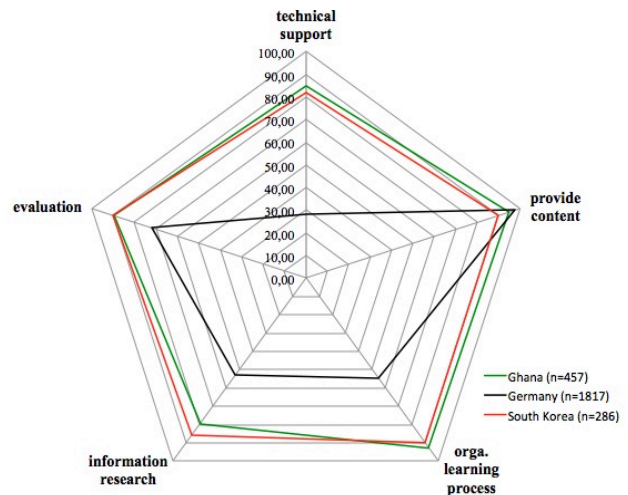
Image 1: Tasks and responsibilities of a lecturer/professor: visual comparison of answers from five-countries

In Germany, the students' expectations regarding their lecturers'/professors' tasks and responsibilities are limited to an appropriate selection of contents and the evaluation of their efforts and results. In contrast, the students from the investigated South Korean and Ghanaian universities additionally expect diverse services in order to provide support for their organization of individual learning proc-

esses and for individual literature research as well as in case of individual technological problems. The results from the South Korean and Ghanaian students are remarkably similar to each other.

We found a certain variance (spectrum) in the answers between faculties and universities (images 2, 3, and 4).
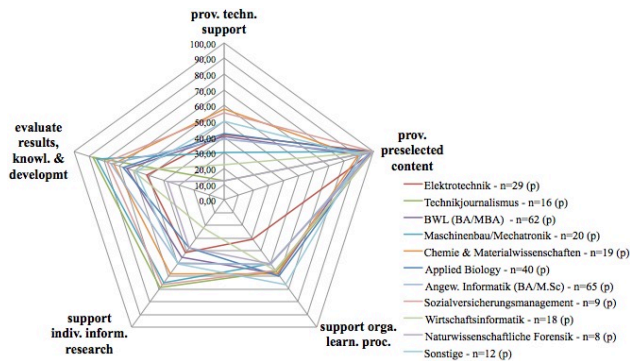

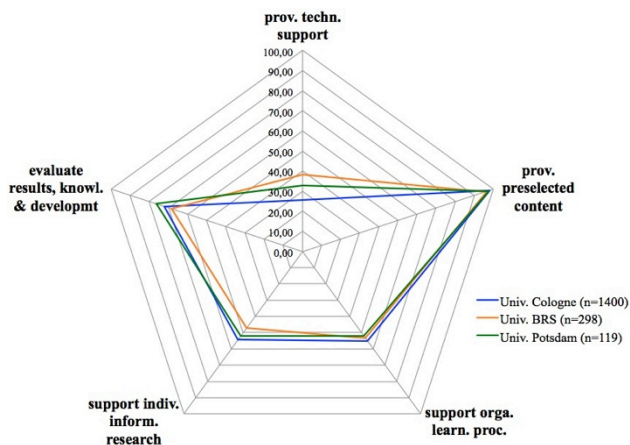**Image 2:** Tasks and responsibilities of a lecturer/professor: Faculties Univ. BRS (in-depth study)

Image 3: Tasks and responsibilities of a lecturer/professor: German universities (in-depth study)
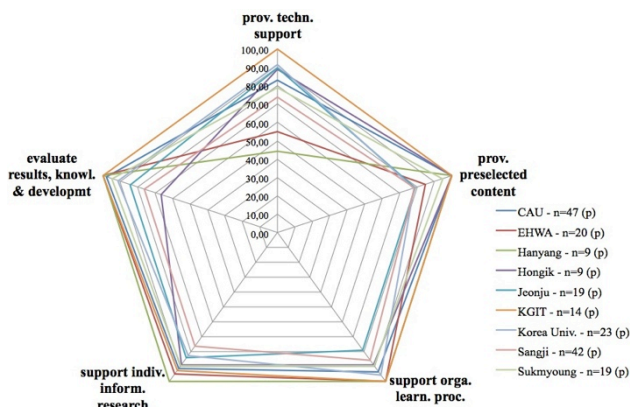

Image 4: Tasks and responsibilities of a lecturer/professor: Korean universities (broad study)

However, the average patterns of the sub-contexts still were very similar to one other and generally, distinguishable from other national patterns (considered the German and the South Korean contexts).

We additionally conducted a small-scale study in Germany, which was meant to investigate whether results from the context of HE could be transferred to the context of Adult Education. For this purpose, we conducted the questionnaire in a slightly changed version (e.g., "professors" became "instructors") within German DAX-noted enterprises (paper-based). The sample sizes were too small to being considered representative but the respondents' answers reflected the peculiarities of each of the enterprises and thus they were sound [24]. The results clearly indicated that a generalization to any educational scenario within the national context would be inappropriate:The patterns of the enterprises (Adult Education) basically differedbetween each other and in average, even more extreme, from those of the HE context (Image 5).
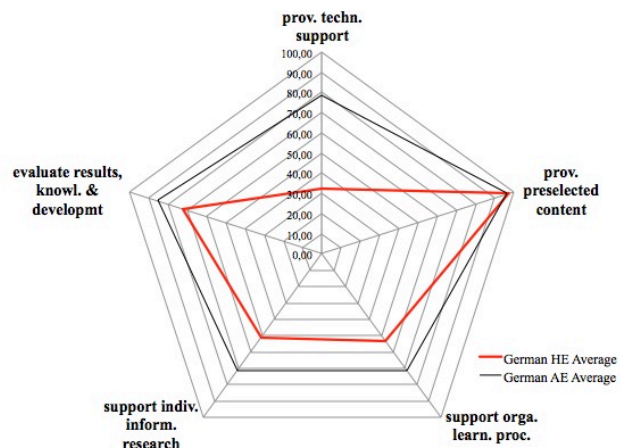
Image 5: Tasks and responsibilities of a lecturer/professor: German Higher vs. Adult Education

Even though the comparison of the average positive answers (Images 1-5) suffices to get an impression of the level of differences between the cultural contexts and to generally decide if further activities are required in order to make a program better manageable for a certain group of learners, a decision on the possible impact of conflicting potential, requires further information. For this purpose, the full spectrum of answers for each item is to be analysed and compared (Image 6).
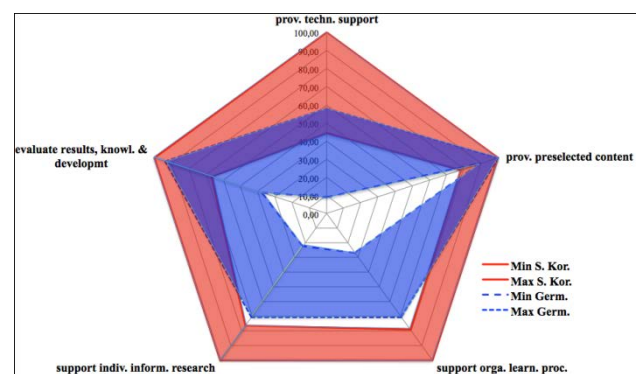
Image 6: Contrasting the spectrum of German and South Korean students' expectations

In Image 6 we exemplarily show such a comparison for the contexts of Germany and South Korea for the contexts of HE. Since the results from the Ghanaian context were found very similar to those of the South Korean context, we resign from integrating this additional context in the figure in order to keep the displayed results clearer. We understand the spectrum of answers as the level of acceptance regarding deviances from the expected (and/or already experienced) circumstances. We expect that stu-

dents generally will experience serious conflicts in their learning processes, as soon as differences exceed their level of acceptance. Pless and Maak promote the level of acceptance as a comparative indicator for cultural differences [25].

We think that in our context of education, the level of acceptance is a good indicator: The average German student can be expected being able to study his/her specific subject at any German university without experiencing conflicts that seriously jeopardize his/her motivation (in this thought, individual happiness is not taken into consideration). This can be understood as a crucial precondition for the appropriateness of the nation-wide centralized distribution of students in Germany.

If we now contrast the spectrum of answers (Image 6) from Germany (blue) and South Korea (red), just the small overlaying part defines expectations on services, which the students of each context actually have in common. Receiving more services than expected may rather be positive (Germ. students) while in contrast, relying on an instructor's support and not receiving it, might be very frustrating and thus, demotivating (Korean and Ghanaian students). In this case of Ghana, Germany and South Korea, it is strongly recommended to at least prepare the Ghanaian and Korean students for the educational situation, which they are going to face when wanting to study in the German university context. Also, the German instructors should be aware of the different expectations in order to avoid misjudgements.

5. LIMITATIONS AND CONCLUSION

As outlined, the herein presented results from HE scenarios cannot be transferred to the context of Adult Education. Further on, the experiments of Buehler et al. [26]in the context of school education revealed that learning culture does not yet bias pupils below an age of twelve years; related consequences are unclear. Another limitation must be set for culturally inhomogeneous contexts. In such cases, the different societies within a national context might need to be separately investigated in order to achieve valid results instead of defining national average values. The use of different languages within a single national context can serve as a first indicator for cultural diversity within suchnational contexts[27].

While our study results show that there actually can be significant differences in the students' expectations regarding instructor-based services between national contexts, we still have no evidence, from which level of differences conflicts result that are serious enough to jeopardize the learning motivation. Further (experimental) research is required and will be conducted within the next years.

CALL FOR CONTRIBUTION
The Learning Culture Survey investigates several further culturally biased issues in education, such as motivation, the perception of feedback, group-work-related issues, time management, gender issues, etc. (102 items in total). As for now, we have managed to organise translations of the questionnaire into Bulgarian, Chinese (simplified &

traditional), English, German, Greek, Japanese, Portuguese, Russian, and Turkish. The translations to Bulgarian, Russian and Turkish still require the acknowledgementof correctness (the back translation is yet missing).

We hereby heartily invite universities from all over the world to take part in and contribute to the survey, be it through conducting (or acknowledging) further translations or through inviting their local students for participation. In the latter case, if the conduction of the online survey is possible and the translation is already available, the required involvement could be limited to addressing a letter of invitation to the students while we take care of the survey implementation and the analysis of the data. On request the resulting data of course would be shared.

The full questionnaire in its English language version is openly published and can be found under the following address on the Internet: http://duepublico.uni-duisburg-essen.de/servlets/DerivateServlet/Derivate-34756/201402_Learning_Culture_Due_Publico_Version.pdf

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INTEGRATING MATHEMATICAL, COMPUTATIONAL AND TECHNOLOGICAL SUBJECTS LEARNING BY MEANS OF THE APPLICATION OF MULTIDISCIPLINARY PROJECTS GUIDED WITH MOBILE DEVICES

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Abstract: With the implantation of the new engineering degrees following the Bologna process, some improvements have been achieved in terms of active methodologies and assessment methods. However there are still open issues related to the involvement of the students in their own learning process, the integration of knowledge and the improvement of the work and study that the student carries out outside the campus, recognized as an important part of the current credits system. This work proposes an action in order to improve the overall student learning by reducing the compartmentalization of knowledge through greater coordination of subjects, all using project-based learning approach with the support of ICT and mobile devices to guide and optimize the methodologies allowing independent student work to develop and test some of their projects and get training through videos and multimedia training manuals, improving their motivation, especially to fundamental subjects such as mathematics, physics and so on. The proposal has been implemented experimentally in several subjects during the project obtaining very interesting results.

Keywords: Project based learning, mobile devices, distance practical learning, skills development

1. INTRODUCTION

The implication of students in their own learning is one of the current challenges in the implementation of the new engineering degrees, further wherein the study outside the classroom becomes especially relevant.

This work seeks to integrate learning through adequately designed and tutored small multidisciplinary real projects guided following a u-learning strategy. One goal is that the students learn mathematics in a technological context, and they are initiated in mathematical modelling, seeing its practical application from the beginning to enhance their motivation and involvement.

In this line, a collection of projects have been designed, where students can also use their mobile devices such as tablets or smartphones [1] with process simulators [2] or real systems that allow them to work in the learning projects in a pleasant way even outside the university. The proposal has been implemented experimentally in several subjects during the project, and will be applied to a wide range of courses in the next academic course.

The rest of this paper is organized as follows. We discuss related context in section 2 analyzing the starting point and the open challenges, the proposed methodology is described in section 3, providing several examples, and section 4 contains the aspects in order to evaluate the approach and a description of the results obtained. Finally, the main conclusions and future lines are presented in section 5.

2. CONTEXT

During the implantation of the new degrees following the Bologna process, some improvements have been achieved in terms of active methodologies [3] and assessment methods [4]. However there are still open issues related to the involvement of the students in their own learning process, the integration of knowledge and the improvement of the work and study that the student carries out outside the campus, recognized as an important part of the current credits system.

In general, higher education is still quite compartmentalized, and particularly there is little connection between the subjects of mathematics and technology subjects. Resulting in low motivation of students to study fundamental subjects (mathematics, physics,..) in some depth because the students do not perceive the practical application of these subjects.

Another important goal is to improve the planning and tracking of the student work and study outside the university, because it cannot be a mere extension of the practice in the classroom or laboratory, since lacks discourse and direction from the teacher, that is a basic piece of the learning activities. Therefore, it is important to work in this direction, and appropriately design activities and projects to be performed outside the classroom with the support of ICT, addressed to achieve a meaningful learning, focused on diversity of skills.

Finally, in many subjects there are a great number of students, which is often difficult to assess properly: there

is no personal attention, and gauge what the student has learned really is unworkable. In this context, in the tutorship work in group, each team will work in supervised group each team will develop a project with the support of ICT, which in part would be done outside the classroom, but with a continued monitoring by the teacher, using mobile devices.

3. LEARNING PROPOSAL

This work proposes a learning innovation in order to improve the overall student learning by reducing the compartmentalization of knowledge through greater coordination of subjects, all using project-based learning approach with the support of ICT and mobile devices to guide and optimize the methodologies allowing independent student work to develop and test some of their projects and get training through videos and multimedia training manuals (see figure 1), improving their motivation, especially to fundamental subjects such as mathematics, physics, etc. In particular, the underlying mathematics of most engineering subjects could be an element able to unify and enhance the learning process.

In this sense, a fundamental aspect of technological work is the development of useful models [5] to solve the problems. For this reason our proposal focuses on train students in modelling capacity, which largely means ability of mathematical modelling. But the computing subjects can benefit from this approach, in order to improve the programming skills of the students, also very important in today's engineers, and applying the ideas that are proposed in this project, wherein a great number of experts and professors of different subjects have participated, in order to propose real and motivational projects to the students of engineering studies, both studying fundamental subjects (such as mathematics) or studying technological subjects.

Moreover it is well known that learning is more robust and durable if the concepts and skills are dealt in concrete situations [6], especially in projects that results motivators to the students [7]. The effort to solve the problems that are arising causes a natural interest to learn the necessary theoretical and practical tools, and managing those tools the students learn significantly. Furthermore, the application of simulators of real systems to solve these problems, which could even run on mobile devices (tablets and smartphones) owned by students, offers a way to guide and optimize the autonomous student work also outside university [8].

Also a problem in many subjects is that the number of students makes very difficult to implement a personalized tracking of the student learning. With the present proposal, based on the realization of real mini-projects in groups of a few students (three at most) allow the professor tutoring the project to ensure that all the students assimilate the involved concepts, techniques and skills. Each professor of the subject would deal with a reasonable number of groups to conveniently address them.
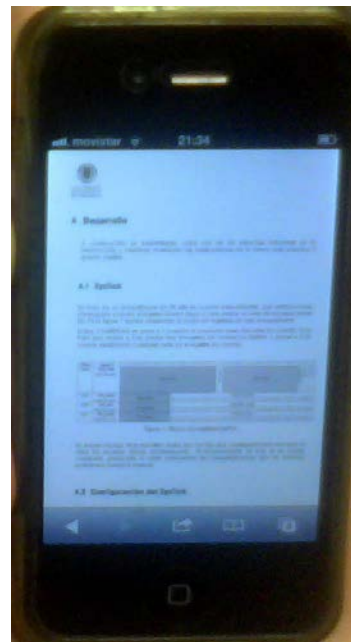

Image 1: Example of accessible content using student's mobile devices

In this line, the main goals are the following:

- Integrate knowledge through multidisciplinary projects showing the applicability of mathematics, thus motivating the students since they may feel themselves its utility.

- Select real and practical applications of mathematics and computing in engineering, in order to bring real and motivating projects for students.

- Increase the level of student involving in their own learning process.

- To favour the learning process of the students, even outside the classroom, guiding their planning of autonomous work through the application of ICT in stimulating activities that go in line with the defined transversal skills.

- Start the extension of project results to a wide range of subjects, establishing mechanisms to allow professors to keep an individual tracking of the students and their evolution.

One of the advantages of this approach was its support for Just-In-Time Learning (JIT-Learning) scenarios. Pupils could access knowledge and train to improve their skills at the specific moment that this was required, in contrast with the classic way in which concepts are acquired with the expectancy of eventually being used. Activities involving highly specialized tasks can benefit from this approach [9][10].

The focus of the students' attempts to find a solution for the projects depended on their previous knowledge. This restricted, in most cases, the techniques and tools that could be used, because the purposes of the subject could

have been confused if an explanation of a certain tool had been given.

Therefore, the advantages to the students of these projects was that they were able to develop teamwork skills, work in group, negotiation techniques, speak in public, learn how to edit technical documentation, present and discuss ideas, etc., all of which made the students better prepared for his professional future.

4. PROJECT EVALUATION

In the following paragraphs the strategies for results evaluation, including indicators and the quantitative and qualitative evidences to determine the degree of achievement of objectives, are presented.

Quantitative evidence:

- Extent of collection of multidisciplinary projects developed.

- Number of projects in which mobile devices are crucial.

- Analysis of the final results in the subjects involved.

Qualitative evidence:

- Surveys at course beginnings about students personal profiles and at the end of course about perception of the experience.

- Quality analysis of the projects developed by students.

- Surveys to teachers involved in the project with teaching in the subjects where the proposal has been applied.

Indicators:

- Degree of compliance of the projects: record of tutoring sessions.

- Number of students who pass the final evaluative test. Proportion of excellent results.

- Minutes of meetings of multidisciplinary coordination.

During the course, we employed the proposal and the first projects were undertaken. The final marks for the course were calculated using different assessment methods, including a problem-solving exam, a public presentation and a practical evaluation.
The final results show that the differences in marks were significant from previous courses.

In order to obtain qualitative information on student satisfaction (and opinions on the course) we conducted a Google Drive-based survey. The survey was anonymous,

but was conducted separately in order to distinguish between the pilot group and the rest of the students.
The results of the survey show a slightly higher level of satisfaction for the pilot group.

5. CONCLUSION

In this paper, we have proposed a new approach for the effective integration of fundamental subjects such as mathematics with other more practical in order to enhance the student's motivation and facilitate to take advantage of the work and study of the student outside the university by means of multidisciplinary real projects tutorized by means of ITC, obtaining advantages in comparison with the use of classic remote labs.

The application of the described proposal had to overcome a number of challenges. The resulting activities and projects should facilitate the learning process supported with the use of mobile devices. This opens up new scenarios for mobile device-based learning without excessive additional costs. Students can use the applications during their spare time while at university, at home, etc.

In the experiments, this proposal provided satisfactory results, and demonstrated the advantages and suitability of the overall methodology. Our approach presents attractive advantages from the economic and teaching staff productivity points of view, while also leading to superior academic achievement. Furthermore, the approach can be deployed successfully in a wide range of subjects, from fundamental subjects such as mathematics to more applied subjects such as technological ones.

ACKNOWLEDGMENTS

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INTEGRATING EXTERNAL EVIDENCES OF SKILL ASSESSMENT IN VIRTUAL LEARNING ENVIRONMENTS

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Abstract: *Learning Management Systems provide a set of facilities for the lecturer to create courses based on learning activities. However, assessing skills is rather limited because activities must are usually assessed with simple grades without considering the links between the activities and the skills aimed to be developed. As a consequence, limited feedback can be provided to the students, thus losing relevant information of the learning process. In this work we present a software architecture for web-based learning management systems to mitigate this issue. It consists of a web service that facilitates the assessment of skills and an extension to the browser that enables to mark and compile the evidences of assessments on web activities. The system has been applied to courses in a Moodle box where different skills that students must develop in an external wiki can be assessed while assessment evidences are tracked. All the software of this experience is fully functional and available as free software.*

Keywords: *skills assessment, learning management system, online learning, learning web service, free software*

1. INTRODUCTION

In the last years, the use of the computer technologies has increased significantly. This rise has forced to do changes in educational environments, like universities or educational centres. Most of these changes are based in the use of Internet, leading new strategies in the educational process [1]. One of them is the massive installation of Learning Management System (LMS) in universities, high schools and educational centres to support learning processes. However, the learning processes can also take advantage of other technologies (those name Web 2.0): like writing blogs as handouts or using collaborative applications through Internet (for instance, wiki applications) [2].

Nowadays, the attention of higher education learning has focused in getting the skills by students, instead of getting traditional knowledge. The Bologna process in Europe (a set of international agreements to ensure comparability in the standards and quality of higher education qualifications) is an example of the use of concepts like skills or learning outcomes. The learning outcomes are defined as skills, and the students must be assessed according to the proficiency level of these skills acquired in the learning process [3]. So, the new degree and master programs and the syllabus in their courses are defined according to these concepts. The skills and learning

outcomes are taught through courses and developed in specific activities in those courses. When these activities are developed in a digital artifacts some benefits are received like repeatability, producing better feedback, having a more transparent assessment process, etc. Therefore, it is necessary that the lecturers redefine new assessment strategies considering all of this.

The new skill-centered learning processes cause the assessment of these skills, not only single activities. Unfortunately, most LMSs have limitations to assess skills. In most of them, every activity can be assessed only with an undimensional (usually numerical) grade and links between activities and the skills developed in them are not consider. Additionally, a detailed feedback about the skills would be desirable to support this way of assessment [4]. Again, limitations about the feedback provided to the students after an assessment have been detected in LMSs. For example, Moodle, one of the most popular LMSs, does not allow to assess specific skills and there is not any built-in mechanism to link activities with skills. Additionally, it can not provide specific feedback for skills, only a text message for every task can be shown as feedback.

We propose overcoming these limitations of LMSs integrating them with external Web services. However, these integrations are not trivial. Since the first versions of

the IMS Learning Tools Interoperability (LTI) specification, some issues are set out about integrating of external applications and tools in a context where they are suppliers of functionalities and the LMSs are the consumers of them. The main reason is that the most of

This paper describes a system to assess skills developed in activities of a LMS using a Restful Web service loosely coupled. Besides, this system provides an extension to mark evidence that can be shown to the students as a feedback. The rest of the paper is organized as follows: Section 2 reviews the background of the state of the art. Section 3 introduces the architecture we implemented. In Section 4 we describe a case study of the assessment of skills in a real Moodle-based universitary course where the students use a wiki to write a collaborative project. In the last one, we provide a discussion along with conclusions and future research lines.

2. RELATED WORKS

Acquiring new skills is the main goal of current learning program. Therefore, it must be considered in based-technology educational frameworks as LMSs. Moodle provides different activities and customizations in the gradebook to create a learning process which assess skills [6]. Unfortunately, the assessment of these skills must be done manually it does not support marking the relation between activities and skills described.

A way to assess generic skills in engineering grades is the use of assessment -specific tools. For example, a set of rubrics were used in [7] to measure ability to work as a team, communicate effectively, apply creativity, and demonstrate a commitment to quality and timeliness. One noted strategy is using peer assessment procedures, where it is very common the use of ePortfolios [8]. Another choice we can see in the related bibliography is about serious games. They are computer systems that simulate situations based on real life to safely integrate these experiences in university curricula [9], [10], [11], [12].

We also can find multiple-choice tests as assessment tools. An example where students had used Moodle quizzes for formative e-Assessment is a project subsidised by the Institute of Education Sciences at the Universitat Politecnica de Catalunya [13]. However, cognitive skills and application of methods cannot be assessed via multiple choice tests and equivalent forms of basic assessment items [14].

Others e-Assessment tools for assessing cognitive skills have been found, like EASy (The E-Assessment System), a tool developed by University of Münster for assessing higher-order cognitive skills in an online environment for general mathematical proofs [15], [16]. It has been identified that with this tool it is not easy to share question banks because the questions were developed specifically. Also, this tool was developed specifically for skill assessments rather than knowledge assessment and it does not support e-tutoring with feedback facility.

Web functionalities (where the learning experiences are developed) are offered by external applications and Web services in the cloud and they can change in an unpredictable way. So, it complicates developing decoupled integrations [5].
Another Web based e-learning tool is ACME. It has been developed by the University of Girona specially targeted towards continuous assessment of the student's skills in an initial mathematics course [17]. According to Soler et al. [18], the system can be adapted to subjects other than mathematics, but is not an open source tool.

Therefore, literature does not provide a general open source system which was able to support both skill and knowledge e-Assessment in a convincing way [19].

3. SOFTWARE ARCHITECTURE

In this section we describe the architecture we implemented. In essence, the system proposed is a group of decoupled Web applications which interact between them. Firstly, we have EvalCOMIX, a Web service for e-Assessment which allows creating assessment tools and use them to assess activities in a LMS. Secondly, we have Gescompeval. It is a Restful Web service used for managing skills and learning outcomes. It allows lecturers to assess their students in skills through assessment tools that EvalCOMIX integrated in a LMS. Both EvalCOMIX and Gescompeval have their corresponding integration in Moodle 2.X (EvalCOMIX_MD and Gescompeval_MD respectively).

In addition we have EvalChrome, an extension for the Google Chrome Internet browser. This extension allows to assess any activity of a Moodle's course from the Internet browser. Besides, the lecturer can mark evidence of the Web page which he is visiting. For instance, if the lecturer is assessing a wiki page where a student has written some homework, he will be able to save the evidence of this assessment through EvalChrome. Figure 1 show system architecture. Next we comment each component in detail.

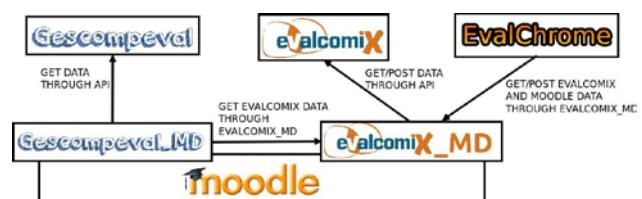
Figure 1: Architecture of the system

EvalCOMIX

First we have EvalCOMIX. It is a Web service for e-Assessment integrated into a LMS. EvalCOMIX enables you to perform two types of activities. First of all it provides a system to design and management assessment tools like Rating scales, Checklists, Rubrics, etc. [20] These tools are composed of dimensions, subdimensions and attributes.

In the second place, once EvalCOMIX is integrated within an e- learning environment (Moodle, LAMS, etc.), it allows to use the tools created to assess any learning activity of the LMS. To use EvalCOMIX, an integration with the LMS Moodle as a block has been developed and it is called EvalCOMIX_MD [21]. It uses the API of EvalCOMIX to create the tools and assess with them. This integration provides three ways of assessment configuration for the learning tasks which belongs to a Moodle course: teacher assessment, self assessment and peer assessment.

EvalCOMIX_MD provides an assessment table which contains every activity of the course. From this table, the lecturers can configure the assessment type or assess the students. The students will be able to assess themselves or other classmates. The grades got are shown in the table, but the lecturer can also send them to the LMS gradebook to consider these grades with the others of the course.

Gescompeval

Secondly, we have Gescompeval, a Restful Web service implementing a MVC (Model View Controller) architecture. It is used for managing skills and learning outcomes and retrieving information of them using its API. The skills and learning outcomes are in an educational context, therefore they refer to abilities and/or skills which a student acquires in an activity, course or career.

Gescompeval consists on a Web interface and a Web server. The API of Gescompeval only offers resources to get data, not to post them, so a Web interface is necessary. Through the Web interface the users can do CRUD (Create Read Update Delete) operations and connect the skills with some learning outcomes and vice versa. These connections are not used in other options, but through the API you can get them and use them in order to get information. For example: in a LMS, a lecturer gives a grade G to a skill C for a student S. If the lecturer wants to get the grade of a learning outcome O which is connected with the previous skill C, he can consider the grade of that skill through the connections to get an average mean for the grade of the learning outcome O.

Once the application for managing an index of skills and getting information is available, an integration with a LMS was created to use these skills and learning outcomes. This integration is called Gescompeval_MD and it is a block extension for Moodle 2.X that uses Gescompeval's API for showing information about assessments of skills and learning outcomes previously created in Gescompeval. This extension allows to assess skills and learning outcomes using EvalCOMIX learning tools allowing the lecturer to connect the skills developed in an activity with the subdimensions of a tool which is used to assess that activity. So, Gescompeval_MD allows to know the grade of each student in a certain skill/outcome through reports that will be able to be showed.

In the first place, the desired skills and learning outcomes must be created using Gescompeval Web service. Then, with Gescompeval_MD a lecturer can include the skills and learning outcomes which will be worked by the students in the activities of a LMS's course. For instance, if a lecturer wants to include three skills which are developed by the students of the course, previously he must select those skills from a box which lists all the skills and learning outcomes created in Gescompeval Web service. After selecting the skills and adding them through a button, they will be included in the course.

With the skills and/or the learning outcomes included in the course, a lecturer can link some of these with subdimensions of EvalCOMIX assessment tools that have been created in that course. To do that, the lecturer must select a subdimension belonging to one of his EvalCOMIX tools. An example of this is shown in figure 2, where a combobox allows the lecturer to select an EvalCOMIX tool and below a listbox to select the specific subdimension on that tool. After clicking in the "Connect" button, he will be able to link some skills and learning outcomes included in the course with the subdimension previously selected. Now, the skills will get the grades from the subdimensions which they are connected with and will combine those grades to get the final one doing an average grade. Finally, the grades of each skill will be shown to the user to provide formative feedback through a report.
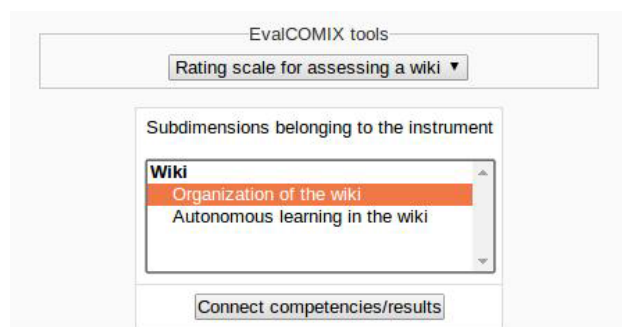

Figure 2: Selection of subdimension snapshot

There are two types of reports: global reports of all students in the course and individual ones of a certain student. Besides, with a check box a lecturer can choose if the connections between skills and learning outcomes must be kept in mind. These reports show dynamic diagrams developed using Google Charts (an example of these diagrams are shown in figure 6). When the user places the mouse pointer over a certain part of the chart, some information is showed in a popup window: code, name and value of the skill/outcome and tasks of the course where the skill/outcome has been developed. In addition, if the user has developed the activity in a Web page (for example a wiki page) evidence collected can be shown here through some URLs which point out the specific sections of a page where the skill has been assessed. This evidence is marked using EvalChrome.

EvalChrome

Finally, we have EvalChrome. It is a plugin for the Google Chrome Internet browser which allows to assess the tasks of a Moodle course from a Web page (for instance, for a wiki page) and mark evidence of the assessment done. EvalCOMIX_MD is used to get information from Moodle and EvalCOMIX, so it must to be installed and configured in the Moodle system where the lecturer had the courses. Besides, the tasks to assess had to be configured with an EvalCOMIX tool. The Moodle system is indicated through its URL, which is written in the configuration page of the plugin. If the lecturer wants to access to another Moodle application, he only has to change the URL.

To assess a student, first of all the lecturer must be logged in Moodle. When he clicks over the EvalChrome icon, a new window will open on the Web page. In this new window (which can be hidden or closed to facilitate browsing in the previous windows), a lecturer will be able to select one of his Moodle courses, its activities and finally the student who he wants to assess. Once all these parameters had been selected, an EvalCOMIX tool will be displayed to do the assessment. An example of an EvalCOMIX tool displayed from EvalChrome is shown in figure 3.
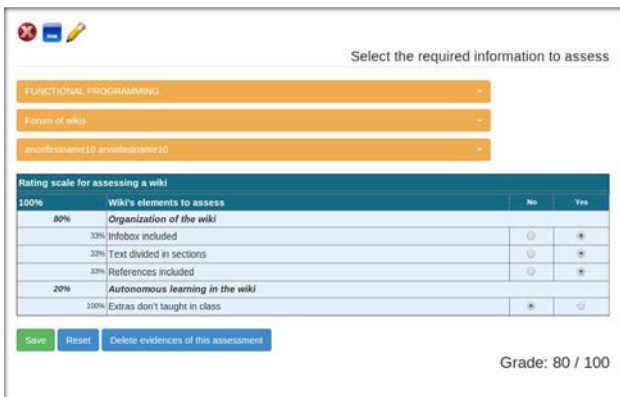

Figure 3: An EvalCOMIX tool displayed from EvalChrome snapshot

Once an assessment is done, if the lecturer wants to add evidence of the assessment done (for instance "this section of the wiki explains why this student has a B grade in a subdimension of the tool"), this can be done through the pencil button, it is on the top of the EvalChrome window. Then, the lecturer can select a text of the Web page and opening the contextual menu, a new option called "EvalChrome" will have been available.

From the new option of the contextual menu, the lecturer can select the subdimensions of the tool which has been used to assess. Once the lecturer had selected one subdimension's name, an information message will appear and the evidence will have been saved and linked with that subdimension for the assessment. If the lecturer wants to delete the evidence marked for one assessment he can do it from the screen where the tool is shown.

With the evidence added to the assessment, the lecturer can see it from the reports of single students of

Gescompeval_MD. In these reports, when the lecturer got the dynamic information of a skill/learning outcome (code, name and activities where it has been developed) a list with some URLs will be shown too. Those URLs link with certain sections of the Web pages assessed. Therefore, the list is the set of evidence marked for the grade that a student has in a skill. This information is got through the relation between Skill-Subdimension-Evidence.

4. CASE STUDY

In this section we introduce the scenario of our case study. It was developed in an elective course on Functional Programming of the degree on Computer Science and Engineering in University of Cadiz (Spain) in 2013/14 academic year. Six students enrolled the course. Theirs assessment was done manually, using Gescompeval and EvalChrome later. This course was coordinated by one author of this paper, who anonymized student's data. One collaborative task of this course was a wiki about Haskell knowledgment. We assess students' performance in the skills of written communication and autonomous learning in that wiki. Later, we mark evidence about the assessment from the wiki Web page.

First, we created an assessment tool with EvalCOMIX which had one dimension and two subdimensions (figure 4). One subdimension was used for assessing the organization of the wiki page (where the skill of written communication was developed) and it was a 80% of the total grade of the tool, while the other one assessed the autonomous learning shown through some new content in the wiki and it was a 20% of the grade. The organization was assessed with three attributes: infobox included, text divided in sections and references included. They could be assessed with No (if the attribute was not achieved) or Yes (if it was achieved). On the other hand, the autonomous learning was assessed with one single attribute: applying extra knowledge don't taught in seminars. It had the same values that the previous attributes: No if no one extra content was detected and Yes if some was detected.

Figure 4: EvalCOMIX assessment interface snapshot

Once the tool was designed, we defined the skills that we were going to use in Gescompeval. Later, we included them in the course and finally connected them with the subdimensions of the tool in this way:

Organization of the wiki subdimension with Written communication

Autonomous learning in the wiki subdimension with Autonomous learning

In the second place, we assessed the students through EvalChrome from the wiki Web page (it also could be done from Moodle with EvalCOMIX). Selecting Programming Functional course, Forum of wikis task and the specific student. Once the student was assessed, we activated the evidence note and added evidence for each subdimension. To do that, we selected an edition of the wiki and then open the contextual menu of the browser. For instance, in figure 5 is shown how we added an evidence for the organization of the wiki. This evidence indicates that the wiki content was divided in sections. When it was added, a Web link to the specific section of the wiki (in the image a link to the content chart) was saved and related with the subdimension selected.
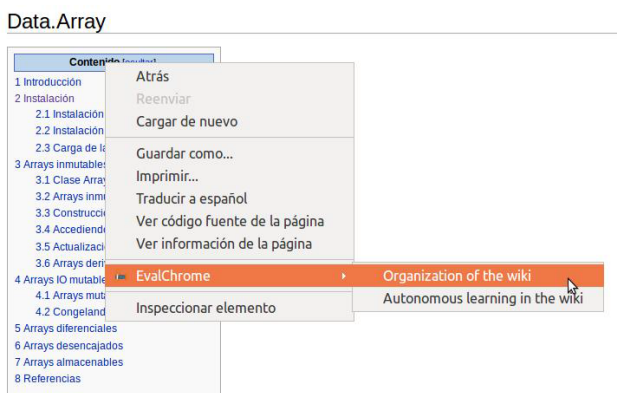

Figure 5: Adding evidence with EvalChrome snapshot

Finally, after we assessed the students and added the detected evidence, through Gescompeval reports we obtained grades in the skills for each student. In addition, the evidence previously added was shown through a list of Web links which indicates sections of the wiki. An example of this is shown in figure 6 where there is one graphic for each skill developed in the course (the skills assessed in the wiki and others).
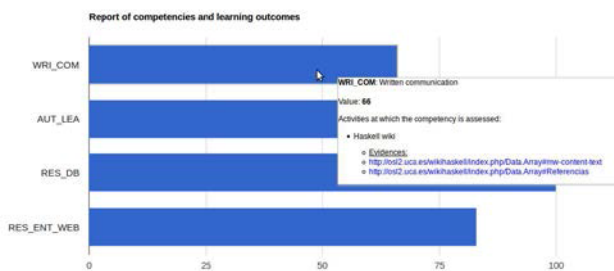

Figure 6: Adding evidence with EvalChrome snapshot

With a conventional assessment, every student had a single numeric grade and a text message as feedback for the activity. While with Gescompeval and EvalChrome, we obtained grades for skills worked in the subject like written communication or autonomous learning, so they could be considered for the final grade. Besides, with the links got as evidence, we could provide a feedback of the

grades of every skill or learning outcome assessed in the course.

5. CONCLUSIONS

Skills are important in professional career.Their development enables students to integrate successfully in employment and social contexts. Unfortunately, most LMS do not support skill assessment and do to consider their links to learning activities. We proposed an architecture that solves this issue in a Moodle-supported course. The implemented was built using a Web service for skill assessment and a Web browser plugin for evidence collecting.

On the one hand Gescompeval_MD allows a lecturer to include the skills and learning outcomes that will be developed by the students through course's activities. Besides, the lecturer can connect some of the skills added to the course before with subdimensions of EvalCOMIX assessment tools. To do that, the lecturer must select a subdimension of his EvalCOMIX tools. After that, he will be able to link some skills and learning outcomes included in the course with the subdimension previously selected. Now, the skills will get the grades from the subdimensions which they are connected with and will do an average of those grades to get the final one. In summary, the lecturer conducted this process in a manual way and achieved its goal effectively.

On the other hand EvalChrome is a Web browser extension that allows the assesser to mark evidences in an external activity of Moodle (a wiki of MediaWiki). The

grade obtained is saved automatically in Moodle as an EvalCOMIX grade and with Gescompeval it is used for getting skill's grades too. Besides, the lecturer has marked evidence from the assessment done as a list of Web links. Again with the use of Gescompeval, a formative feedback about the skills developed was received by the students through the reports. The feedback was composed of specific values because it came from the assessments done manually by the lecturer.

As stated at the beginning of this paper, the skills assessment in a course of a LMS is very limited, just like the feedback provided to the students. With the system presented, both limitations are overcome and new possibilities are offered about skills assessment.

As a future work, we have the possibility of exporting Gescompeval reports with customize options would add more feedback to the lecturer and it could be a more specific information. Additionally, we want to do a comparison with EvalCourse, a system with a Model-driven architecture which obtains indicators of the work of students [22], to check the results obtained in a Moodle course and how both systems could be complementaries and study the applicability to mark evidences in serious games [12].

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TEACHING AND LEARNING IN COMPETENCY-BASED EDUCATION

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Abstract: There is a growing trend towards competency based education in Europe this is emphasised by the implementation of European Key Competency Framework in many duristinctions. This paper reflects on the attributes of competency based education its domains and teaching approaches for effective competency teaching and learning.

Keywords: E-Learning, Competency Based Education

1. INTRODUCTION

Teaching and learning in any curriculum require common goals, shared responsibility and accountability between teachers and learners, and supportive or enabling environments to maximize success in learning. Effective learning is learning which is lasting and capable of being put to use in new and differing situations. Learning has traditionally been conceptualized as theory based on academic frameworks where achievement is judged by the ability to recall key points, information imparted or details and sequences memorized. The leap from this to the ability to recall, act and perform to set standards of ability and expertise is the leap to a framework based on competence. This paper discusses competency in teaching and learning. It further examines the type and form of learning strategies which promote competency-based learning.

We first define competency-based education. Then we review competency-based education and the domains and specific attributes of teachers and learners that are required to make competency-based education successful. This is followed by a brief discussion identifying competency-based objectives and the teaching methods and learning activities that contribute to competency development. We finish with the key qualifications points of competency-based education.

2. WHAT IS COMPETENCY-BASED EDUCATION?

Competences as defined by European bodies, as well as by educational experts, to consist of three interrelated ingredients:

1. A knowledge component (the understanding part),
2. A behavioural components (the overt behavioural repertoire) and
3. A value component (including values, beliefs and attitudes).

So a competent person performing a task will possess a combination of skills, knowledge, attitudes, and behaviours required for effective performance of the task or activity. A competence is defined as the holistic synthesis of these components. At another level, a competence again may be divided in three components or aspects.

It is the ability of a person to show:

1. A particular behaviour in
2. A particular context and with
3. A particular quality.

Defining *competency* is complex, and an educational competency even more so. The *Organization for Economic Cooperation and Development* (OECD) through PISA, (Programme for International Student Assessment) has done much work on defining competencies, and created a framework for comparing student competencies for purpose of assessment. A report completed by PISA states:

> *"A competency is more than just knowledge and skills. It involves the ability to meet complex demands, by drawing upon and*

mobilising [mobilizing] *psychosocial resources (including skills and attitudes) in a particular context. For example, the ability to communicate effectively is a competency…"* [PISA]

3. COMPETENCY-BASED TEACHING

The attributes of competency-based teaching are listed below. These teacher characteristics and expectations contribute to learner success. They also demonstrate the shared responsibility of teachers and learners to reach the goal of competence. The most important characteristic of competency-based education is that it measures learning rather than time. Students progress by demonstrating their competence, which means they prove that they have mastered the knowledge and skills (called competencies) required for a particular course, regardless of how long it takes. While more traditional models can and often do measure competency, they are time-based -- courses last about four months, and students may advance only after they have put in the study or application time. This is true even if they could have completed the coursework and passed the final exam in half the time. So, while most colleges and universities hold time requirements constant and let learning vary, competency-based learning allows us to hold learning constant and let time vary.

Attributes of Competency-based Teaching

- Understand how learners learn
- Match principles of learning and teaching
- Facilitate, rather than control learning
- Model humility, critical thinking, respect, competency & caring at all times
- Support acquisition of knowledge, skills & professional behaviours in all learning domains (cognitive, psychomotor, affective)
- Promote & expect learner accountability for learning
- Provide timely, specific feedback on learner progress beginning with learner self-assessment
- Individualize learning experiences according to needs
- Expect increasing complexity of performance as the learner progresses throughout the programme

4. TEACHING AND EFFECTIVE FACILITATION OF COMPETENCY DEVELOPMENT

Competence based education programs build from the idea that it is more important to focus on outcomes—what a student knows and can do—than on inputs like how the student learns it, where the student learns it, or how long the student takes to learn it. This break from inputs means that CBE programs are free to explore new ways to help students learn and new dimensions of what constitutes a "course." Some CBE programs are designed to allow students to learn in a variety of formats, sometimes drawing on *open educational resources* (including written materials, videos, recorded lectures, etc.) or hands-on, project-based learning. Many programs are also designed for students to progress at their own pace, rather than at a pace dictated by semesters or credit hours. This means that motivated and efficient students can complete their degrees in less time.

Teaching strategies need to be matched to the domain of learning. We briefly outline the various domains and how a competency-based curriculum may be implemented and the strategy that may be chosen.

Psychomotor domain:
- Demonstrate the expected way to perform a given skill. Allow the learner to practice for a while, and then ask for a return demonstration of that skill.

- Set up models or create a simulation exercise in the practical laboratory where learners can have repeated practice of skills with peers and/or teacher supervision.

- Arrange for sufficient practical experiences requiring skill performance of the competencies under direct supervision.

- Create a valid and reliable assessment tool for use in determining competency in skill demonstration.

Affective domain:

- Create "values clarification exercises" for personal values.

- Provide a framework for a written analysis of learner activities against the measurable outcomes

- Structure opportunities for role play requiring recognition of differing values and beliefs, with time for discussion of how these differences may affect one's ability to perform the competency

- Arrange for the discussion on different values and beliefs,

- Create a valid and reliable assessment tool for use in determining competency good practice and integrity, respect for all.

Cognitive domain:

- Develop case studies from actual practice requiring discovery or problem-based learning to determine the most appropriate, evidenced based approach to competency.

- Support learner-led discussions, structure debates to address practical situations.

- Always require that the learner provide their reasons (rationale) for their responses to knowledge questions or plans.

- Avoid the temptation to answer every learner question, especially when the learner knows or should know the answer.

Other strategies include self-study modules with suggested learning activities that the learners can complete on their own prior to interaction with fellow learners and teachers. It is important that teachers provide ample time for discussion/dialogue and clarification of concepts to be learned. They also need to encourage and help the learner use their own knowledge and ideas to find possible solutions.

One of the most effective teacher strategies for guiding the learner to discover how to proceed or act is called Socratic questioning. The primary purpose of Socratic or higher order questioning is to encourage the learner to challenge how they are thinking, what they are thinking, and what revision of their thinking will lead towards their goal of becoming a competent.

Each of these teaching strategies are aimed at helping the learner develop new ways of thinking about what they are learning, encouraging them in their discovery of new knowledge and skills using critical thinking, and supporting their efforts to integrate this new learning into their practice. The teacher becomes a coach or facilitator of learning, rather than an all-knowing sage telling the learner what to learn, how to learn it, and what to do with the new learning.

5. IMPLEMENTING COMPETENCY-BASED LEARNING

Competency-based learning is a way of structuring learning activities so that the individual learner can meet a predetermined set of competencies. Given that learners have a variety of ways of learning or learning styles, it is important for them to recognize that competency-based learning will require that they actually perform or do, rather than learn by observing. Observation, reflection and listening are important learning activities, but competency demonstration is the expected outcome for competency-based education.

The following list summarizes the key attributes of competency-based learning.

- Understand how one learns best (style)
- Understand exactly what is expected outcome(s) of learning
- Take responsibility for one's learning
- Motivated to learn – goal oriented
- Ethical person and practitioner

- Critical thinker
- Self-assess learning & performance
- Commitment to ongoing learning

6. LEARNING AND EFFECTIVE FACILITATION OF COMPETENCY-BASED EDUCATION

There are several learning activities that are competency-based. Examples of some of these activities follow related to the domain of learning.

Psychomotor domain:

- Review written description of a particular skill (text, handouts).

- Take time for repeated practice of skills in the safety using models, simulation if available, or peers as patients supervised by teachers until mastery of the skill is demonstrated.

- Seek out practical experiences that allow the learner to increase confidence as well as competence in the skills required.

- **Affective domain:**

- Review text for content on definition of values.

- Participate in selected values clarification exercises for personal values provided by teachers (self-study or group work).

- Write up an analysis of a code of behaviour and values and share with peers and teachers.

- For many learners, becoming a competent begins with observing positive role models of practice to reflect on: This is who a competent person is. This is what a competent person does.

Cognitive domain:

- Competency-based learning requires high levels of critical thinking and reflection (metacognition – thinking about thinking). Such skills are learned best with some form of discovery-based learning or problem-based learning.

- The goals of discovery or problem-based learning include helping learners become active participants in and take responsibility for their own learning, encouraging the development of critical thinking by supporting learners' efforts to retrieve and retain knowledge and apply it in practice (rather than telling them what to think or do), and creating learners who develop the habit of life-long learning in order to stay current in practice.

- Teamwork is an essential component of this type of learning as many learning activities are structured for groups of learners working together to discover the best solution to a given need or problem in both theoretical and practical work.

- Other cognitive learning activities creating and following an individualized learning plan, self-directed reading and completion of suggested activities that will add to one's knowledge and experience base, and self-directed use (browsing) of the world wide web or internet and intranet (if available) for resources related to topics being learned.

- Prepare for and lead seminar discussions.

- Keep a journal or log of progress in learning

7. COMPETENCY-BASED EDUCATION PRACTICE

Defining Competency-based Objectives

Competency-based education and its teaching and learning approaches have received a good deal of support in education systems in recent years. Competency-based education is characterised by the learner's engagement and activity in all aspects of acquiring the knowledge, skills and professional behaviours needed to demonstrate practice in a specific discipline.

Many contributors state that competency-based education must involve teaching and learning strategies that facilitate the development and the demonstration of a competency. A critical feature of competency-based education must include a clear, evidence-based definition of the learning outcomes and objectives. The learning objectives must include demonstrated for performance criteria of the role (i.e., the specific competencies). This clarity is vital to both teachers and students. The expected outcomes of learning, how performance is measured and how the learning objectives relate to the outcomes must be clear.

When writing competency-based objectives consider the following questions:

When reviewing objectives, ask the following questions:

Objective	*Is the objective related to intended outcome(s), rather than the process for achieving the outcome(s)?*
Performance	*Is the performance of the learner relevant to the learning outcome?*
Conditions	*Are the conditions, the context, of the performance relevant to the learning outcome?*
Criteria	*Are the criteria relevant to the learning outcome? Are they tangible? Are they measurable? Are they sufficient?*

Performance	*What will the learners be able to do?*
Conditions	*What are the conditions under which they have to perform?*
Criteria	*How will we/they know if they perform successfully?*

8. PEDAGOGICAL CONSIDERATIONS IN COMPETENCY-BASED EDUCATION

Competency-based education must include attention to the learner's needs and styles, providing the time needed for the learner to acquire and repeatedly perform or demonstrate the expected competencies (knowledge, skills, professional behaviours) and creating a supportive environment for learning. Competency-based education can be pursued through various teaching approaches. However, all curricula need to be evidence-based and outcome focused and all teaching strategies need to be matched to their learning domain (psychomotor, cognitive and affective).

Competence based learning places an emphasis on powerful or rich learning environments that enable students to engage in meaningful learning

processes. The most distinctive features of this approach may be summarized as follows:

- *Meaningful contexts*
  The teacher will create or to look for meaningful contexts in which students will in a natural way experience the relevance and the meaning of the competences to be acquired.

- *Multidisciplinary approach*
  Competences are holistic and as a consequence the educative approach needs to be integrative and holistic too.

- *Constructive learning*
  The philosophy of competence based education has its roots in the social constructivism. So, learners engage in a process of constructing their own knowledge by interaction with their environment, rather than as a process of absorbing the knowledge that the traditional teacher might try to transfer to them. By focusing on the construction of models, products, guidelines, rules of thumb, reports, or other tangible outputs the learning easily and naturally will turn out to be constructivist.

- *Cooperative, interactive learning (with peers, teachers.)*
  The basic idea behind competence based education is to help learners to develop and construct their own knowledge and seek ways to make optimal use of other people's competence in their learning journey. This is what social constructivism is about. For learning outcomes aimed at developing individual and personal competences, the approach must take diversity of learner needs into consideration to meet the leaners goals and objectives. This requires an open approach in which education includes dialogues between learners and educators about expectation, needs, goals, choices etc.

- *Discovery learning*
  Discovery learning as opposed to receptive learning means making content available and accessible and that the way of acquiring this knowledge or competences, could not be just a process of providing information, but should always be embedded in a discovery based approach.

- *Reflective learning*

  Competence based learning also places an emphasis on the learning processes of the learner. As the learner reflects on their own needs, motivation, approach, progress, results etc. they develop learning competences that may be considered "learning to learn".

- *Personal learning*

  In the competence oriented theories learning is conceived as a process of constructing the learner's own personal knowledge and competences. Information, knowledge, strategies, only become meaningful for a person if they become an integral part of their own personal body of knowledge and competences. In education this implies that students need to be able to identify with the contexts, the persons, the situations and interests that are included in the learning domains involved.

SUMMARY

Competency consists of three interrelated ingredients: a knowledge component (the understanding part), behavioural components (the overt behavioural repertoire) and a value component (including values, beliefs and attitudes). Teaching and learning strategies need to match to the appropriate domains of learning. Competence based learning places an emphasis on powerful or rich learning environments that enable teachers and students to engage in meaningful learning processes.

An important aspect to competency-based education is that practice-based learning requires direct supervision and multiple opportunities for the learners to demonstrate their competency in practice over a period of time. Competency objectives must include outcomes, criteria, performance standards, conditions that are tangible, measurable and relevant.

Implemented effectively, competency-based education can improve quality and consistency, reduce costs, shorten the time required to graduate,

and provide true measures of student learning. It is required to:

1. Measure student learning rather than time.
2. Harness the power of technology for teaching and learning. Computer-mediated instruction gives the ability to individualize learning for each student. Because each student learns at a different pace and comes to college knowing different things, this is a fundamental requirement of competency-based education.
3. Fundamentally change the faculty role. When faculty serve as lecturers, holding scheduled classes for a prescribed number of weeks, teaching takes place at the lecturers' pace. For most students, this will be the wrong pace. Some will need to go more slowly; others are able to move faster. Competency-based learning shifts the role of the faculty from that of "a sage on the stage" to a "guide on the side." Faculty members work with students, guiding learning, answering questions, leading discussions, and helping students synthesize and apply knowledge.
4. Define competencies and develop valid, reliable assessments. The fundamental premise of competency-based education is that we define what students should know and be able to do, and they graduate when they have demonstrated their competency. This means defining competencies very clearly.

People learn at different rates and in different ways, so a handful of demonstrations or activities may be sufficient for one learner to demonstrate competence while the same level of performance of this skill with another will require much more to meet the same learning outcome. This understanding of the learner and learner needs is the primary reason why competency-based education may include direct observation of competency demonstration over time and the clear definitions and classifications of learning outcomes and objectives.

Another point to consider for example a learner with a lack of motivation to learn most often results in learners dropping out of the programme.

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J&pg=PR10&lpg=PR10&dq=.+%E2%80%9CEffective+learning+is+learning+which+is+lasting+and+capable+of+being+put+to+use+in+new+and+differing+situations.%E2%80%9D&source=bl&ots=mK_1WJPE-k&sig=aGKDvFb1I_RJCGj2uoMGv75Us9o>

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ENRICHING THE E-LEARNING CONTENTS USING INTERLINKING

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Abstract: *Interlinking e-Learning resources on the Web enriches the contents and help learners to reach more qualified resources. Due to the acceptance of the Linked Data approach by many e-Learning repositories, creating links between e-Learning contents and useful information on the Web of Data can lead to the enrichment of the contents in the repositories. This paper focuses on the text enrichment aspect of interlinking, where we discuss how the descriptions of learning objects as part of the metadata can be enriched when they are connected to the LOD datasets. A case study on Open Discovery Space (as an e-Learning repository) is also presented in this research.*

Keywords: *E-Learning, Linked Data, Interlinking, Text enrichment.*

1. INTRODUCTION

The emergence of the Linked Data approach [1] in recent years has facilitated the discoverability and availability of e-Learning contents on the Web of Data [2]. Moreover, a learning resource is enriched when it is connected to useful and related information on the Web. To take an example, when a researcher explores a learning portal to discover a specific resource, she might find a course on the subject of her interest. She becomes more precise on one of the courses' description, but there exists several specific terms that she does not have any clue about. As the resources in the portal were previously interlinked with DBpedia[1], she finds more explanations about the terms including their different translations or can be redirected to the related resources. As the example above shows, creating links between e.g., descriptions of a resource in a learning repository to related datasets on the Web, enriches, defines and to some extent explains the text itself. Moreover, it improves the level of knowledge of learners, as they discover more digital objects in different formats (e.g., pictures, video) in various domains when they explore a learning portal.

This brief paper focuses on the enrichment aspect of interlinking. Here, we will show that how we can enrich a text by linking its terms to the LOD datasets. The rest of this paper is structured as follows. In Section 2, we will briefly describe the related works in the interlinking context and exposing e-Learning resources as Linked Open Data. Section 3 presents the proposed approach along with a case study. Finally, conclusion is provided in Section 4.

2. RELATED WORKS

Interlinking different kinds of data on the Web has been recently addressed by several studies [2] [3] [4]. Dietze et al [2] investigated several solutions aimed at linking educational resources by exposing them as Linked Data

using interlinking techniques. Another approach, also proposed by Dietze et al [3], proposed linking learning resources to exploit the wealth of existing technology-enhanced learning (TEL) data on the Web of Data in the context of the mEducator project [5]. A study by Fernandez et al [6] suggests linking educational resources across universities using the Linked Data approach by focusing on exploiting information of lectures in video format produced by several educational institutions according to some vocabularies, e.g. FOAF. In another empirical study, Rajabi et al. [4] applied two matching techniques to interlink a semi-structure learning collection to 2 datasets and discussed the generated results in details. Several projects such as LinkedUp [7] and Linked Universities [8] have been devoted to reuse and share e-learning resources based upon the Linked Data principles. Notably, LinkedUp aims at advancing the exploitation of the vast amounts of public data available on the Web in educational institutions and organizations.

In the case of linking tools and applications, a framework for data interlinking was proposed by Scharffe and Euzenat [9]. In this effort, several linking tools were discussed and compared to be applied in interconnecting data. Datalift [10], another project in this area, described the data linking task within the project deliverables and analyzed 11 linking tools to select the most appropriate software.

Given its short length, this paper focuses on one of the advantages of interlinking only: text enrichment. Although there exist a lot of interlinking tools for finding similarities between datasets on the Web, parsing and enriching a large metadata description of learning objects by making use interlinking has not been largely explored.

3. APPROACH

Interlinking e-Learning contents can be taken place in various contexts with different approaches. One of the solutions to carry out the interlinking among educational repositories implies the use of interlinking tools to connect some parts of an e-Learning resource to useful information and datasets on the Web. Enriching the

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[1] http://www.dbpedia.org

learning object description and the rest of its metadata elements with some external links can help students and educators to extend their knowledge about the context. To identify an appropriate element in the metadata of learning objects, we investigated several schemas in the e-Learning context and realized that the description of an e-Learning resource is one of the main specifications of each metadata schema, as it describes the resource itself. The content of this description is usually represented under the form of descriptive text strings in different languages and includes a detail explanation about the resource using specific terms. Enriching descriptions with new links to references on the Web also improves the quality of the content. Appendix shows the proposed approach for text enrichment using interlinking. The process in the workflow shows how after a text extraction step, an interlinking process is carried out. In particular, each term of the text is tested to be interconnected to the Web of Data. As a result, a list of similarities for each text is presented to the repository owner. The content owner reviews the list of results for each resource and decides either to accept or to reject each individual term. The accepted concepts are later imported to the actual repository so that the final enriched text is presented to the end users. The acceptance of each term may refer to its importance in the context. In particular, one term may be approved because it is very scientific or difficult for learners to understand the meaning in the context. In this case, providing a link to a dataset e.g., DBpedia describes it in detail.

To implement this approach as a case study, we selected several random e-Learning resources from Open Discovery Space (ODS)[2], as a collaborative and multilingual open learning infrastructure designed to boost demand for Europe-wide e-Learning Resources. At the time of research, ODS includes nearly 700K educational resources collected from 24 digital repositories in e-Learning context. ODS has currently released a sample of its e-Learning resources as Linked Open Data temporarily[3]. This endpoint allows other educational datasets to query the ODS learning contents. As a consequence, the description of 20 resources in English language were retrieved using SPARQL[4] queries. As part of the interlinking, a JAVA program read each individual e-Learning resource description and split it to several string tokens in order to check them against the DBpedia dataset. If the term was available in DBpedia, we stored the term along with the corresponding URL as an output. The following table illustrates a sample of output in which the user rejected some results due to their simplicity.

Table 1: A sample of results

Term	Link	Accepted
an	http://www.dbpedia.org/page/An	No
insurance	http://www.dbpedia.org/page/Insurance	Yes
market	http://www.dbpedia.org/page/Market	Yes
with	http://www.dbpedia.org/page/With	No
asymmetric	http://www.dbpedia.org/page/Asymmetric	Yes

Figure 2 depicts the percentage of linking between the descriptions of 20 selected learning resources and DBpedia. The X-axis illustrates the resource number whose description was selected for our evaluation, while the Y-axis shows the percentage of terms linked to DBpedia. As an example, resource 1 had 70 words of which 51 (nearly 73%) were linked to DBpedia. As it can be seen, around 77% of the terms in average were linked to DBpedia pages before the user review.
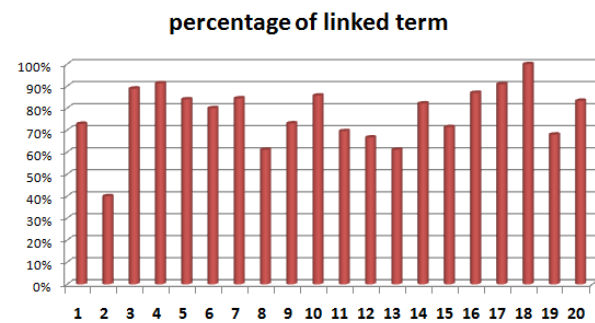
percentage of linked term

Image 2: percentage of interlinking for 20 selected texts

5. CONCLUSION

This paper concisely reported on a research about interlinking educational resources to the Web of Data. We believe that enriching e-Learning metadata elements, particularly the description element studied in this paper, helps learners and teachers to reach more useful information on the Web. Beyond that, the repository owners can connect their content to more than one datasets at the same time depending on the context of learning resources and their complexity, particularly when they include scientific terms and vocabularies.

ACKNOWLEDGEMENT

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Appendix: Proposed approach for the enrichment of the contents of eLearning repositories
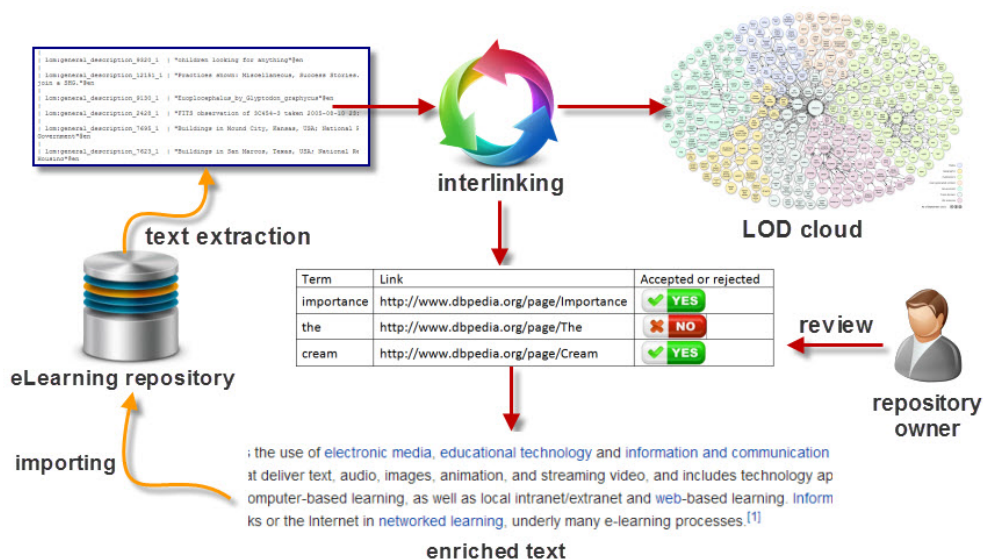
GALICIAN TEACHERS' PERCEPTIONS ON THE USABILITY AND USEFULNESS OF THE ODS PORTAL

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Abstract: The Open Discovery Space (ODS) project has among its objectives modernising school education, creating a pan European e-learning environment, promoting flexible and creative ways of learning, and improving the way educational content is produced, accessed, and delivered. The ODS portal is a key element towards those objectives; it is a community-oriented social platform where teachers, students, and parents can discover, adopt, and adapt educational resources on their areas of interest. This paper reports the evaluation results of the ODS portal; in particular those that have to do with its perceived usability and usefulness—gathered from an evaluation questionnaire that teachers of primary and secondary education filled up after an introductory workshop, which was conducted by the University of Vigo, involved in Working Package T12.4 (measuring use and usability of content and services).

Keywords: Open Discovery Space, Perception survey

1. INTRODUCTION

Through the creative use of new technologies, effective content organization, and learning processes that respect local school problems, Open Discovery Space [1] tries to address the challenge of the "social appropriation of knowledge" by empowering all school audiences, but mainly teachers, pupils and parents. The approach to be followed contributes to the development of self-esteem, an increased "sense of belonging", and an improved perception of one's own capacity to solve problems and contribute to the "construction of the surrounding community". These factors have been clearly related to the development of "social capital" and a greater degree of conviviality and peace. The school component and the community dimension of the project place an emphasis on developing certain key values and attitudes that play an important role in this process, such as the capacity of team work and a spirit of collaboration as a way of developing learning networks and communities. Consequently Open Discovery Space is promoting Open Education as key approach to opening up contents, learning and collaboration. The main outcome of this process will be the Open Discovery Space portal[1]: a community-oriented social platform where teachers, pupils and parents will be able to discover, acquire, discuss and adapt eLearning resources on their topics of interest.

Furthermore, the main aspect of Open Discovery Space project is innovation; in fact, it is bringing innovation to three key areas:

- Proposing innovative ways to encourage educational communities to use eLearning resources and exchange their experience and views on ease of use and quality of those resources.
- Proposing an innovative educational design and an educational metadata organization scheme. These measures will seek to exploit the elements of the learning context in eLearning resources (i.e., educational objectives, pedagogical models, learners' personal characteristics and needs, etc.), as well as the teachers' competence profiles (knowledge, skills and attitudes) making it possible to measure and assess the impact of eLearning resources ON schools both in terms of learning outcomes and learning activities.
- Proposing innovative solutions that could remove linguistic and cultural barriers, improving the ease of use in existing repositories in order to deliver relevant Learning Resources to teachers, students and parents more effectively.

In the other hand, this initiative was performed by a multidisciplinary consortium composed of a varied group of universities (e.g. University of Vigo, Oslo and Akershus University College of Applied Sciences, Open University of Nederland, etc.), governmental organizations, international institutions (e.g. UNESCO - Italy) and technological groups (e.g. Greek Research and Technology Network S.A., Institute TELECOM, Centre for Research and Technology HELLAS, etc.), being in total more than 50 partners.

Regarding with task assigned to University of Vigo is related with measuring use and usability from two levels, content and services. Therefore, the goal of this task (i.e. T12.4 according planning work) is to systematically and iteratively test usefulness and usability of the system

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[1] http://portal.opendiscoveryspace.eu/

through a panel including selected representatives of end-users and intermediaries. Methodologically, the usability evaluation would be conducted as a streamlined cognitive walkthrough. This and alternative inspection methods are more efficient and have been shown to be as effective as more expensive laboratory-based experiments (eye-tracker, camera-based observation with think-aloud). The main focus of the validation study is to assess whether the proposed system operates under the same influences of technology acceptance as traditional desktop interactive systems. In identifying the total explanatory power of the model and proportional influences for the key factors of perceived ease of use and usefulness, implications can be drawn with respect to design and evaluation of such systems.

As a conclusion, upon the completion of this project, around April 2015, it will have contributed to the modernisation of school education, supported stakeholders in acquiring digital competences, stimulated demand for innovative eLearning resources and engaged teachers and pupils in the development of innovative educational practices. Crucially, this project will strengthen European integration by increasing cooperation across state borders, bringing together different cultures and supporting multi-lingual practices.

2. THE OPEN DISCOVERY SPACE PORTAL

To support the optimisation of the eLearning resources and the development of strong and self-sustained communities of implementation the project aims to deliver a European-wide, socially-powered, multilingual Web Portal that will allow teachers, students and parents to intuitively discovery, acquire, share, discuss, reuse and revise digital educational resources that are available through an Advanced Learning Technological infrastructure.

The Open Discovery Space Portal will act as a laboratory of ideas, a standard setter, a capacity builder for the community and a catalyst for international cooperation between the distributed user communities, in particular users with an active role in education field. Actually this portal is commonly referred as "A community for Teachers by Teachers". In figures ODS Portal, at the time of writing this article, contains 563257 Educational Resources Available, 1322 Connected Teachers, and Teacher Communities 172.

Consequently, the ODS Portal [2] provides the following functionalities in order to get the goals mentioned in last paragraphs:

- **USER REGISTRATION**. To become an ODS Portal user you have to select "Create new account" in the window that opens when clicking on the Login in the header of the page.

- **USER PROFILE**. Through this functionality user can: i) Access his/her profile; ii) Admin his/her account; iii) Teacher's Competence Profile (i.e. the ODS Competence profile allow teachers to make a self-assessment to define their competences in a wide range of educational aspects); and iv) Management his/her Content and Activities.

- **JOIN AN ODS COMMUNITY.** To become a member of an ODS community, user have first to be a registered user of the ODS Portal. So that, through this functionality user can: i) Find a Community; ii) Become member of a Community and iii) Management all communities that user is member or creator. In Figure 1 below is illustrated an example of this area of the ODS Portal.

- **CREATE NEW COMMUNITY.** In ODS Portal a new community can be created as an independent community or as a "child" community of another one. Consequently, user can carry out this functionality by means of several options: i) Create a "child" Community (i.e. in this case, user has first to be member of the "parent" community in order to have the privilege to create a new one under this); ii) Create an independent Community; iii) Administration of the community after approval; and finally iv) Admin member requests.

- **CREATE EDUCATIONAL CONTENT IN A COMMUNITY.** This is one of the most relevant aspects of the ODS Portal, because allows user create his/her own content into a Community that he/she is member by selecting one of the three options: i) Create Educational Content, ii) Create Lesson Plans and iii) Create Learning Scenarios. Each one of these options will lead user to a new page that includes all content created into this Community by all members and also provides him/her the possibility to create new content.

- **ORGANIZE YOUR COMMUNITY.** User's ODS Portal can organize his/her Community using the six main modules that this can include: i) Groups, ii) Activities, iii) Events, iv) Blogs, v) Discussions and vi) Polls.
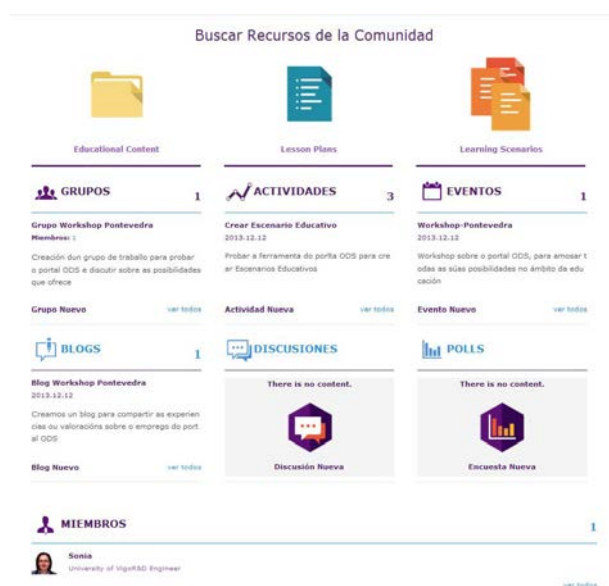

Figure 1: Capture about an ODS Community created in Workshop – Pontevedra (12/12/2013)

As a final conclusion, it is noteworthy that the ODS Portal includes components that allow communities of

implementation to easily set up and deploy their own lightweight portal versions, commonly known as My Discovery Space, that be fit to their community needs (e.g. thematic or linguistic). Indeed, the My Discovery Space sites could popularize and promote the effective use of digital resources, introduce freely available technologies and software, and share good practice, as well as practical information on how to set up new eLearning initiatives and how to attract more users. Therefore the ODS Portal provides an opportunity to test the infrastructure and the methods in the local setting, could promote acceptance of the proposed approach by even the most traditional institutions and could help to break down barriers to knowledge sharing, promoting a truly Open Access to Learning.

3. TESTING THE USABILITY OF THE ODS PORTAL

The task of testing the usability of the ODS portal was carried out by a multidisciplinary team of researchers from the areas of Information and Communication Technologies and Pedagogy. Besides, the process of measuring the use of that technological tool—both of contents and available services—was directed by the e-learning group from University of Vigo. Overall, the team counted with experts on technology plus experts on pedagogy. Both aspects—tecnology and pedagogy—were taken into account when designing the study and analysing the results obtained.

Research was structured in accordance with the following stages:

- Identification of the most representative services in the portal, from the point of view of teaching.
- Definition of a set of proper indicators for representing the real perception of users on the value of the ODS portal for providing access to Open Educational Resources.
- Definition of the surveys for capturing the perception of users, in accordance with the identified services and indicators. This definition was performed by another working package. Two surveys were defined: one for capturing the immediate perception of users, and another one for capturing their perception after several weeks using the portal.
- Plannification of the workshop by assigning tasks to field technicians and by performing the temporal planning of the workshop in two face-to-face sessions.
- Filling up of the paper questionnaires during the workshops. Online versions of the questionnaires were also available [3], [4].
- Analysing data, and sharing results with the rest of the ODS consortium.

Image 1: Parcipants were teachers of primary and secondary education.

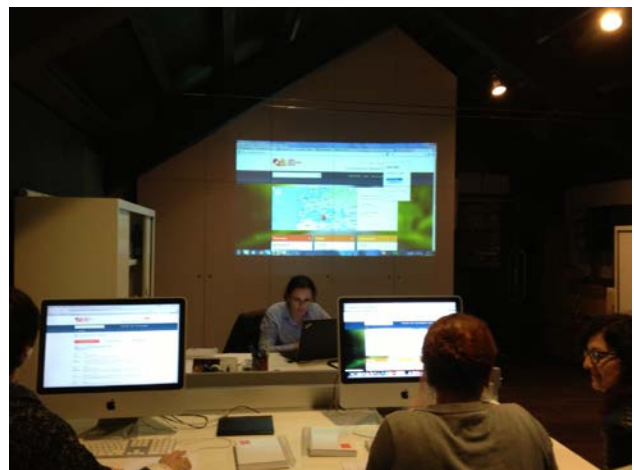**Image 2:** Introducing the ODS portal to teachers.

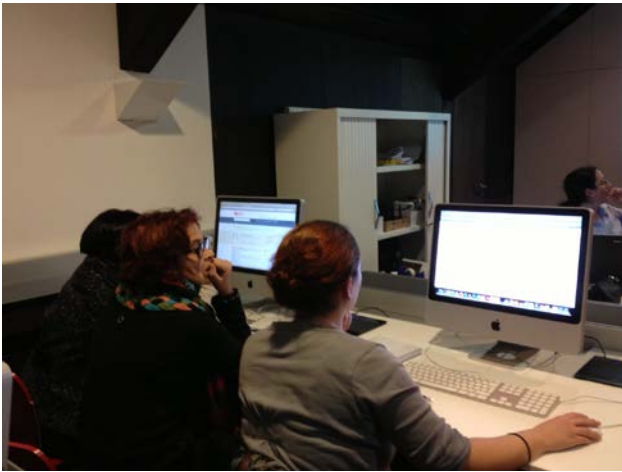**Image 3:** The workshop was conducted in a very guided way—step by step.

Image 4: Teachers interacting with the ODS portal and performing the assignments.

Image 5: Teachers filling up the paper questionnaire.

3. RESULTS AND CONCLUSIONS

Validation of the usability of the ODS portal was performed during two workshops that took place in Pontevedra, Spain between 12th December, 2013 and 31st January, 2014 at the facilities of University of Vigo. The first workshop included a brief course to teachers on the functionalities and aims of the ODS portal and an assessment survey [3]. The second workshop was devoted to answer the questions posed by the teachers participating after a 6-week period of usage and reflection. Again, the workshop was completed with an assessment survey on the ODS portal [4].

As pointed out at the beginning of this paper, the main objective of this work was to find out which was the perception of teachers on the usage of the ODS portal, and how teachers assess the impact of the ODS portal on the provision of digital educational content to be used in learning processes. From the results obtained during both assessment sessions we can drive the conclusions below.

First, 66.67% of participating teachers (incidentally, 100% of participants were a group of nine female teachers) declared that they agree on the use of portals offering educational content and services online. This interest is confirmed by the positive assessment of ICT integration in their educational institutions. More than 57% insist in the pertinence of such integration.

Another relevant aspect of this study is related to the perception on how the ODS Portal will enhance their work as teachers. As shown in Figures 6 & 7, 44% consider during first workshop that it may be integrated in their actual educational curriculum, but after some weeks of usage and reflection this percent increased up to 55,55%, and 77% consider that its introduction would improve the educational experience of their students. It is also noteworthy that after the second workshop the perception of the ODS Portal being very useful to communicate with others increased by over 11%. These results also show the proactiveness of teachers for these kind of solutions, and also the positive perception on the impact of educational resources in their teaching activities and in the learning processes of their students.

With respect to the overall perception on the ODS portal, the result obtained show that more than 44% claim that they agree with the innovative character of the portal, while more than 33% consider the ODS portal to be easy to use. Besides, 100% of participants consider very relevant to have a version of the digital educational resources available in their native languages, and finally more than 55% see as a motivating challenge to use educational resources produced in other countries.

Collected data on the participating teachers's perceptions on how their institutions and especially their peers respond to this new educational trend around open educational resources is discussed below. At least 66.67% of participating teachers perceive a positive acceptance both of these resources and the services provided by the educational tools tested. Besides, 55.56% consider that the institution in which they develop their teaching activities encourages ICT-based learning, and 44.44% think that their host institutions valued the efforts made by the teachers in creating open educational resources.

It is important to highlight the impact of previous training, that is, the time passed from the first workshop, implying weeks of reflection & usage before the second one took place. In particular, the 66,66% of participants consider that it was important for their awareness and knowledge on repositories and the 77,78% for their awareness and knowledge on ICT usage in their work.

Finally, free-text perceptions were also collected on usability and those usability aspects that they believed should be improved in the ODS website. In this regard, it should be noted that the data obtained was very consistent with a workshop held in Greenland [5]∫ within the ODS validation process carried out in different European countries. Participating teachers in both Spain (Pontevedra) and Greenland requested some improvements in ODS website affecting i) the registration process, ii) language management, iii) processing speed and iv) fill-in forms to collect teachers' data, and v) educational resources provided by teachers.

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OPEN EDUCATIONAL RESOURCES, STRATEGIES FOR SUSTAINABILITY OF AN E-LEARNING PLATFORM, INNOVATIVE PRACTICES AND SERVICES - THE APPROACH OF THE OPEN DISCOVERY PROJECT

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Abstract: In recent years there has been a slew of reports detailing the large number of countries, regions and states that have begun to implement ongoing tightening of education budgets in the context of the economic downturn and subsequent demands to sustain through own revenue generation and so reduce public spending. Sustainability of educational resources and innovations is becoming a crucial issue which requires research on different approaches, business models and case study examples in order to reach the desired results.

Open educational resources, advanced e-learning applications, products, tools, services and innovative practices, and portals are considered a deus ex machina approach to the educational budget cuts. A recent initiative in Europe is the Open Discovery Space project, which aspires to be an open innovation platform for primary and secondary education. This paper will summarise the findings of research undertaken in order to inform the ongoing sustainability strategy and planning for the Open Discovery Space Project as well as the ways in which the sustainability planning was recently developed.

Keywords: Open educational resources, advanced e-learning applications, products, tools, services and innovative

1. K-12 E-LEARNING AND OPEN EDUCATIONAL RESOURCES (OER) TRENDS

In 2013 IBIS Capital [1] reported that the spend on e-learning at K-12 level is predicted to grow globally at a Compound Annual Growth Rate (CAGR) of 33% between 2012 and 2017, which would mark an increase from $16.6bn in 2012 to $69bn in 2017. The 2012 annual global spend on e-Learning (all education sectors) was reported to be $91bn and the projected 2017 spend is expected to be $255.5bn (23% CAGR). Europe is widely reported to account for approximately 25% of global spend on education generally.

However, in recent years there has been a slew of reports detailing the large number of many countries, regions and states that have begun to implement ongoing cuts to education budgets due to the economic downturn and the subsequent demands to reduce public spending. In the US, 80% of educational technology leaders predicted that budgets would "flat line or decline" in the immediate future [2]. Whilst there may appear to be a contradiction between the global e-learning spending and the new era of

spending constraints, a number of possible explanations have been suggested [3]:

"some countries are still investing heavily in educational technology since they are either starting from a lower base or have not been (acutely) affected by the economic recession; some countries prioritise e-learning above other education spending and some spending may be shifting from central governments, school districts and schools to parents and students. Generally, educational technology is far more pervasive and, for example, the increasing availability of mobile devices would suggest penetration will continue to increase. Of course, taking mobile technologies as a general trend and Bring Your Own Device (BYOD) as a specific example, it is clear that the increased frequency of e-learning activity and engagement is not necessarily contingent upon ever-increasing (public) budgets."

In connection with the concluding clause of the above quotation in particular, one might also consider whether an increase in spending is, or will be, driven by the increased involvement of private sector providers who may be offering solutions "outside" of schools.

The K12 (ISCED 1-3) e-Learning landscape within Europe is characterised by a generally improving infrastructure but also by significant, and often persistent, disparities between countries and regions, or even between individual schools and across grades [4].

The 2013 (most recent) annual European Commission ICT in Schools survey, notes that broadband is almost ubiquitous; whilst laptops, data projectors and interactive whiteboards are also used extensively [5]. Not surprisingly, there is also a trend towards the deployment of smaller and more mobile devices and BYOD. Notwithstanding the improving infrastructure and availability, teachers and head teachers felt insufficient ICT equipment was a barrier to ICT use in schools and noted that;

"The low use of digital resources and tools is a concern. Digital textbooks and multimedia tools are the resources most frequently used. However, only 30% of students use them once a week or almost every day, but more than 50% of students at all grades never or almost never use such resource".

Another report to the Commission (MATEL) posited a possible explanation [6].

"... there may be some complacency arising from a belief that an abundance of digital resources already exists."

In contrast, which is of significant pertinence to ODS, the 2013 POERUP Report to the Commission "POERUP Policy Advice for Schools" [7] concludes that;

"It appears that there are "millions" of European OERs which are potentially appropriate for K-12 education"

The POERUP Report explained the discrepancy by detailing how K-12 OER were often "hidden" from researchers, either by being hosted within repositories which were not "pure" OER, or simply because the term OER is much less widely recognised in the schools sector than it is within Higher Education

2. OER BUSINESS MODEL TRENDS

ODS (Open Discovery Space) is *a "socially-powered multilingual open learning infrastructure to boost the adoption of eLearning resources"* by schools, teachers, students and parents. Funded by the European Commission, ODS is a collaboration of 50 partners (universities, education networks, non-profits, private technology companies, small to medium enterprises) from 20 countries.

Research conducted under ODS, has identified 13 potential OER and/or MOOC "business models/revenue models":

- Give away to reduce costs
- Digital for free, print for fee
- "Give away the recipe, open a restaurant"
- Tuition free but pay for registration, pay for examination/accreditation
- Give away to generate increasing enrolments
- Subscription
- Advertising
- "Course In A Box"

- Donations and Memberships
- Analysis and sale of data
- Peer to peer sales
- Sponsorship
- Job placement services

Just because these have been suggested, or even championed, as "business models" does not, of course, mean that they are tested or even credible ways to sustain OER. In the field of MOOCs the positive coverage engendered when Coursera announced that it had generated $1m by charging students for verification certificates has been contrasted with the $65m it has attracted in venture capital and funding from ed-tech companies.

Not surprisingly, commercial publishers have been quick to respond to the threats and opportunities posed by OER and MOOCs. Clearly, in certain cases, the term "open" also includes "free" or "freely available" resources; and therefore the publishing industry is being presented with the challenge of how to charge for "free" resources. A typical initial response is that of Pearson which has leveraged its huge library of resources to create a "curated marketplace" through which it hopes to generate income by hosting 3rd party content and also through the collection and exploitation of student data.

However, it is still too soon to determine whether these paradigms are effective. [3] noted:

"The situation is remarkably dynamic with new models emerging and suppliers regularly amending, supplementing and refining theirs"

"There is a blurring of the free, open and commercial models (although 'pure' free and open models still survive)"

"Similar business models are appearing across OER, MOOCs and traditional content (and associated platforms) and indeed Open Course Ware."

In [3] concluded:

There appears to be an increasing willingness amongst the commercial sector to offer a menu of products and services".

3. APPLYING AN INTERNAL SWOT ANALYSIS

Using the data previously gathered during the ODS "Review of Open Learning Requirements" an informal SWOT of the individual and collective Products and Services of ODS was undertaken. The SWOT findings were set within the context of the TEL and Business Model trends outlined above and this was used to inform sustainability planning.

The identified internal positive factors (i.e., strengths) have the potential to dramatically facilitate the dissemination of ODS content and services, and enhance its impact. Key amongst these are the large amount of up-to-date, freely-accessible and shareable, language and device-independent resources and learning materials that are easily adaptable to different educational levels, the provision of multilingual support in content and services, the implementation of quality assurance measures, and the

provision of advanced browsing and searching mechanisms.

The internal negative factors (i.e. weaknesses) are mostly related to the lack of homogeneity, which mainly affects quality and the metadata approaches used to support classification, discovery and retrieval of resources. Inevitably, many resources are offered in local language versions only and/or are targeted to specific audiences or geographical regions.

The external positive factors identified (i.e., opportunities) predict a significant increase in **the demand of electronic content and services for the schools in the near future.** Among the reasons for this situation that stand out, are an underexploited market, the positive cost-benefit balance for e-content and a positive attitude to foster ODS-related products and services in the public and private sector.

However, the situation described above also promotes strategies in content producers/developers and publishers to optimize their market position. This may foster attitudes towards market domination affecting the dissemination of content (e.g., bundling together hardware and content, content protection, dumping, etc.). Lack of funding may also contribute negatively to this situation, in that small independent producers would have additional difficulties to place themselves competitively in this new market. In some cases, target audiences are not mature enough to adequately understand or accept the new technology, or they may be overwhelmed by a saturation of information. These weaknesses are the most relevant external negative factors.

4. SUSTAINABLE DEVELOPMENT

Sustainable development "is a participatory, multi-actor process, involving a diversity of societal stakeholders, administrators, policy makers, practitioners and scientific experts" [8] [9] [10]. Sustainability can be defined also "as a conscious strategy that takes into account the availability and restrictions of resources over a long period of time with the aim of nourishing diversity without "feeding" on other" [11] [12] and incorporates the following actions/results [12]:

- Interventions/Improvements/changes that endure over time

- Interventions/Improvements/changes that can be supported by available or achievable resources

- Interventions/Improvements/changes that should not have a negative impact on the surrounding Internal and external environment

- Only diverse organisational structures/results are sufficiently flexible and stimulating to build up a self-sustaining dynamic

Sustainability is one of the main priorities of every sector as well as of the e-learning field [11].

4. PAST EXPERIENCES

The relevant literature, but also the experience of School+ project [12], points that technological changes/interventions are depended on the willingness of key stakeholders and actors to adopt and implement them, and more specifically are depended on the principals, teachers and policy makers as well as on the existence of relevant infrastructure. In [11] emphasize that in order for the intervention and technological innovation to be successful/ sustainable, it should build on the specific needs of the target school community involving students, parents, teachers and policy makers and other key actors/stakeholders [12]. Moreover, in order for the intervention in education to be sustainable, it should be performed after a socio-economic analysis. The analysis should evaluate the project investments and requirements beyond purely economic factors, so that it will be able to drive the decision-making process for making the investments yielding the maximum return for the educational community itself [11]. Equally crucial for the success and sustainability of an IS intervention in the education field is to offer training, professional development and further support [12]. Furthermore, in learning networks for sustainable development, it is vital that the partnerships of mixed actors (societal stakeholders, administrators, policy makers, academics, industry partners etc.) aim innovative solutions through knowledge sharing or collaborative knowledge development [12]. Finally, it is proposed that the management team should maintain the technology under close inspection in order to ensure that e-learning would be useful to the learners and students [13].

5. THE ODS APPROACH

The ODS consortium fully acknowledges the importance of the implementation of a sustainability strategy in order to ensure the longevity of the project's outcomes. As the literature suggests, an effective sustainability plan requires data and action in many areas concerning the project's outcomes. Figure 1 shows the main areas of interest for data collection for the sustainability plan creation.

The ODS approach includes the identification of the needs and requirements of users and other key stakeholders and devised a plan to address them. Moreover, the next steps involve a comprehensive SWOT analysis and identification of potential opportunities and threats in the external environment that provides information to ODS consortium to adjust its strategy towards key stakeholders, as well as to form a mitigation plan for the threats and address the weak points of the portal highlighting its strengths.

Moreover, the business plan/model, establishing a very clear organisational structure, aims to generate revenue through various sources and with the support of its stakeholders. It is considered more suitable and appropriate to generate revenue from multiple sources rather than to rely on a single revenue generation model.

According to the ODS model, content and technology providers contribute content to the portal server and if it is commercial then they generate revenue from sales of this content while the ODS consortium generates income from a premium on the price of the commercial content.

Another source of revenue could be the ODS Training Academy which aims to shape innovation leaders who will promote the uptake of e-Content in schools through training programmes and online support specially targeted for a set of stakeholders' key to the uptake of content. The ODS Academy has already successfully established itself as a facility that showcases innovative scenarios of school reforms, and provides professional development training, courses and workshops. In addition, the ODS consortium can generate revenue from other sources, such as advertising on the portal, memberships, donations and sponsorships, or by introducing charges for printing, technical support or technology transfer agreements.
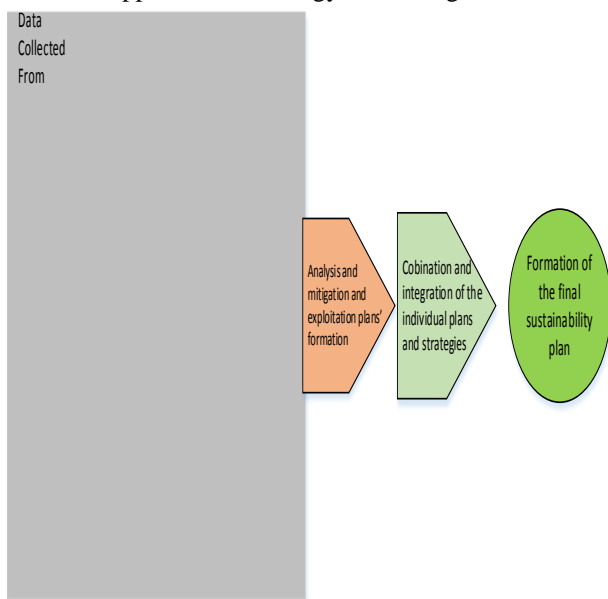
Figure 1: ODS sustainability strategy

6. EXPLOITATION PLAN

Initiatives can be sustainable if they have been designed, developed and evaluated from a user's perspective, are regularly updated, and implement innovative approaches, practices and business models [14].

From the market analysis conducted under ODS, it was clear that most competitor OER systems/platforms use two main revenue/ business models; either a) a sponsorship revenue model, which allows them to offer free services to users while being sustained by a larger funding body/organization/institution, or via a university grant etc (i.e., LRE, OER commons, among others) (table 1); or b) a model which involves offering free services to individual end-users, but charging larger organizations for these services. (i.e., TES resources and Education Elements among others). Furthermore, our analysis provided evidence that advertising and sales models are the least preferred ones, as opposed to the fee-based services that are among the most preferred sources of revenue.

Following the latter, ODS could consider offering free services to the individual end-users, while charging the education institutions/schools for the use of services. As it described the ODS sustainability approach, advertisement, sponsorship and technology transfer models can lead to generation of revenue.

Table 1: An overview of key OER initiatives

Type of OER initiative	Project/ Initiative	Target Audience	Funding Scheme
OER Platforms/ Portals	1. TES Resources	Primary: Teachers /Secondary: schools education jobseekers	None
	2. Didactalia-GNOSS	Primary: teachers, students, parents/Secondary: organizations	None
	3. Education Elements	Primary: schools/ Secondary: teachers, students and administrators	None
	4. Edmodo	Teachers, students, parents	None
	5. Schoology	Teachers, schools, students, enterprises	None
	6. Open Class	Primary: Educators, Students, Institutions/Secondary: Content creators-providers	None (Supported by Pearson)
	7. OER Commons	Primary: educators/ Secondary: students, lifelong learners, institutions	Supported by the William and Flora Hewlett Foundation, ISKME
	8. OpenScout	Educational institutions, Instructors, Learners, Librarians, Entrepreneurs, Freelancers, enterprises	EU-funded project
	9. LRE	Primary: schools-teachers/ Secondary: content providers	EU-funded project
	10. eTwinning	Primary: schools/ Secondary: Staff (teachers, head teachers, librarians)	EU-funded project
	11. ODS	Primary: Teachers/Educators, students, parents, schools, institutions, governments, curricula developers, policy makers/ Secondary: Teachers, Learners, Content creators/providers, technology providers	EU-funded project
	12. Coursera	Students, individual learners, life-long learners	Private funds
	13. Udacity	Professionals and students	Funded by Charles River Ventures and private funds
OCW-OER Repositories	14. Curriki	Teachers, students, parents	None
	15. OSR (Open Science Resources)	Primary: teachers, museum educators/Secondary: students, museum visitors	EU-funded project
OER Search Engines	16. ScOT	Primary: Teachers, schools/Secondary: organizations	Sponsored by Australian Education Ministry
	17. Pearson Bluesky (Gooru)	Primary: instructors – schools/ Secondary: students	None

- ODS has already successfully attracted the interest of many web-content providers, technology providers and e-publishers. This is evident in the findings of the online ODS survey (July 2013 – February 2014) which indicate that business actors are very much interested in:

- Participating in a pan-European OER platform such as ODS (61%)

- Receiving information about ODS (i.e., newsletter) (50%)

- Adding their own repository of educational resources to the ODS platform (39%)

- Offering your products/services/tools/technology via the ODS platform for a fee (39%)

- Forming strategic alliances with the ODS consortium (strong linkage) (33%)

- Participating in ODS events (33%)

- Becoming an external collaborator of ODS (loosely linked) (22%)

- Becoming an affiliate partner in ODS (22%)

- Sponsoring the ODS platform (22%)

7. CONCLUDING REMARKS

The ODS platform has many strengths and advantages over the competition - in particular, the wealth of up-to-date, freely-accessible, shareable, language and device-independent resources that are easily adaptable to different educational levels, the provision of multilingual support in content and services, the implementation of quality assurance measures, impact evaluation mechanisms and tools, and the provision of advanced browsing and searching mechanism, in addition to a broad and vibrant community of members.

One of the strongest points of ODS is the Training Academy programme, which, through the training and support it offers to its stakeholders, helps them to become innovation leaders who will champion the uptake of e-Content in schools.

These strengths coincide with a number of trends in the broader education landscape to uncover a number of clear opportunities. The predictions of an increasing demand for electronic content and services during times of austerity point to the potential for user-generated resources, OER, and free or low-cost options.

However, there may be some concerns about the lack of consistency across the ODS repositories, federations and tools – particularly regarding attitudes to metadata, Quality Assurance processes, and the collection of data. The internal factors identified do not apply in a uniform way to all repositories analysed, but individual cases have their specific strengths and weaknesses. As these are internal factors, they can only be addressed by the corresponding repository promoters. For this purpose, by and large, good practice guidelines identified in the positive/successful cases may serve as model and source of inspiration for significantly improving the overall quality of the services and products offered by ODS and, in general, open innovation and OER platforms.

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AN INTRODUCTION TO THE ITEC SCENARIO DEVELOPMENT ENVIRONMENT

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Abstract: This paper describes the Scenario Development Environment, a Web application that enables users to find, select, and combine educational resources.The main distinctive feature of the SDE is that documents in the system are represented by the concepts they contain, rather than by the words they contain—as in traditional information retrieval systems. Software agents perform the task of creating semantic annotations of documents, thus creating the concept-based representation of documents automatically. The concept-based approach is particularly well suited for enabling exploration of the space of concepts, by navigating from an educational resource to others that have a common semantic annotation, and also for exploring semantically related resources. Besides, the SDE provides convenient functionalities for gathering resources while performing an exploratory search, and for combining them afterwards, in a sort of "learning story".

Keywords:Information Retrieval, Bag-of-Concepts Document Representation, Exploratory Search

1. INTRODUCTION

In the past few years, technology is playing an increasingly important role in classrooms. Thus, governments, ministries of education, and entities with competences in education are launching programs that aim at providing classrooms with technological infrastructure.

The availability of technologies in the classroom opens up a world of possibilities for the teaching practice. However, in spite of the great potential of technology-provided classrooms, a big part of them remain underused. In the literature, we can find several reasons for that:

- The first one is that technology does not fit well traditional teaching approaches—those based on master classes, in which technology is perceived as a distracting element.
- The second one is that teachers lack training on how to effectively use technologies in their teaching practice. Training has a twofold dimension: pedagogical and technological.

As a step towards overcoming those problems, several research groups working together within the framework of the iTEC project have proposed a series of pedagogical approaches, which have been tested in large-scale pilot experiences throughout Europe. Those pedagogical approaches emphasise the importance of teacher training for their adequate implementation.

The cornerstone of those approaches is the so-called Future Classroom Scenario, conceived as a small cooperative project in which students, working in groups, carry out several Learning Activities. In those Learning Activities—in addition to the contents of the curriculum—students practice the so-called XXI Century Skills, such as: working cooperatively, using technology, and speaking in public.

The final outcome of iTEC is an integrated set of tools grouped under the name of Future Classroom Toolkit, especially designed to facilitate the implementation of iTEC pedagogical approaches. The software tools created under the umbrella of iTEC—aimed at facilitating the process of defining and planning new Future Classroom Scenarios, as well as adapting existing ones—are a key part of the Future Classroom Toolkit. More concretely, iTEC has among its objectives "To build a prototype assistant for advising users how to find, select and combine resources that support the project scenarios"[1]. That software application is called the Scenario Development Environment (SDE), and it can be accessed at:

http://www.itec-sde.net

The approach followed in the SDE for enabling the discovery of educational resources is based on exploratory search. In an exploratory search, the search terms denote a concept—understanding concept as a *unit of knowledge*[1]. Retrieving documents in which a

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[1]iTECDoW, page 11.

specific concept is relevant presents serious difficulties, which have to do with synonymy and polysemy:

- As spotted by [2], when the search terms are different from the terms used in a particular document, that document will not be retrieved. That is to say, synonymy negatively affects recall.
- Besides, polysemy negatively affects precision. When a user is searching for documents about planet Mercury, the retrieved documents that are about the chemical element called mercury have to be seen as an imprecision of the search engine.

The rest of this paper is organised as follows. Section 2 presents the concept-based representation of documents used in the SDE, which is fundamentally different from traditional representations on bag-of-words. Section 3 describes how to find educational resources by performing an exploratory search. Section 4 outlines the selection of resources. Section 5 explains how to combine learning resources in a sort of «learning story». Section 6 presents some evaluation results with end-users. Finally, Section 7 presents some conclusions.

2. CONCEPT-BASED REPRESENTATION OF DOCUMENTS

Fundamentals

In traditional information retrieval systems, documents are represented in accordance with the bag-of-words paradigm. Let's suppose that we have two text documents:

- Document A: "mercury is a chemical element".
- Document B: "Mercury is a planet of the solar system".

On the basis of the two documents above, we can build the following dictionary: "mercury": 1; "is": 2; "a": 3; "chemical": 4; "element": 5; "planet": 6; "of": 7; "the": 8; "solar": 9; "system": 10.

Following with this representation, documents are represented as vectors—with as many dimensions as entries in the above dictionary:

- Document A = [1, 1, 1, 1, 1, 0, 0, 0, 0, 0]
- Document B = [1, 1, 1, 0, 0, 1, 1, 1, 1, 1]

In this way, when a user introduces the term "mercury" the search engine checks the representation vectors and returns documents A and B—being document A completely irrelevant for a user that is looking for information on planet Mercury.

Automatic extraction of concepts

To know what concepts are referenced in a text document is a non-trivial task. Traditional approaches to this problem are based on using humans for generating the so-called *semantic annotations*[3], which are chosen from a set of possible annotations called taxonomy.

The principal problem with "manual" annotations is that is does not scale well. The generation of manual annotations is very time-consuming and error-prone. In order to overcoming that, some authors have proposed the automatic extraction of concepts from text documents, using techniques from the fields of Natural Language Processing and Machine Learning [4], [5]. Following that approach, given a text document, a software component "extracts" the concepts that particular document refers to.

In the literature, we can find several examples of automatic extraction of concepts [6]–[8]. [4]propose a method called Explicit Semantic Analysis (ESA), by which any text document is represented as a weighted vector of concepts from Wikipedia. The authors chose Wikipedia because it is the greatest repository of knowledge in the entire Internet. Evaluation of the effectiveness of this approach was performed by comparing its performance in the task of computing semantic relatedness between text documents to the traditional bag-of-words approach, concluding that ESA gives better results than the traditional method.

In a similar line, [9] represent documents on the basis of concepts from Wikipedia, to be used in the Koru search engine. According to the authors, Wikipedia is very suitable for this task, because it contains a big number of terms, with relationships between terms that have been added manually and are domain-independent.

Other systems build on resources different from Wikipedia for their concept-extraction task. Thus, [10] derive the concepts for representing documents from linguistic resources such as WordNet and WordNetDomain.

3. FINDING EDUCATIONAL RESOURCES

Suggesting concepts

The interaction with the system starts with the introduction of some search term in the search box. Thus, following with the example proposed in the introduction we can introduce the search query "tesla". As it can be seen in the Figure, "tesla" may refer to several different concepts. Hence, retrieved resources may relate to any of those concepts. As a consequence, for the particular case of the query "tesla", we can see among the search results some resources that refer to, among others:
- Nikola Tesla.
- Tesla, the international unit of magnetic fluid density.
- Tesla, the car manufacturer.

Seeing concept summaries

When we select a concrete concept from the list of suggested concepts, only the resources about that particular concept are displayed—all the rest are filtered. Thus, if we select the concept "Nikola Tesla", all the resources about "Tesla (unit)", "Tesla Motors", and "Nvidia Tesla" are filtered.

As it can be seen in the Figure, the grey box at the top of the page displays information on the concept "Nikola Tesla": a short paragraph describing his life and works; a representative picture of Nikola Tesla, a portrait concretely; and also a list of key-value pairs that relate Nikola Tesla to other concepts. That list of key-value pairs allows users to explore the graph of concepts. For instance, from the concept "Nikola Tesla" we can navigate towards the concepts "Induction motor", "Rotating magnetic field", and "Tesla coil", which are taken from Tesla's area of work; but we can also navigate towards "Smiljan" and "New York City", which are, respectively, the places where Nikola Tesla was born and died.

This way of interacting with the system described in the paragraph above is called Exploratory Search through the Space of Concepts, since from a particular concept we can keep on exploring through other related concepts.

After the description of the concept "Nikola Tesla", the system displays a list of the educational resources that have been annotated with the concept "Nikola Tesla". We can see, among other categories and resources:

- Places of interest, such as the Nikola Tesla museum in Belgrade.
- Biographies, such as the one of Nikola Tesla.
- Lectures, including the talk delivered by Marco Tempest entitled "The electric rise and fall of Nikola Tesla" in TED.
- Documentaries, including the ones: "The eye of the storm - Tesla", "Lost lightning: the missing secrets of Nikola Tesla", "Nikola Tesla – The genius who lit the world", "Nikola Tesla – The greatest mind ever", and "The electricity war".
- Books, such as: "Makers of electricity" by Bother Potamian, "Inventions, researches, and writings of Nikola Tesla" by Thomas Commerford Martin, and "Experiments with alternate currents of high potential and high frequency" by Nikola Tesla.
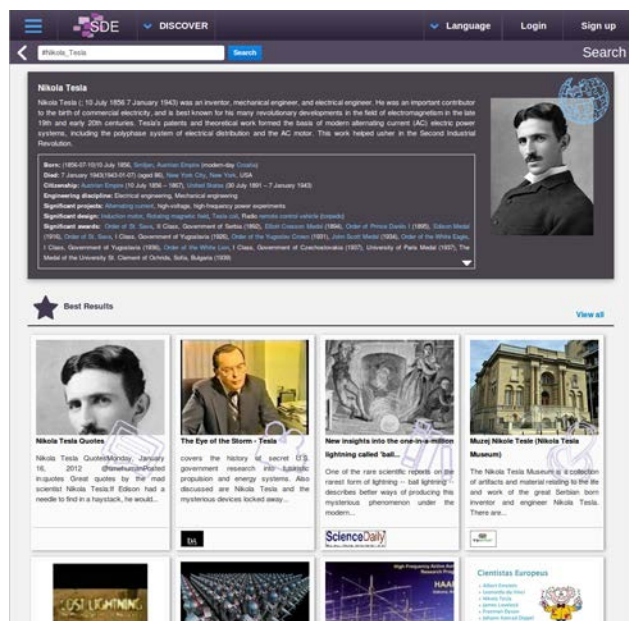
Image 1: Detail of the concept "Nikola Tesla".

Detail of an educational resource

When a user chooses an educational resource from the search results, the system displays a summary of that educational resource—which includes a brief extract from its textual content, a representative image (in case it is available), plus metadata of the educational resource. Besides that, the system shows the tags that have been automatically generated, and that correspond with the bag-of-concepts representation of the resource. Each of those tags is a navigable link, in such a way that clicking on a tag the user can navigate to a concept summary—and to the relevant resources for that concept.

The behavior described above is called exploratory search through the space of tags. This kind of exploratory search works seamlessly in conjunction to the exploratory search through the space of concepts.

The exploratory search through the space of tags is inspired in social tagging sites such as Del.icio.us, Flicker, or even Twitter and Instagram. For instance, in Del.icio.us, users assign tags to the resources that they incorporate into the platform; and those tags are navigable—clicking on a particular tag, other resources that were assigned the same tag are retrieved. In Flickr, where users assign descriptive tags to pictures, the same mechanism is applied. In all those systems that implement social tagging the exploration of new documents through tags is natural and convenient.

A similar approach is used in repositories of educational resources such as Klascement, in which users assign tags to the educational resources that they aggregate to the repository, and those tags may be used for exploring related educational resources. In other repositories, professional indexers perform the task of tagging educational resources.

Our approach to assigning tags presents some advantages over the "manual" generation: it is less time-consuming; it has not any problems with synonymy and polysemy; and it is very consistent—it does not depend on personal preferences when assigning tags.
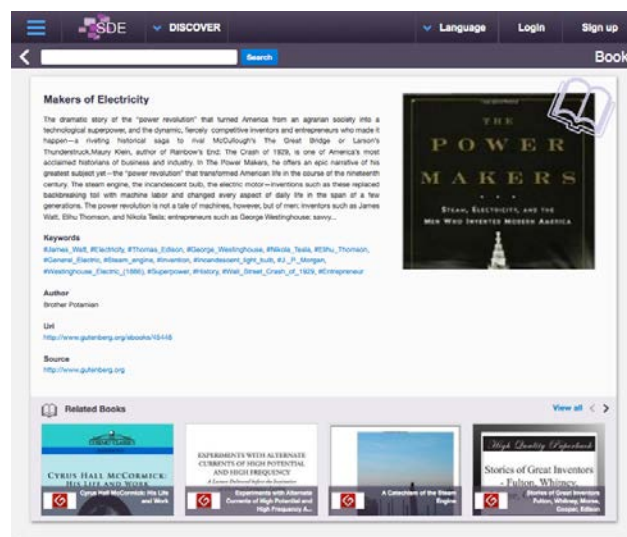

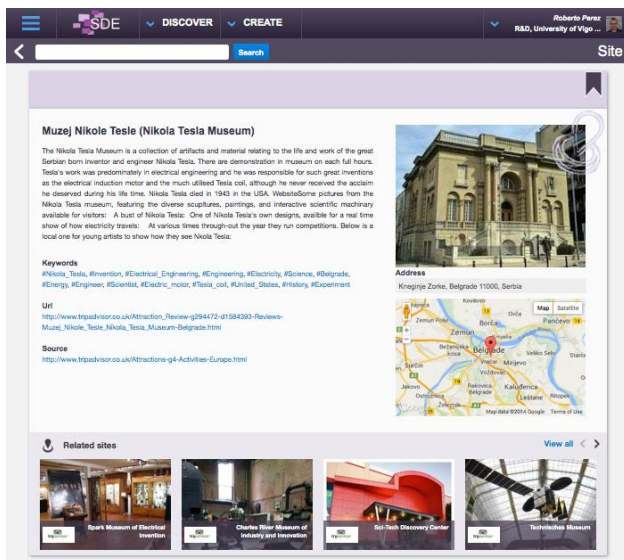**Image 2:** Detail of an educational resource—a book.

Image 3: Detail of the Nikola Tesla Museum in Belgrade, and related museums.

Related resources

In the detailed view of a particular resource, we can see how the system suggests to the user other resources that might be of interest, on the basis of the semantic relatedness to that resource.

In the first place, the system suggests resources from the same type of that currently being displayed. For instance, when the system is displaying the details of a particular book, the first row of related resources is composed of other books with a similar thematic. Immediately below, the system displays related resources from other categories—documentaries, lectures, etc. Thus, the user may click on any related resource and navigate to its detailed view, which in turn will display its own related resources. This procedure for discovering content is called exploratory search through the space of related resources.

4. SELECTING EDUCATIONAL RESOURCES

Our approach to exploratory search has to do with the idea that users interact with the SDE, navigating through the space of concepts, using the semantic annotations in educational resources for navigating through other concepts, and navigating towards the resources related to a given one. The final objective of that exploration is the gathering of educational resources that may be later combined in the didactic planning of a Future Classroom Scenario.

As a mechanism for gathering educational resources, we implemented the functionality of bookmarking them, in a similar way to that of a Web browser. Thus, from the page for visualising a resource, users can bookmark the resource that is being currently displayed. Besides, in the personal space of users, they can access to "My bookmarks", which is a page that displays all the resources they have bookmarked insofar, organised in accordance with their categories.

For each one of the categories the SDE shows a thumbnail with the title plus a representative picture of each

bookmarked resource. In this screen, users can also un-bookmark resources. Following with our example of the Future Classroom Scenario entitled "Life and Works of Nikola Tesla", the figure shows some bookmarked educational resources, gathered in an exploratory search:
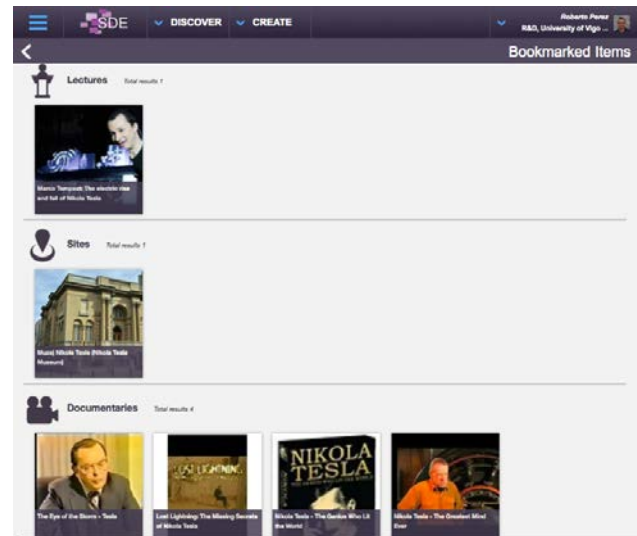

Image 4: Selected resources on Nikola Tesla.

5. COMBINING EDUCATIONAL RESOURCES

In the SDE, we integrated an editor devoted to the lightweight planning of Future Classroom Scenarios. The approach of that editor is combining resources and free text in the form of a narrative. In this way, a teacher may combine biographies, lectures, events, documentaries, and rest of elements, in a sort of "story".

Thus, the concept of narrative or "story" is central in this proposal. This is a key distinctive feature from other planning alternatives, which choose a more structured approach.

The bar at the bottom of the page allows for selecting the type of element that we want to incorporate into the narrative: free text, application, event, etc. We wanted the editor to be as easy-to-use as possible; hence, the interface works in a drag-and-drop way, enabling a convenient sorting of elements of the narrative.

Image 5shows a narrative with tree elements: free text, a biography, and a lecture. The user is dragging the second paragraph. In the bottom of the editor we can see the bar for adding new elements to the narrative.
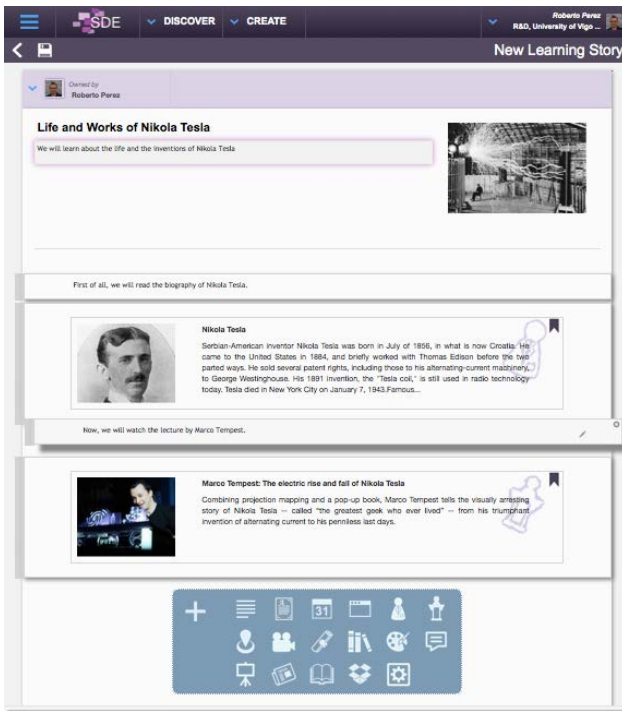
Image 5: Combining educational resources on Nikola Tesla in a Learning Story.

6. FIRST EVALUATION RESULTS

In order to design the search engine, we followed the problem-centred approach described by [11], and that is known as Design Science Research Methodology (DSRM). We think that DSRM is particularly well suited to address the evaluation of an artefact such as the SDE.

In order to evaluate the search engine, several workshops were conducted under the umbrella of the iTEC project. As DSRM proposes, every workshop allowed us to gather feedback for refining the design. The table shows data of those workshops. At the end of the iTEC project, an online survey was issued. The sample of the survey consisted on20 teachers. The online questionnaire served us to gather data that enabled a more formal evaluation.

The results gathered from the questionnaire are very positive, and they indicate teachers perceive that exploratory search very positively. The following images show the answers to the questions: "How do you evaluate the navigation through the space of topics?", "How do you evaluate the exploratory search through the keywords of particular resources?", "How do you evaluate the exploratory search through related resources?", "Are bookmarks useful?", and "Evaluate the usability of the tool for creating new Learning Stories".
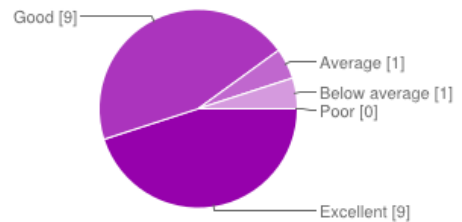
Image 6: How do you evaluate the navigation through the space of topics?
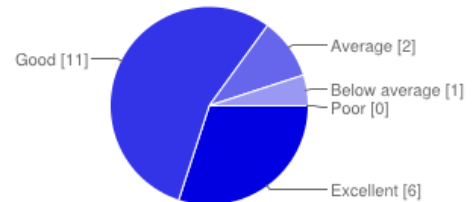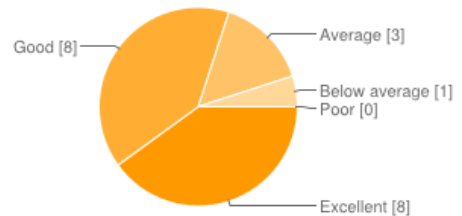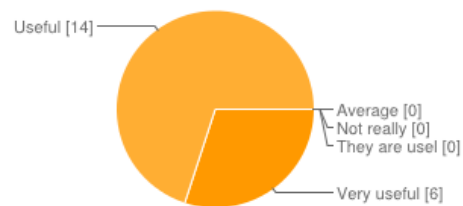

Image 7: How do you evaluate the exploratory search through the keywords of particular resources?

Image 8: How do you evaluate the exploratory search through related resources?

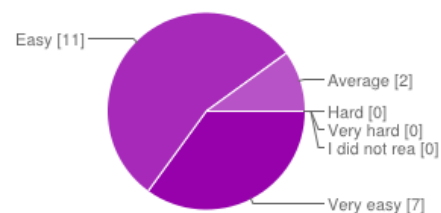**Image 9:** Are bookmarks useful?

Image 10: Evaluate the usability of the tool for creating new Learning Stories.

7. CONCLUSION

In the first place, it is remarkable the great potential of the techniques for Exploratory Search that were outlined in this article, which are well suited for discovering educational resources that deal with particular concepts. The concept-based approach completely overcomes the problems of synonymy and polysemy, associated with traditional keyword-based searches.

It is worth noting that the foundations of Exploratory Search could serve as the basis for the implementation of information retrieval systems on top of existing

repositories of educational resources, which could benefit enormously from all the possibilities that Exploratory Search offers.

Finally, we want to remark the usability of the application for supporting the full process of creating didactic plans: finding resources, selecting resources, and combining resources.

ACKNOWLEDGEMENTS

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STUDENT'S PERCEPTION AND LEARNING OUTCOMES WHEN USING AN ELEARNING-SCENARIO

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Abstract: The present study analyses 10th graders' perceptions of eLearning by examining a student's rating of an eLearning scenario and their cognitive load while working on a web-based module. Additionally, we focus on learning outcomes monitored by a pre- and post-test questionnaire as well as by digital workbooks. Additionally, the completion of an eLearning task triggering critical thinking was taken into account. Summarizing first analyses, data points to a positive perception of an eLearning scenario, a cognitive achievement effect as well to a support of critical thinking.

Keywords: eLearning; student's perception; learning outcome; rainforest; climate change

1. INTRODUCTION

eLearning is regarded as a "new learning paradigm" [1], [2] and consequently enters more and more today's education. These circumstances are reflected in the Digital Agenda for Europe, where especially Action 68 requests to "mainstream eLearning in national curricular for the modernisation of education". Consequently, requirements for digital literacy of educators and students lead to the establishment of initiatives like the Open Discovery Space Project (ODS). The main objective of ODS is to introduce changes in educational practices and develop resource-based learning. As a starting point, pedagogical best practice scenarios were developed and uploaded to a digital access point: the ODS portal. The evaluation of ODS mainly addresses teachers through the monitoring of their actions on the portal and the implementation of questionnaires paired with more qualitative direct evaluation through workshops, interviews and focus groups [3].

Nevertheless, students need consideration as actual end-user whom should profit the most by the integration of new learning methods. Thus, it is important to examine how students are affected by eLearning which should promote critical thinking and prepare them for the labour market [4]. However, Manochehr [5] complains about a lack of documentation for eLearning as an "effective delivery mechanism" regarding for instance learning outcomes.
Up to now, some statements exist concerning students' perception of eLearning and the related learning outcomes: Morgil et al. [6] found students as pre-set to acquire knowledge „through the teacher" and consequently as hesitant to use computer assisted educational applications; nevertheless, this perception changed after participating in an eLearning class. Cox [7] reported students' attitudes being dependent "upon their overall experience of using e-learning".

Our present study focuses on the first results of the implementation of a learning scenario of the ODS portal: Tropical Rainforest and Climate Change. Herein, we present the cognitive achievements, the rating of student's in regard to their cognitive load (CL) and perception of usefulness.

2. MATERIAL AND METHODS

114 tenth graders (age 16.51; SD 1.459; 50.88% male, 49.12% female) participated in an 1.5 hour learning programme dealing with tropical rainforest and climate change. Student's followed the learning scenario available on the ODS portal and worked with the learning resource "Bayreuth goes Ecuador" which is a website compromising several applications like a video, texts, an interactive animation, a carbon footprint calculator and an analysing tool to examine two original datasets of a DFG group recorded in Ecuador. Students are guided through these activities by dividing the unit in three different tasks including five leading questions each which they directly answer on the website (and sent themselves via email) or in a digital workbook.

In order to analyse perceptions on this learning scenario, the participants were asked to rate how appealing they found the three different tasks according to school grades ranging from 1 "pleased me very much" to 6 "pleased me not at all". Additionally, we asked students to state their CL) varying between 1 very small CL and 9 very high CL with 5 as an anchor point defined as the CL of an everyday class. 82 students provided their opinion on these variables. Measuring the learning outcomes is based on a pre-, post-test design (Figure 1, retention test not available yet). All tests contained 30 questions dealing with tropical rainforests and climate change, which were covered by the eLearning programme and a previous preparing hands-on circle. All 114 students answered the questionnaire.
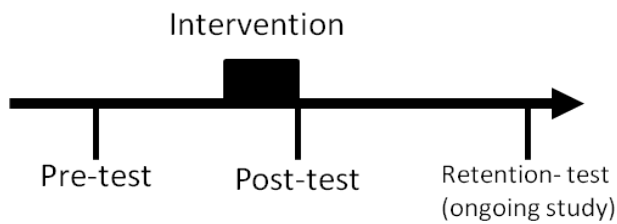
Figure 1: Study design

Furthermore, the digital workbooks of these 114 students were analysed regarding two exemplary tasks. Task A contains the shading of tropical rainforest regions on a map (example provided in Figure 2) while task B focussed on the analysis of original data and asked students to draw their own conclusions concerning the existence of a temperature trend, it's causes and its consequences. The latter task was analysed according to Mayring's qualitative content analysis [8], whereas statistical analysis was performed using SPSS Version 22 [9].

3. RESULTS

In general, students rated all three tasks within the fair ranges (means between 2.46 to 2.74) although some of them required the total spectrum for feed back. This is reflected by written comments (in the digital workbooks) like "It was interesting and was fun." (male student, age 14), "...all [other] tasks were ok" (male student, age 15), "really helpful, recommendable" (male student, age 16). Some students stated the tasks were "complex to handle..." (female student, age 17) which points to a CL situation. Herein, the complete range was needed in order to rate the tasks. Generally, students rated all tasks below the CL of a usual lesson in their classes. All measurements are detailed in Table 1.

Table 1: Students' perception of eLearning tasks

task	Mean	SD	mini-mum	maxi-mum	Percentile		
					25.	50.	75.
Grades							
T1	2,46	,840	1	6	2,0	2,0	3,0
T2	2,74	,894	1	5	2,0	3,0	3,0
T3	2,56	1,002	1	6	2,0	2,0	3,0
cognitive load							
T1	3,52	1,701	1	9	2,0	3,0	5,0
T2	4,04	1,810	1	8	2,5	4,0	5,0
T3	3,52	1,513	1	8	2,0	3,0	5,0

Using Kolmogorow Smirnow depicts all variables (age, grades, CL and gender) as not normal distributed by a significant p-value < 0.001. Consequently, non-parametric analyses were used for examining further interrelations. There is no connection between gender and the perception of the eLearning programme (neither grades nor CL), which is supported by a non-significant

Mann-Witney U and Wilcoxon Test using gender as grouping variable (Table 2).

A positive correlation exists between the provided grades and the CL of each task (marked bold in Table 3). Furthermore, CL correlates positively between the different tasks and additionally the grade of the first task correlates positively with the second and third task (table 3).

Table 2: Gender equality

	T1_grade	T2_grade	T3_grade
Mann-Whitney-U-Test	768.500	702.000	719.500
Wilcoxon-W	1363.500	1297.000	1895.500
U	-,483	-1,131	-,983
Asymp. Sig. (2-tailed)	.629	.258	.326
	T1_CL	T2_CL	T3_CL
Mann-Whitney-U-Test	794.500	657.500	763.5
Wilcoxon-W	1970.500	1833.500	1939.500
U	-.206	-1.511	-.502
Asymp. Sig. (2-tailed)	.837	.131	.616

In regard to student's learning outcomes, all 30 items showed a Cronbach's alpha of 0.769 and thus can be used reliably. Students generally improved their knowledge by using the eLearning resource. The maximal knowledge increase constitutes 11 items whereas the mean is 3.16 items with a standard deviation of 2.45 items. No gender effect is present according to a non-significant (p=0.118) Man Whitney U (U=-1.562) and Wilcoxon (W=3062.5) test. No significant correlation between age and knowledge gain are present (Spearman Rho=-0.114; p=0.229). Concerning Task A, 4.17 correct regions (SD=2.04) were averagely shaded in the pre-test. After participating in the scenario students correctly shaded almost two new regions during the post-test (mean 1.96 SD 1.828) depicting a significant (p<0,001) knowledge increase.

Figure 2: Shading tropical rainforest regions

Table 3: Spearman Correlations

		Age	T1_ grade	T1_CL	T2_ grade	T2_CL	T3_ grade	T3_CL
Age	R	1.000	.034	-.088	-.053	.052	-.006	-.035
	Sig.		.762	.434	.638	.642	.960	.753
T1_grade	R		1.000	**.272**[*]	.414[**]	-.028	.240[*]	.020
	Sig.			.013	.000	.800	.030	.858
T1_CL	R			1.000	.090	.361[**]	.054	.495[**]
	Sig.				.423	.001	.631	.000
T2_grade	R				1.000	**.228**[*]	.211	.136
	Sig.					.039	.057	.222
T2_CL	R					1.000	.114	.345[**]
	Sig.						.308	.001
T3_grade	R						1.000	**.367**[**]
	Sig.							.001
T3_CL	R							1.000
	Sig.							

* Correlation significant (two-tailed) at 0.05 level.

**Correlation significant (two-tailed) at 0.01 level.

The majority of students correctly recognized a raising temperature trend in the DFG data of task B, whereas only 7% did not report a trend. Additionally, some students assessed the quality of this temperature increase. Hereby, 4% regarded the increase as huge over time, while 6% stated the increase as very small (shown in Figure **3**). While reflecting on the reasons for this temperature trend, students provided four concepts: global climate change, the anthropogenic greenhouse effect, human land use and generally the loss of the tropical CO_2-repository. Hereby the general global reasons climate change and greenhouse effect were dominant as shown in Figure 4.. A similar proportion can be found by examining the consequences which students indicated. Here as well global consequences like "melting of poles", "changing of seasons" or "sea level rise" were mentioned often although students were explicitly asked to describe consequences for the tropical rainforest ecosystem. The distribution of consequences is shown in Figure 5. About 50% of the students focussed on the actual task and described consequences for the tropical ecosystem.
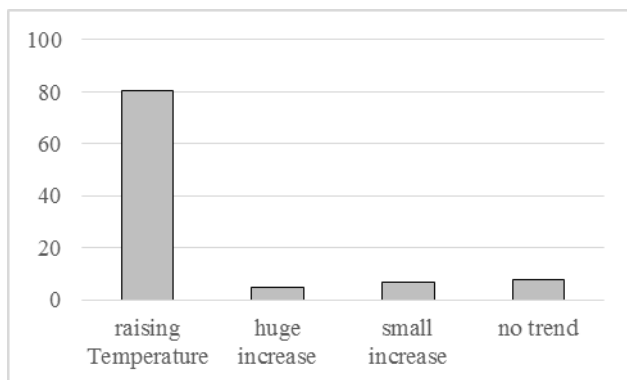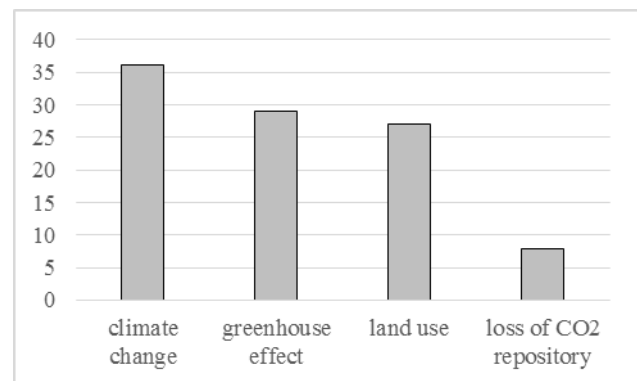

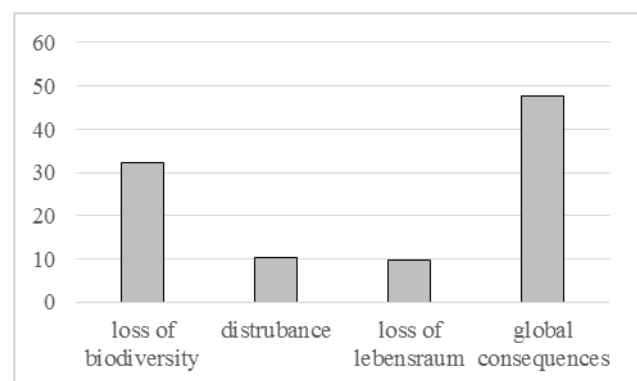**Figure 4: Reasons for temperature increase**

Figure 5: Consequences in tropical rainforest ecosystem

More than half of these students depicted the loss of biodiversity whereas the disturbance of the ecosystem including all connected biological consequences (adaptation, migration, speciation and extinction) and the loss of lebensraum (mainly for animals) were described by each 10%.

Figure 3: Students' statement on temperature trends

4. DISCUSSION

In our present study, a general positive perception for an implemented eLearning scenario was found. This possibly resembles student's familiarity and comfort with modern pedagogical practice. Already at home technology seems to be a matter of course as 85% of German households own a personal computer and 93% of youths (16-24 years) use the internet daily[1].

However, not all students rated the tasks as pleasant reflected through the utilisation of the complete spectrum of grades. This different perception of students is in line with Cox [7] who described students' attitudes being related with their prior experiences which are individual and thus probably different within our sample. Although in our very first case study, we could not collect data about computer skills the ongoing study will tackle this issue soon. When examining the interrelations of task grades a significant correlation between the first task and the rating of the subsequent tasks was found. This could be interpreted as a loss of motivation. If students did not like the first task (high = bad mark), they did not like the others either. This might reflect a general problem with the learning method as described below. Sun et al. [2] found seven variables as determining an eLearners' satisfaction namely "learner computer anxiety, instructor attitude toward e-Learning, e-Learning course flexibility, course quality, perceived usefulness, perceived ease of use, and diversity in assessment". Consequently, these aspects need to be taken into account for the ongoing study. Another crucial factor is the correlation between student's rating and CL. Although CL was stated to be below a typical classroom experience, we found a positive correlation between CL and grade. As in the German school rating system a high grade reflects a bad mark we find students perceiving the task as difficult are rating it badly. Furthermore, the correlation context pinpoints a relation between the CL of the first and other tasks. If students had difficulties with the first task, they are expected to encounter difficulties with the other tasks as well. This needs consideration as a general difficulty with the learning object and thus the media internet and digital workbook. As the webpage contains a variety of interactive information sources, these findings are in accordance with Van Merriënboer and Ayres [10] who concluded "element interactivity [...] may be too high to allow for efficient learning. However, other factors like learning styles should be taken into account as well. Manochehr [5] found eLearning to be more effective for particular learning styles than for others. In his study students following the "Assimilator and Converger" learning style performed better and thus reached a higher knowledge increase than the other students. In our study, all students could achieve a knowledge increase both in the pre and post-test knowledge questionnaire and in the development of shading tropical rainforest regions. Herein, we could not find any relation, neither between

gender nor age, suggesting our eLearning programme to be efficient for the complete target group. Knowledge increase through the implementation of an eLearning module was already found by other authors [6], [11] even leading to the statement "Online e-Learning is an alternative to traditional face-to-face education" [2]. However, this conclusion should not be drawn too quickly and is not yet broadly agreed on. Clark [12] explained it is "not the medium that causes learning. Rather it is the design of the lesson itself and the best use of instructional methods that make the difference". Consequently, further studies are needed to find a broader consensus on this issue.

Regarding the students' competencies within our eLearning scenario, a majority was capable to correctly interpret a plot of more than 40.000 data points. Nevertheless, the answers mostly followed a media-influenced pattern tending to blame global climate change as the ultimate reason. Although a smaller portion of our sample reflected more in detail and, when stating the greenhouse effect as a reason, clearly emphasised its anthropogenic origin. Additionally, the concept of land use included statements like "tropical rainforests get deforested for palm oil plantations (for our daily consume goods) which leads to an increased carbon dioxide emission and thus an increased greenhouse effect" (female student aged 17). These observations are congruent with the question on consequences. Although specially asked to report on consequences affecting the tropical rainforest ecosystem, the vast majority named global consequences like in the following example: "The consequences of the raising temperature are rising sea levels and melting glaciers." (male student, aged 17). Here as well students with a focus on the actual task provided more elaborated statements on the loss of biodiversity "which we did not even discovered completely and might withhold important medical plants or interesting animals" (female aged 18). Statements like these might originate from a general interest on environment or from a preparation lesson within the botanical garden. The loss of lebensraum which was mainly stated in regard to animals depicts a classical phenomenon named "zoochauvinism" [13]. Students generally neglect plants as living organisms as a result of education in which plants are seldom used as examples and their daily perception of plants that are not moving and do not show the signs of living on a quick glimpse. As students did not necessarily encounter plants in the eLearning module, it is not remarkable to find this common pattern. Interestingly students who pinpointed the disturbance of the ecosystem included all possible biological consequences and thus did not evaluate the temperature development as something bad but more as an ongoing process which conveys evolutionary trade-offs. This interpretation might result from prior class teaching as ecology and thus adaptation and speciation are topics of the 10^{th} grade curriculum. Certainly, it is interesting to see students connecting an already existing prior knowledge throughout our eLearning scenario. These findings are in line with [4] and [11] as both studies emphasize eLearning to promote critical thinking and the ability to apply learning.

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[1] Number provided by the federal statistical office

5. CONCLUSION

A successful implementation of any eLearning scenario needs reflection by significant learning outcomes and activation of critical thinking. Our study points into this direction. Furthermore, in our study students generally perceived an eLearning scenario as a good learning environment in which they could accomplish successful learning outcomes. Although our study is just one single showcase, as other studies also point to successful learning achievements we tend to conclude that eLearning offers a good opportunity to pass on knowledge to today's youth. Nevertheless, in a broader context other variables such as learning styles and design improvements should be taken into account to further improve this way of learning and students perception.

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TEACHERS' CPD PROGRAMME IN FOSTERING COMPETENCES – SUPPORT THROUGH COMMUNITIES OF PRACTICE

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Abstract: The key competence acquisition by every young person is one of the long term objectives of the updated strategic framework for European cooperation. Most of the EU Member States are formulating and at least beginning to implement policies that move their school systems from being predominantly input led and subject-oriented towards curricula which include competences, cross-curricular activities, active and individual learning, as well as a focus on learning outcomes. Yet, these developments do not necessarily result in significant, widespread changes in practice – that is, in how schools actually organise and provide learning experiences for pupils. The difficulty is in all cases translating these policies into practice. TRANSIt is a European project that aims to contribute to the enhancement of transversal key competences of students through building teachers capacity for competence oriented education. This paper presents the outcomes from the needs analysis survey on key competence acquisition in Greece, as well as the design and localisation of the TRANSIt Training Framework and environment based on the collected responses and the specifications set from the Greek Curriculum, the community support mechanisms that have been developed with synergies with the Open Discovery Space project developed in order to facilitate TRANSIt services.

Keywords: Competences, professional development, communities of practice, assessment, ePortfolios

1. INTRODUCTION

Key competence acquisition (KCA) is one of the long term objectives of the updated strategic framework for European cooperation (Official Journal of the European Union, 2009). The concept of key competence originated with the adoption of the Lisbon Strategy in 2000 and it resulted in the European Reference Framework (European Commission, 2006). Key competences in the EU framework are those that 'all individuals need for personal fulfilment and development, active citizenship, social inclusion and employment'. The Framework identifies and defines eight (8) key competences, among which the five (5) are considered as transversal. Most of the EU Member States are beginning to implement policies that move their school systems from being predominantly subject-oriented towards curricula which include competences, active and individual learning, as well as a focus on learning outcomes. One such example is Greece, where in the school year 2011-2012, pilot curricula for competence driven education have been introduced. In Austria however, the promotion of holistic teaching methods has been supported at policy level for several years. In other countries (e.g. France, Netherlands) innovative policies are already embedded in national strategy documents and in some cases these have already led to major structural changes, such as the introduction of new qualifications frameworks or the reform of the curriculum around the Key Competences (European Commission, 2009a). In general, there are a variety of different models of competences in European countries (European Commission/EACEA/Eurydice, 2012).

Yet, these developments do not necessarily result in significant, widespread changes in practice – that is, in how schools actually organise and provide learning experiences for pupils. The difficulty is in all cases translating these policies into practice. One of the core problems for the effective implementation of the above policies is the lack of initial education and training, as well as systematic support of teachers. One more obstacle regarding KCA is the lack of effective assessment practices. Assessment of competence is one of the vehicles that can be used to support teachers in making this paradigm shift (Black & William, 1998). This places new demands on the competences of teachers and trainers and therefore on the structure and content of initial and continuing teacher education (European Commission, 2009b). "TRANSIt - TRANSversal key competences for lifelong learning: TraIning teachers in competence based education" approach aims to support teachers at bridging the gap between policy and practice on a European scale.

In this paper we present the current state of Competence-Based Learning (CBL) policy and practice in Greece, the results from the needs analysis study, the design and localisation of the Training Framework and Environment based on the collected responses and the specifications set from the Greek Curriculum, the user/community support services that have been developed, as well as indicators from the user exploitation of these services and feedback collected by users with the use of online questionnaires and interviews.

2. STATE OF THE ART

According with TALIS Report 2013 (OECD, 2014) the types of professional development activities undertaken 12 months prior to the survey in descending order are:

courses/workshops with a percentage of 71%, participation and presentation in education conferences (44%) and the third highest rate surprisingly enough is through participation in a network of teachers formed specifically for the CPD of teachers (37%). These data needs to be considered in the design of teachers CPD Programmes. Below follows a short description of two current initiatives active in the field of teachers' CPD under which the specific research has been undertaken.

Current initiatives

In line with the EU objectives the improvement and quality of teacher education can have a positive impact on the development of students' competences (Official Journal of the European Union, 2007). In order to achieve this, a pilot teachers training methodology has been developed on the didactics and e-assessment of key transversal competences following a holistic view of students learning, going beyond subject boundaries and finding application in a wide spectrum of curriculum subjects. The TRANSIt approach contributes to the development of creativity, intercultural and multilingual competences, social development, and "learning to learn" competences. TRANSIt aims to contribute towards the improvement of the quality of competence education by improving teachers' awareness and professional skills regarding the didactics and e-assessment of the key competences with the use of ePortfolios, and supporting them to bring European and national policies into practice. The overall approach is based on the methodological principles of participatory design with the user groups in the development of the training framework. To this end, stakeholders' needs analysis was performed in order to identify the obstacles in the process of introducing innovative approaches in teaching practice and to identify enablers that will effectively support such interventions.

With an aim to foster innovation in the classroom Open Discovery Space (ODS) project tries to engage teachers, parents, content designers, policy makers in numerous meaningful online communities of peers who create, share, discuss and rate resources, ideas and experiences. Furthermore, a crucial development would be to bring the ODS Communities of Practice to the next level: to the formation of the Virtual Schools on different thematic areas and strong networks of practitioners and teachers-as-content-designers, working in similar fields. Below we will present the synergies between the two initiatives towards the delivery and creation of a community around CBL.

Current state of CBL in Greece

In this section we focus on specific aspects about current policy and practice regarding CBL activities in Greece. First, we give an overview of the features from the educational system that may have an impact in current practice. Then, we present the results of needs analysis.

Policy

The method by which competences have been introduced in the education system varies among countries. Some have introduced these approaches through adaptations of the curriculum, whilst others have done it through legislative change (Gordon, et al. 2009). Greece is such an example, where in the school year 2011-2012, pilot curricula for competence driven education based on the National Life Long Learning Strategies for the 'New School' of the Greek Ministry of Education have been introduced.

Needs analysis

LimeSurvey was used for the administration of the online questionnaire aimed at identifying the profiles of the possible participants in training activities, the current implementation of CBL teaching and assessment, as well as training needs. The link for the survey was made available through the etwinning mailing list by the National Contact Service. In the survey 648 responses were collected in total. The survey is analytically presented in Riviou & Sotiriou (2013).

User profile

From the participants, 196 (30%) were men and 452 (70%) women with the majority in the age range of 41-51 years old. Respondents are mostly teachers in secondary education (74,80%) and primary education (48,60%). The next group of participants with highest representation are School leaders (11%), Teachers' trainers (10,40%), Pre-service Teachers with percentage of 3,60%, Curriculum developers and Educational Policy Makers (1%), each, whereas other roles were 3,40%. The majority of respondents have a more than 15 years' experience in their profession. Regarding usage of ICT, the highest percentage defines themselves to be "Enthusiastic on the use of ICT" (56,64%), while those claiming to have taken part in continuing professional development (CPD) activities on the theme of competence acquisition was (55,25%). There is a wide and varied spectrum of training activities, mostly around technology enhanced learning; use of Web2.0/social media tools, training for implementing projects, and creative drama activities/creativity techniques.

Current implementation of didactics and assessment of key competences

Throughout the survey, participants reflected on their own competence on teaching and assessing transversal key competences. Participants feel most confident about teaching digital competence (49%). Additionally, a great percentage of participants mention the collaboration with colleagues for the design and implementation of cross-curricular projects, as crucial factor. Regarding the assessment tools/methods that teachers mostly use ePortfolios and Rubrics have the lowest levels of use with percentages of 57% and 52% respectively. In general, teachers report a lack of knowledge about competence-based assessment techniques.

Training needs

Data collected on training needs is consistent with the current implementation of CBL. The most important item is "Didactics and teaching methods" and most particularly regarding the themes applied throughout competences: critical thinking, creativity, initiative, problem solving, risk assessment, decision taking, and constructive management of feelings. The second most required training need is competence-based assessment. Participants are particularly interested in learning about specific tools to assess competences. Regarding the activities/methods to be incorporated in training workshops, participants expressed their high interest primarily for Demonstrations of tools and instruments (60,80%), Practical assignments (56,20%) and then

Examples of good practices (53,90%), demonstrating the need to undertake hands-on training.

Training Framework

The TRANSIt Teacher Competency Framework defines the criteria from which it will be possible for a teacher to determine how competent they are in didactics and e-assessment of transversal key competences (using rubrics). A competence framework is a model that broadly defines the blueprint for 'excellent' performance within an organisation or sector. The frameworks that influenced its design were the UNESCO ICT Competency Framework for Teachers (United Nations, 2011) and the Western Australia Teacher Competency Framework (Western Australia Department of Education, 2009). The TRANSIt Competency Framework comprises of four dimensions and three stages. The four dimensions are:

1. Facilitating Student Learning
2. Assessing and Reporting Student Learning Outcomes
3. Engaging in Continuing Professional Development
4. Establishing Partnerships and Collaborations.

Each stage identifies standards in the use of skills, knowledge and attitudes/values according to the dimension being used by the teacher. Teachers at any stage in their career may operate in different stages or parts of all stages. As teachers identify areas for improvement in particular competencies, it is recommended that they seek CPD to address a specific competency or part of a competency, visiting the respective areas of the TRANSIt training course.

Based on the needs analysis survey the Training Framework has been designed in a modular format, so that it could be localised with an approach inspired by constructivist methodologies. Teachers taking the course or course modules will be handled as learners participating in authentic learning activities; also creating and using e-Portfolios as part of their learning process. This is supported by the tools and features of the TRANSIt learning environment. A combination of open source tools has been chosen; Moodle for delivering the training resources and Mahara as eportfolio tool. In addition, collaboration is supported as teachers have access to the Open Discovery Space (ODS) portal to access and publish learning resources and competence based learning scenarios created in the course of the TRANSIt program. Below follows the suggested assessment process for CBL.

Regarding assessment in order to be authentic, TRANSIt proposes the use of eportfolio with a rubrics combination, in two levels, in teachers' training, as well as for the classroom practice. Eportfolios is a means where learners might collect the evidence of their choice in order to demonstrate the achievement of the educational goals and desired competences. Rubrics are suggested for peer and self-assessment. Mahara is suggested to be used in two levels for teachers' training/competence development, as well as students' projects in Upper Secondary School. Teachers are trained and supported to use the Mahara eportfolio tool with their students working on projects, e.g. upper secondary school as set by the national curriculum. Rubrics are suggested to be used by teachers for evaluating the teams, as well as students' eportfolios and activities, according with the guidelines set by Matsagouras (2011). The approach towards supporting

teachers in designing learning scenarios is to provide exemplar templates or descriptions which can be shared, re-used and adapted to different contexts. Below follows short description of the approaches for KCA.

3. DIDACTIC APPROACHES PROMOTING COMPETENCE BASED LEARNING

According with the literature among the didactic approaches that promote competence acquisition are: project based learning, the storyline approach, guided discovery, action learning, Problem based learning, Co-operative learning and Inquiry learning. A review by the EPPI-Centre at the Institute of Education, University of London (2005), found that and collaborative professional development was linked with a positive impact upon teachers' repertoire of teaching and learning strategies, their ability to match these to their students' needs, their self-esteem and confidence, and their commitment to continuing learning and development. They also found evidence that such professional development was linked with a positive impact upon student learning processes, motivation and outcomes. On the other hand, recent studies highlight the value - in terms of professional development - of engaging teachers as learning designers (Sagi & Kali, 2014; Voogt et al, 2012; Voogt et al, 2013). To this end, in order to support the design and sharing of user generated scenarios, suggested templates describing pedagogical approaches promoting KCA, as well as specific cross-curricular competence based scenarios and lesson plans have been developed as demonstrators and a source of inspiration for teachers.

Development of templates, scenarios and lesson plans

The most of the approaches have been already described in the format of a template therefore the Storyline approach was documented as a template by Riviou (ODS D4.3) and became available on the ODS Authoring Tool in order for teachers to be supported in the development and sharing of their own competence oriented educational resources, with an aim to ensure that all above approaches are provided to the community in the form of a template. As a next step, templates have been populated with resources leading to the production of scenarios. Such example of Scenario is the "3d printing of a minoic vase"[1] with linkage with the National Curriculum. Numerous e-Resources have been used as active links, for the facilitation of community members.

Supporting the community

The key to effective professional development is finding a way to organise qualified teachers, so they can collaborate with their colleagues. Collaboration and exchange of practices needs to be encouraged through training. The specific Parent Community is a Professional Development and Innovation Seeking one. Multilingual sub-communities have been created for users support (EL, NL, ES, FR). Moreover, with an aim to support the engagement of teachers as learning designers a series of online, as well as offline events have been delivered. A short description follows as well as the dates of events delivery, since these events have a great impact on the community (fig. 1-7).

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[1] http://portal.opendiscoveryspace.eu/el/educational-scenarios/270

Events/Community support mechanisms

In the case of Greece at the time of writing the following programme has been designed and delivered: provision of the online pilot course, as well as face to face training workshops that would take place in Athens, as well as in Patras. Participants in every case were given instructions on the dedicated TRANSIt Greek Community on ODS portal[2].

Face to face training events

The summer school 2013 (July 2013) focused on practices fostering competences. Best practices on CBL were presented and ICT tools were used. The participants developed their own learning scenarios with the Octopus learning design tool[3] and uploaded them to the summer school community, a sub-community of TRANSIt. Moreover, workshops have been implemented in the following dates, 24th June 2014, 1 & 3 July 2014. Invitation for participation in the online as well as the offline events has been delivered through the etwinning mailing list. The dates that the newsletters have been circulated are: 17/6/2014, 6/8/2014, 4/9/2014. The impact of these activities is depicted in the following graphs.

Online training events

The webinar "Evaluation and ICT integration in project based learning" was held on 23/06/2014. Guidelines for the conduction of the webinar have been announced on the TRANSIt Greek Community on ODS Portal. More than 170 people have registered on the event page of the webinar and the webinar recording on YouTube has currently more than 1.150 views. This shows the value of such activities as well as the great flexibility that online CPD offers.

Contest

As the NESTA Challenge Guide states "Prizes are thriving in the context of opportunities for connection and collaboration offered by the internet and social media[4]. To this end, a Contest has been organised among the members of the TRANSIt Greek Community the period 1/6-9/7/2014. The contest winner has been granted the attendance of the five-days Summer Course 2104.

4. INDICATORS

In the following section indicators about the TRANSIt Greek Community that currently has 555 members are presented. The tools providing analytics data developed by the portal developers has been used with the use of specific queries. The Analytics tool, that is developed in the context of the ODS project, provides the necessary and proper mechanisms and user tools for following, collecting and analysing statistical information for the ODS portal and supports monitoring of four main elements: (a) the importance of the resources, (b) the user engagement and participation, (c) the community progress and "status" and (d) the evolution of the portal. In the following figures the dates of the events have been marked with an asterisk, showing the impact on the community lifetime.
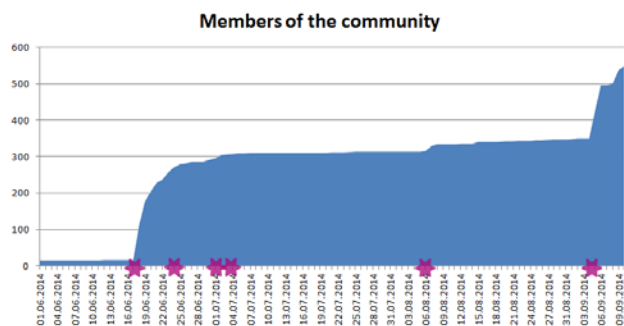
[2] Κατάρτιση εκπαιδευτικών στην εκπαίδευση για ανάπτυξη ικανοτήτων, http://portal.opendiscoveryspace.eu/community/katartisi-ekpaideytikon-stin-ekpaideysi-gia-anaptyxi-ikanotiton-184334
[3] http://learn.ced.tuc.gr/octopus/
[4] http://www.nesta.org.uk/publications/challenge-prizes-practice-guide

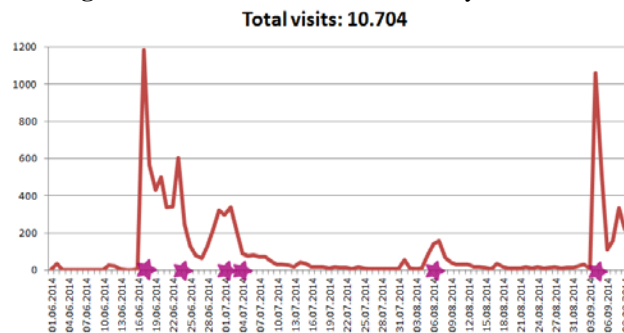**Figure 1:** Greek TRANSIt Community members
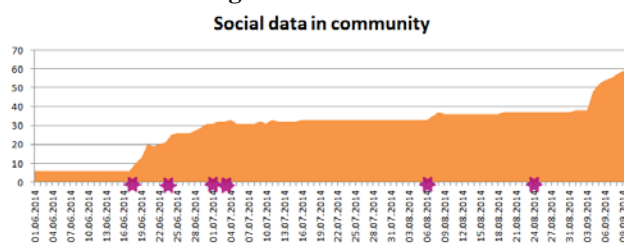

Figure 2: Total visits

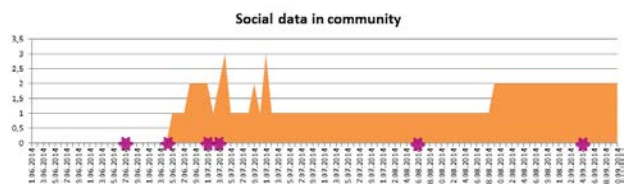**Figure 3:** Social data in Greek TRANSIt Community

Figure 4: Social data on the resources of the Community (e.g. tags, bookmarks, comments etc.)

Figure 4 presents the impact of the events in the social tagging of the educational resources created and shared by trainees/participants.
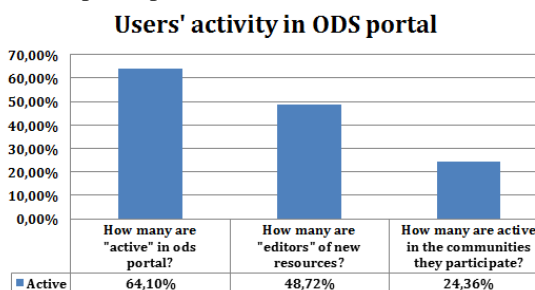

Figure 5: Contributions per registered user

Participants are partly hesitant in sharing their educational resources (fig. 5); therefore such a culture needs to be promoted. Table 1 presents the number of page views in the Community, the average session duration, the number and rate of revisits. The revisit rate is quite high (44%), showing the interest of members in "consuming" data

taken the fact under consideration that the analysis timeframe is not the ideal one (summer school break).

Table 1: Community Views

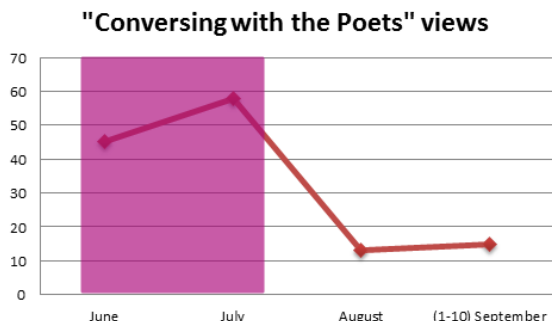| Page	Views	Average Session Duration	Revisits	Rate
TRANSIt Greek Community	8.429	111,35	3728	44%

Figure 7: Contest winner scenario views (contest period 01/06-09/07/2014)

Regarding the Contest winner scenario views (fig. 7) the biggest percentage of views is during the contest period, there is a drop during the period that schools are closed, but the encouraging element is that early September with the school year opening the rate is increasing again. Moreover, the submitted learning scenarios are competence based cases and can act as demonstrators for the rest of the community members.

5. EVALUATION RESULTS FROM USERS

Organisational aspects such as the venue, the programme and the materials of the training activities/events, as well as the actual training content have been assessed. The main areas covered were awareness, didactics, and assessment of Transversal Key Competences, as well as the impact of the pilot training activities.

Assessment tools
The tools used were a user satisfaction questionnaire and an interview guide. The questionnaire was filled in by 142 participants and 11 interviews have been conducted.

User profile
Regarding participants' profession, 59% of participants were secondary education teachers, 32% primary education teachers, 5% head teachers, 1% teacher trainers and 1% other (educational psychologists, etc) with 37% having more than 15 years of experience Participants graded their satisfaction with organisational aspects of the webinar, as well as the face to face workshops on a five-point Likert scale from 1 (very bad) to 5 (excellent). Overall, the mean value of overall assessment of all implemented events completed by 142 teachers is 4.33 in the scale of 5 that is a rather satisfactory result.

Data from interviews
Interviews conducted allowed gaining deeper knowledge on specific aspects of CBL, as well as a way to record the impact of the training programme.

Awareness of Transversal Key Competences
All interviewees state that as a result of the events they have increased their awareness on transversal key competences, the skills/horizontal themes that exist in all

(critical thinking, communication, creativity), as well as the ways that Transversal Key Competences affect their current practice.

Professional skills and knowledge on didactics of Transversal Key Competences
Generally, participants have gained useful knowledge and skills on didactics of transversal key competences. They can see how educational practices based on project-based learning can help them to design and implement learning scenarios that foster students' competences.

Professional skills and knowledge on e-assessment of Transversal Key Competences
Two teachers believe that e-assessment of competences is a difficult task and ICT tools are a means for focusing and aiming at competence acquisition for 21st century citizens.

Impact
Participants are rather satisfied about the best practices/scenarios demonstrated, as well as about the skills they developed regarding planning, structuring and sequencing cross-curricular learning activities with ICT tools. Especially, the interviewees highlight the value of learning how to share resources and practices and collaborate with other teachers. More specifically, those that have been interviewed are generally in favour of participating in an online community in which teachers share and collaboratively design competence-based learning scenarios.

6. CONCLUSION

In general, the EU is prioritising the improvement of the quality of teacher education so as to have a direct effect upon levels of students' acquisition of competences. Therefore, the professional development of teachers and their training is a key requirement for the way forward (European Commission, 2010). Our needs analysis confirms that, given the limitations imposed by the official curriculum in Greece, teachers are generally motivated to make a paradigm shift towards CBL. The profile of the participants demonstrates that there is a strong interest especially by secondary education teachers to get trained and exchange practices within peer networks and communities of practice. This is aligned with the literature findings that the situation is even worse for teachers of secondary education since their training has not prepared them for the most part for holistic methods and cross-curricular teaching, although primary teachers may have more expertise in CBL approaches (European Commission, 2009a).
The preference of teachers and head teachers to learn primarily from demonstration of tools and instruments, practical assignments and examples of good practices, demonstrates the need of stakeholders to undertake hands-on training, and that teachers need support in their everyday practice. TRANSIt training framework and environment designed has been presented. TRANSIt environment has been designed with use of open source tools, as well as the Open Badge Infrastructure, as a mechanism for accrediting teachers. TRANSIt training content includes specific examples/good practices and tries to address the training needs with an emphasis on assessment methods and tools, also by taking into

consideration European reports (Redecker, 2013), as well as the national context requirements set by the Greek Curriculum.

The key to effective professional development is finding a way to organise qualified teachers, so they can collaborate with colleagues. Collaboration and exchange of practices needs to be encouraged through training, let alone since participants refer to the benefits of collaboration with colleagues. Events such as contests and webinars and wide dissemination of such activities have proven to be a valuable tool for the support and population of these communities. The fact that there are many newcomers during the summer period is very encouraging, but it's early enough to come to conclusions regarding the use of the portal. Time is needed so that a new user proceeds from the basis of consuming content to the process of contributing. The feedback we got though from the interviews conducted so far is that teachers would be eager to contribute their resources on the portal. As shown by contributions per user (fig. 5), participants are quite hesitant; therefore such a culture needs to be fostered. Further work remains measuring the impact of the CPD materials with analysis of qualitative and quantitative characteristics of user-generated open educational resources (OER) content uploaded in the dedicated community and sub-communities on ODS portal, as well as teachers' competence development after their participation in pilot training activities and events and being members in professional development communities.

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DESIGN ON MOOC FOR MANDATORY UNIVERSITY COURSE AT UGD

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Abstract: *As a result of the rapid development of new technologies nowadays, there are lots of new trends in higher education. Massive open online courses (MOOCs) are one of them. MOOCs are online courses aimed at unlimited participation and open access via the web. This paper discusses this MOOC trend and its implementation in higher education. Moodle is one of the platforms used for creation of MOOCs. In the paper we are also explaining the use of Moodle platform at University "Goce Delcev" (UGD) - Stip and we are discussing about what is necessary for one course to be MOOC; so we are comparing the characteristics of MOOCs with the course Computer Science that we are creating on Moodle aimed for the UGD students. Also, we are explaining in details the procedure of designing a MOOC, and show how these steps are applied in the creation of our course. At the end we conclude that the design of a Massive Open Online Course is not easy and that many factors should be taken into consideration and sometimes many people are included. But, anyway, the trend of the Massive Open Online Courses is present now and his appearance will grow even more in the future.*

Keywords: *E-Learning, MOOC, Moodle, Computer science*

1. INTRODUCTION

The continuous development of new technologies has brought new challenges for the higher education. The development of the Internet has played the main role in bringing new ways of communication and information sharing. Different kinds of digital platforms (like Moodle) are now part of peoples' everyday lives and have significantly improved the availability of data from all fields.

These trends haven't bypassed the higher education. The wide use of computers and the Internet have made distance education easier, faster and available to a big number of users from any part of the world. Distance programs become more popular with the beginning of the new century and their popularity grows every day. Another trend associated with higher education emerged in 2008, with the creation of the first Massive Open Online Course, "Connectivism and connective knowledge", by George Siemens and Stephen Downes [11].

2. WHAT IS A MOOC?

Massive open online course or MOOC is an online course aimed at unlimited participation and open access via web. MOOCs integrate social networking, accessible online resources, and are facilitated by leading practitioners in the field of study. In addition to traditional course materials such as videos, readings, and problem sets, MOOCs provide interactive user forums that help build a community for students, professors, and teaching assistants.

There are two kind of MOOCs: xMOOCs and cMOOCs. xMOOCs is a business model, while cMOOCs is a pedagogical model. Also, xMOOCs usually have a higher education institution behind them (and, in some instances, a for profit corporation) and cMOOCs have groups of people delivering the course. From these, we can see that xMOOCs are more significant for higher education, because they are closer to the traditional education i.e. face to face education.
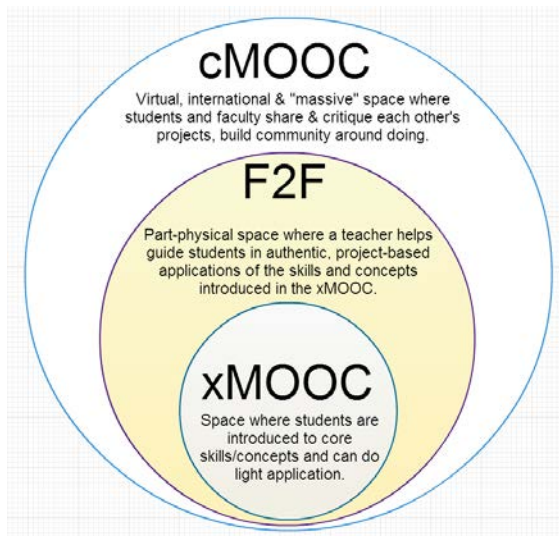

Image 1 Retrieved from [16]
http://www.educause.edu/blogs/mcaulfield/xmooc-communities-should-learn-cmoocs

3. WHAT IS MOODLE LMS?

Moodle LMS is one of the most popular Learning Management System. A big reason for that is that it's open source and it is customizable. The LMS can be used to conduct courses online or to support face-to-face teaching and learning. Moodle is a learning platform designed to provide educators, administrators and learners with a single robust, secure and integrated system to create personalized learning environments in which they will manage online learning and online training. It can also be extended with modules for assignments, quizzes, grading, certification, social and collaborative learning in an engaging manner. And also, we can use Moodle as platform for creating MOOCs.

The first Moodle site was developed in November 2001. Since then Moodle has grown to become a powerful set of learner-centric tools and collaborative learning environments that empower both teaching and learning. The philosophy of Moodle includes a constructivist and social constructionist approach to education. Constructivism means that people actively construct new knowledge when interacting with their environments, while constructionism asserts that learning is particularly effective when constructing something for others to experience. Social constructivism extends constructivism into social settings, wherein groups construct knowledge for one another, collaboratively creating a small culture of shared artefacts with shared meanings. This philosophy basically emphasizes that learners, not just teachers, can contribute to the educational experience.

Moodle is used by variety of institutions and individuals including: universities, high schools, primary schools, government departments, healthcare organizations, military organizations, airlines, home schoolers, independent educators etc. There are tens of thousands of registered Moodle sites; however it's impossible to know the exact number of sites, since Moodle is an open source, free to download and distribute, and doesn't force registration on its users. The popularity of Moodle is due to many factors like: the ease of use, the support for teaching and learning, it's free with no licensing fees, it's always up to date, it's available in more than 120 languages, it's highly flexible and customizable, scalable to any size, robust, private and secure, you can use it anytime, anywhere and on any device, it has extensive amount of resources available, it's backed by a strong community etc.

4. USE OF MOODLE AT UGD

Starting from September 2008 until today (August 2014), at University "Goce Delcev" in Stip, exists an e-learning system, which uses the Moodle 2.7 platform. Over the years this system has become popular for both professors and students, and therefore its services are increasingly utilized. Initially the system served only for posting news, learning materials and test results, but today it is used for online exams, seminar assignments, surveys, discussion forums and it enables a 24 hour interaction between students and professors.

Our goal is to create a MOOC for the subject Computer Science at UGD. Computer science is a mandatory subject for all departments, except for the Faculty of Computer Science. The course is taught in the first semester, the format of the classes is 2+2+1, and it adds 6 credits. It is taken from approximately 3500 to 4000 students annually. The University Senate decided that this course should be taken online, because of the big number of students who take it, and with the goal of achieving better results. The traditional way of teaching the course has shown that only 10% of students who take it actually finish it. With the new electronic way of taking the course and having exams, it is expected this number to grow and even achieve 100%.

On the Moodle platform there is already a Computer Science course which is adequate and active. This brings up the question, is this course a MOOC or not?

4.1. WHETHER THE UNIVERSITY COURSE ON MOODLE IS MOOC OR NOT?

For a course to be MOOC, first of all it needs to be massive, that is to have a large number of users. It needs to be open, with free registration, available to anyone, with free content (videos, documents etc.) and with no paying fee. It needs to be online, which means available anytime, anywhere in the world. The MOOC needs to possess all the features a course should have: continuity, beginning and end, credits, own identification (ID), lecturer, group of students, assignments and feedback.
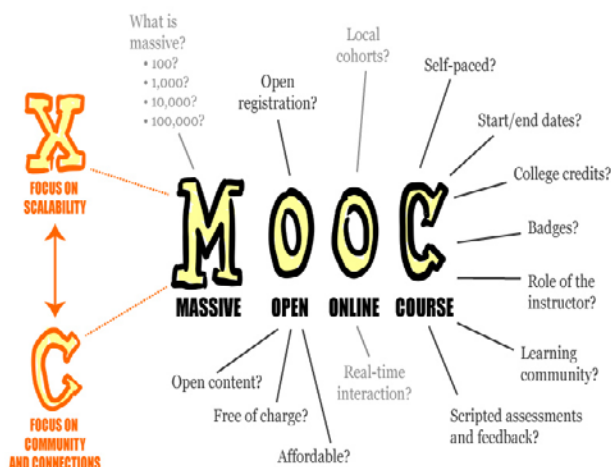

Image 2 Retrieved from [11]
http://en.wikipedia.org/wiki/MOOCs

To answer the question whether our course is MOOC or not, according to characteristics we mentioned, we give the following conclusions:

- Our course is massive. This is supported by the fact that the course is taken by 3500 to 4000 students annually.
- There is a deviation from the rule that the course should be open with free registration, free content, free of charge and available to anyone. Our course only partially meets these requirements because it is available and open for registration just for the students of UGD, which

have already paid the participation and enrolment costs. For these students all of the course content is free and available.

- The course is online and accessible anytime (24/7) and anywhere for the registered users.
- Last, but not least, the course possesses all the features a course should have.

According to these we come to conclusion that our course is only partially MOOC, because it is not free and available to anyone, but meets all the other requirements.

5. DESIGN AND IMPLEMENTATION OF MOOC FOR THE SUBJECT COMPUTER SCIENCE

In this part we will explain the procedure of designing a massive open online course and its implementation for the subject Computer Science. The procedure is as follows:
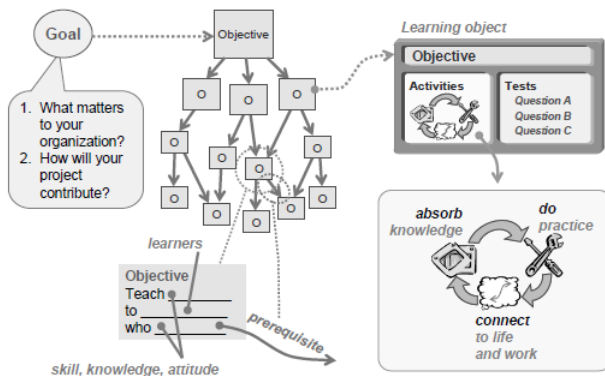
Image 3 Retrieved from [15]

I. At first a **subject (topic)** about the course is chosen and **the goals** of the course are decided. Our chosen subject is Computer Science and the main goal is "students to gain knowledge trough e-learning and to pass the exam in bigger percent".

II. The next step is defining of course **objectives**. The course objectives include:

1) Definition of the course **audience** – Computer Science is a compulsory University subject, which means that if it's present in the study program, all the students from that study program at the University should take it. At UGD Computer Science is present in all the study programs, except at the Faculty of Computer Science, and it is taken by 3500-4000 students annually.

2) Some **prerequisite** about enrolling the course may or may not exist. For university subjects preconditions are usually passing an exam of another subject or enrolling into the semester etc. The main condition students should fulfill for taking the Computer Science course, is to be enrolled into first semester of studies.

3) **Defining course lecturers**. In addition to the main lecturer (the course creator) there should be at least one or two people who will assist him in the job. This is mainly because the courses are massive and online, so studying materials should be regularly uploaded and updated, assignments should be created, and feedback given about them, participation in the discussion forums is sometimes necessary etc.

The lecturers of the Computer Science course are one professor and two assistants. The professor uploads the studying materials for the course, defines the deadlines for the assignments and term papers and deals with the final grading of students. The assistants check the assignments and term papers take part in the discussion forums and are the main people for students to contact if they need help with the course. The presence of the lecturers in the course should be minimal, i.e. they need to monitor the events and to be active, but not dominant in any way.

4) Defining the **learning object** of the course which includes a) **Testing** and b) **Course activities**.

a) **Tests.** Whether we call them tests, assessments, quizzes, drills, examinations, competence monitors, or demonstrations of mastery, they, nonetheless, remain essential for gauging a learner's progress. The Computer Science course has electronic tests with 4 types of questions (matching, true/false, rounding and multiple choice) and so far this method has proven to be very effecting for evaluation. Here are some reasons for testing. Some are good, and some are not.

Table 1 Good and bad reasons for testing

Good reasons	Bad reasons
Let learners gauge progress toward their goals.	Fulfill the stereotype that all e-learning courses have tests and all tests are unpleasant.
Emphasize what is important and thereby motivate learners to focus on it.	Reinforce the instructor's power over learners. Pay attention or else.
Let learners apply what they have been learning—and thereby learn it more deeply.	Torture learners. Training is supposed to be painful. Tests can ensure that it is.
Monitor success of parts of the e-learning so that the instructor and designers can improve it.	Artificially bolster learners' self-esteem by giving them easy tests with gushingly positive feedback.
Certify that learners have mastered certain knowledge or skills as part of a legal or licensing requirement.	Use a testing tool you paid a lot of money for.
Diagnose learners' skills and knowledge so they can skip unnecessary learning.	You can't think of any other way to add interactivity.

b) Course activities. Course activities include assignments, proposal topics for papers and proposal topics for projects. The Computer Science course has 9 assignments like: discussions on given topics; adding a new word in the dictionary of terms; making a presentation with pictures and effects; attaching a text document prepared in Microsoft Word; and making a print screen of a sent email. One of the activities is the creation of reading materials (pdf and doc files, power point presentations etc.), uploading useful links to additional studying materials and creation of short videos. Further, within Moodle we have implemented the Big Blue Button module, which allows interesting ways of presentation.

The videos can be in form of lectures (given by the lecturers), tutorials/demonstrations (resolving a problem step-by-step), interviews with experts in the field of the courses' topic, discussions on the topic etc. The videos should be short (10-15 minutes), so they can keep the listeners attention. It is important to mention that tutorials are better if they are written on board step-by-step, instead of making print screens from every step.

There are three general types of activities:
- Absorb activities - are activities during which the learner reads, listens, and watches.
- Do activities - Exercise, experiment, and discover.
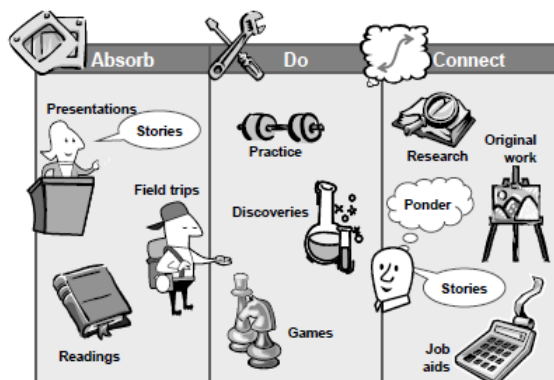- Connect activities - Link to prior learning, to work, and to life.

Image 4 Retrieved from [15]

Absorb-type activities
Absorb activities are the ones closest to pure information. They usually consist of information and the actions learners take to extract and comprehend knowledge from that information. In absorb activities the learner absorbs some of the knowledge offered by the content. Several types of absorb activities which are established in conventional education and have made the leap to online learning are:

- **Presentations** during which learners watch or listen to a slide show, demonstration, podcast, or some other organized explanation. They are analogous to a classroom lecture or an explanation by an expert.

- **Story telling** during which the teacher tells a story relevant to the subject of learning. Story-telling activities relate individual human experiences. They make information real and personal.

- **Readings** include activities for which the learner reads from online or paper documents, such as textbooks, research papers, or technical manuals.

- **Field trips** take us to educational examples and intriguing displays. Field trips include activities for which the learner visit museums, parks, battlefields, zoos and greenhouses, archaeological digs, manufacturing plants, and ancient ruins, historic sites, and other places to examine many relevant examples. Although the learner may be physically active on a field trip, the learner learns by absorbing information.

In our course we often use a presentation and readings. Sometimes we are telling a story, but we do not use a field trips.

Do-type activities
While absorb activities provide information, do activities transform that information into knowledge and skills. They elevate learning from passive reading and watching to active seeking, selecting, and creating knowledge. In do activities, learners discover, parse, decode, analyze, verify, combine, organize, discuss, debate, evaluate, condense, refine, elaborate, and, most importantly, apply knowledge. Common types of do activities are:

- **Practice activities** give learners experience applying information, knowledge, and skills. They include drill-and-practice, hands-on, guided-analysis, and teamwork activities. Practice helps learners strengthen and refine skills, knowledge, and attitudes by applying them and receiving feedback.

- **Discovery activities** are times for experimenting and exploring. Their goal is to lead the learners to discover concepts, principles, and procedures for themselves. They include virtual laboratories, case studies, and role playing activities. Discovery activities do not present ideas, but lead learners to discover ideas on their own.

- **Games and simulations** allow learners to practice tasks, apply knowledge, and infer principles—all while having fun. These activities include quiz show games, word puzzles, jigsaw puzzles, adventure games, software simulations, device simulations, personal-response simulations, mathematical simulations, and environmental simulations. Games and simulations let people learn by playing.

The course Computer Science offer a practice activities like guided-analysis and teamwork, discovery activities like case studies and some kind of games and simulations (quizzes, word puzzles).

Connect-type activities

Connect activities lead learners to link what they are learning to prior learning and to situations in which they will apply the current learning in subsequent courses or on the job. Connect activities range from simple stop-and-think questions to complex real-world work assignments. Here are types of connect activities that have proven themselves in classroom and online learning:

- **Ponder activities** require learners to think deeply and broadly about a subject. They require learners to answer rhetorical questions, meditate about the subject, identify examples, evaluate examples, summarize learning, and brainstorm ideas. They are typically used for connecting to what the learner already knows.

- **Stories told by the learner** require learners to recall events from their own lives and to draw on their own experiences. They require the learner to connect the subject of learning to personal experiences.

- **Job aids** are tools that help learners apply learning to real-world tasks. As such they help connect learning to work. They include glossaries, calculators, and e-consultants.

- **Research activities** require learners to discover, identify and use their own learning resources. They require accessing and interpreting outside resources.

- **Original work** requires learners to perform genuine work and submit it for critique. It fully connects learning to the life of the learner.

After course completing, the student will be able to answer rhetorical questions, meditate about the subject, identify and evaluate examples, summarize learning, and brainstorm ideas, also will be able to connect the subject of learning to personal experiences, interpreting outside resources, to perform genuine work and submit it for critique.

III. The next thing is defining **the length and duration** of the course. Our course is 14-15 weeks (or one semester) long and the number of classes is 2+2+1 or 6 hours a week.

IV. Defining **accreditation and certification**. Since the course is a compulsory University subject, after the successful passing of the exam, the student gets a grade and specified number of credits. The number of credits for Computer Science is 6.

V. The **interaction** during the course can be written or face-to-face.

a) Written interaction. This type of interaction is facilitated by discussion forums, blogs, email messages or social networks. The participants in the written interaction must have an internet connection.

b) Face-to-face interaction. This type of interaction is desirable but not necessary for every course. The face-to-face interaction is present in our course, with possibility for the students to have a direct consultation with the professor or to visit classes and exercises.

VI. **Promotion** of the course to the general public and sharing it through social networks and email is also very important for increasing the number of students and the interest for the course.

VII. **Repetition and improvement** of the course. After one group of students finishes with the Computer Science Course, the course continues to exist and it's ready for the new students. The forum has a thread for recommendations and suggestions, where students can post ideas for improving the course functionality in the future.

Име на курсот
- Информатика
- задолжителен универзитетски предмет

Цели на курсот

Слушатели
- Студенти запишани на прв циклус на студии

Предуслови за упис
- упис на семестар и платена партиципација

Предавачи
- Професор
- Асистент 1
- Асистент 2

Присуство на предавачи
- активно
- не доминантно

Објекти за учење
- Тестирање
- електронско тестирање
- Активности
- апсорбирачки
- практични
- поврзувачки

Image 5 MOOC for Computer Science

6. CONCLUSION

As we have shown in our paper the design of a Massive Open Online Course is not easy at all. Many factors should be taken into consideration and sometimes many people are included. Anyway, the trend of the Massive Open Online Courses has been going up since their appearance and it has the potential to grow even more in the future. This is especially important for the higher education institutions that want to stay up to date and offer modern and quality education to their students. Creation of MOOCs enables customization of studying and inclusion of more students. It is also important for the University staff because it lets them learn new pedagogical techniques, gain significant experience in the use of modern technologies, which also leads to enhancing the traditional methods of teaching.

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BOOSTING - A METHOD FOR IMPROVING THE ACCURACY OF PREDICTIVE MODEL

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Abstract: *In this paper, some models for predicting students' performance in the final exam have been shown. Applying special machine learning techniques and algorithms more accurate classification/predictive models can be obtained. Analyzing generated models the specific administrative and demographic data that most influence students' performance in the course Introduction to programming that is performed in Faculty of Electrical Engineering in East Sarajevo were identified. The models were created using WEKA data mining tool.*

Keywords: Educational data mining, Classification, Predictive model

1. INTRODUCTION

The highest quality in performing the teaching process should be the priority task of any education institution. One of the key factors for quality assurance of teaching process is its organizational strategy and educational institutions should pay special attention on it. To create a good organizational strategy it is necessary to have available as many as possible data about students for whom the teaching process will be organized. Efficient analysis of those data would provide information for teachers and management of educational institution in order to perform maximal adoption of teaching process to the needs of students who will attend it. In this way students' motivation and learning outcomes could be significantly improved. Information systems of educational institutions store large amounts of data about students. Some of those data are more or less important but as a whole they contain potentially useful information and knowledge about the students. In order to gain that knowledge it is necessary to perform the efficient processing of those data. One efficient way for performing that process is applying data mining techniques.

Data mining involves techniques for discovering implicit patterns in the data that could provide new knowledge. Input data for applying data mining techniques are presented in the form of a set of examples, and the output can be expressed in the predictive or descriptive form of the analyzed data structure. Data mining is a multi-disciplinary field involving machine learning, statistics, databases, artificial intelligence, information retrieval, and visualization [1]. There are four the most common tasks used in data mining applications: supervised learning (or classification), unsupervised learning (or clustering), association rule mining, and sequential pattern mining. Each of them is characterized by different styles of learning but all of them provide necessary guidance for better understanding of analyzed data and some useful knowledge about connections between input and output data. One of the most commonly used data mining task is creation of classification or predictive model. It is desirable for generated models to have as higher as possible the accuracy of classification and prediction. In addition, it is also desirable for the model to be present in the form of some comprehensible formalism and to be easily interpretable by those users who are not data mining experts.

Data mining applied for analyzing the data that come from different types of educational environments present special research field known as Educational Data Mining (EDM) [2]. EDM analyzes the unique types of data generated by any kind of information system that is used for supporting learning or education. These data can be generated through interactions of individual students with an educational system but they might also include administrative data (e.g. school, school district), demographic data (e.g. gender, age, school grades), data about student affectivity (e.g. motivation, emotional states), etc. [2]. The main objective of educational data mining is to extract implicit and useful patterns or to obtain useful knowledge about the ways students learn and factors that affect their learning. Different data mining models can be implemented to evaluate students' performance. Analyzing those models it is possible to identify some connections between data and the factors that have key influence on students' achievements. That knowledge can help teachers to get proper understanding of student's learning capabilities and provide useful guidance for improvement of teaching process.

In recent years a lot of research in the field of educational data mining was performed. An overview of the current state and the progress made in the development and implementation of educational data mining is given in [2]. In [3], the ranking of factors that influence the prediction of academic performance in order to identify students who will need to study harder to pass the exam was performed by the application of data mining methods. Applying different data mining classification techniques for predicting the marks in the final exam of the students that use Moodle courses has been shown in [4]. Using clustering analysis comparing of two algorithms for measuring the potential of students' academic skills has been done in [5]. The impact of the certain e-learning tools on the achievement of students' objectives is discussed in [6]. A survey about the application of data mining to web-based electronic courses and learning content management systems was performed in [7].

In this paper, some models for predicting students' performance in the final exam has been shown. Applying special machine learning techniques and algorithms more accurate classification/predictive models can be obtained. Analyzing generated models the specific administrative and demographic data that most influence students' performance in the course Introduction to programming that is performed at the Faculty of Electrical Engineering in East Sarajevo were identified. The models were created using WEKA data mining tool [8].

The rest of this paper is organized as follows. The main characteristics of applied data mining methods and techniques are described in second section. The third section describes input data for creating classification/predictive model. Performed experiments are described in fourth section, and fifth section provides conclusion remarks and outlines directions for future work.

2. CLASSIFICATION AND BOOSTING

One of the most common tasks used in data mining applications is the classification. Classification is type of machine learning analogue to human learning from past experiences to gain new knowledge in order to improve our ability to perform real-world tasks [1]. Computers using machine learning learns from data which are collected in the past and represent past experiences. In most cases classification is used for learning a target function that can be used to predict the values of a discrete class attribute, e. g. classification is one type of predictions methods. The goal of prediction is to infer a target attribute, predicted variable, from some combination of other aspects of the data or another attribute. Classification here means the problem of correctly predicting the probability that an example has a predefined class from a set of attributes describing the example.

A lot of different classification algorithms have been developed, but the most popular are so called "white-box" classification algorithms. They provide an explanation for the classification result and their results are directly suitable for decision making. Among those algorithms one of the most popular is C4.5 decision tree algorithm. Decision tree based algorithms predicts outcomes using a series of questions and rules for data classification. The decision tree branching occurs as a result of meeting the requirements of classification issues. Each question will divide data into subsets that are more homogeneous than the senior set. If the question has two answers, then the response to the question arise two subsets (binary tree). Subsets arise according to number of questions answers. Therefore the classification of certain data are carried out. Predicting the behavior of a particular client can be made on the basis of its belonging to a particular event (which is classified based on a number of issues and conditions), for which we know how it acts. During the construction of decision trees is important to know the right questions. The classification results obtained by applying C4.5 algorithm is usually very comprehensible, but drawback can be pretty low accuracy of predictive model - those classifiers are usully pretty weak.

Special kind of classification learning is so called ensemble learning which includes techniques based on combining different models learned from the data [9]. Applying these techniques several different training sets are derived from original training set and for each of them a classification model is learned. The ensemble classifier combines these models and produces one ensemble of learned models. In that way, relatively weak classifier can be transformed into very powerful ensemble classifier. These techniques are particularly suitable for applications with so-called unstable learning algorithms like Decision tree and Neural networks [9]. Unstable learning algorithms usually produce quite different classification results even if only small changes in the input data happened. From the perspective of ensemble learning classifier these instabilities are desirable: combining multiple models makes sense only if these models are different from one another.

One of the most frequently used and very powerful ensemble machine learning scheme is boosting. Boosting can be applied for creating classification model and predictive accuracy of generated model is very often significantly higher than the one obtained using a single model. For creating single classification/predictive model boosting uses voting: it combines classification results obtained performing classification algorithms of the same type over different subsets of training dataset. Boosting is iterative process in which each new model is influenced by the performance of models that have been built previously. It creates single prediction combining the outputs of individual models using voting together with weighting. It gives greater weights to those instances that haven't been handled correctly performing previous models. In that way, boosting forced every new model to try to obtain correct classification result for those instances. Combining voting and weighting on each test instance more reliable prediction can be obtained in most cases.

There are many variants on the idea of boosting. Two the most commonly used are AdaBoost.M1 developed by Freund and Schapire (1996) and LogitBoost algorithm developed by Friedman et al. (2000) [9], [10].

One of the drawbacks of ensemble learning techniques is loss of interpretability of the obtained classification/predictive model. In recent years some methods that combine the performance benefits with comprehensible models have been developed. Some of them produce standard decision tree models while others introduce new variants of trees that provide optional paths [9]. All of them are part of so called Interpretable ensembles. One approach for creating a single tree structure that can represent an ensemble of classifiers compactly can be done if the ensemble consists of decision trees. The result of this approach is called an option tree. Option trees differ from decision trees in that they contain two types of node: decision nodes and option nodes. For classifying an instance it is necessary to filter

it down through the tree. At a decision node just one of the branches has to be taken but at an option node take all of the branches have to be taken. In such way, the instance ends up in more than one leaf, and the classifications obtained from those leaves must somehow be combined into an overall classification. This can be done simply by voting, taking the majority vote at an option node to be the prediction of the node [9].

Option trees can be generated by incrementally adding nodes to it. This is commonly done using a boosting algorithm and this is one of the approaches implemented in Weka data mining tool. The resulting trees are usually called alternating decision trees instead of option trees. In that case, the decision nodes are called splitter nodes and the option nodes are called prediction nodes [9]. The standard alternating decision tree applies to two-class problems. A positive or negative numeric value is associated with each prediction node. To obtain a prediction for an instance it has to be filtered down all applicable branches and sum up the values from any prediction nodes that are encountered. Depending on whether the obtained sum is positive or negative the predicting class is generated. Alternating decision trees always have a prediction node at the root. The alternating tree can be grown using a boosting algorithm that employs a base learner for numeric prediction, such as the LogitBoost method, and can be extending for solving the multiclass problems by splitting the problem into several two-class problems [11].

3. INPUT DATA FOR CLASSIFICATION

For the purposes of this study, administrative and demographic data of students who have attended the Introduction to Programming course were collected and their impact on students' performance was analyzed. This course is performing during the summer semester of the first year of study at the Faculty of Electrical Engineering in East Sarajevo. Randomly sampling, the data of the 2013/14 generation of students from all three study programs that are running at the Faculty have been taken into account. Open source data mining tool WEKA [8] was used to apply the learning methods to a dataset and analyze their output to extract useful information about the data and their impact on students' performance. The data collected, which represent the attributes for data mining process, include:

- city from where students came (*city*),
- high school they graduated (*school*),
- obtained mark of subject mathematics in all four high school years (*m1, m2, m3, m4*),
- obtained mark of subject informatics in all four high school years (*i1, i2, i3, i4*),
- average mark of subject mathematics in high school (*matav*),
- average mark of subject informatics in high school (*infav*),
- graduated average mark in high school (*hsav*),
- points obtained on the faculty qualification exam (*test*),

- total number of points collected for enrolment to faculty (*total*),
- enrolment period (*enroll*),
- way of financing the study period (status) ,
- department (*depar*),
- average mark obtained on passed exams at the beginning of second semester (*exam_av*),
- number of passed exams at the beginning of second semester (*exam_num*),
- obtained mark on 6 subject performed during the first semester (*eng1, math1, fct, phy, fee1, man*),
- obtained mark in the course Introduction to Programming (*mark*).

The last attribute was used as a class attribute.

To be able to apply data mining techniques, it was necessary to pre-process input data. In the initial stage of pre-processing step the attributes that have no predictive value are identified and discarded (the index number, student name, and so on). By manually discretization process [2] a numerical values which represented the marks obtained on six subject performed in the first semester are transformed into two nominal values, passed or failed, and the final grade of class attribute 'mark' were transformed into the same nominal values (grade 5 – failed, grades 6, 7, 8, 9, 10 - passed). Excel .csv file is formed of these data and exported to WEKA data mining tool.

Three experiments were conducted and performance and results of obtained classification models were analyzed.

4. EXPERIMENTAL RESULTS

The first experiment was performed applying J48 decision tree classification algorithm which is Weka implementation of above described C4.5 algorithm. The obtained results are shown in Image 1. The classification accuracy which is the number of correctly classified instances in the test set divided by the total number of instances in the test set was used as a measure for estimation the strength and the accuracy of a classification/predictive model.
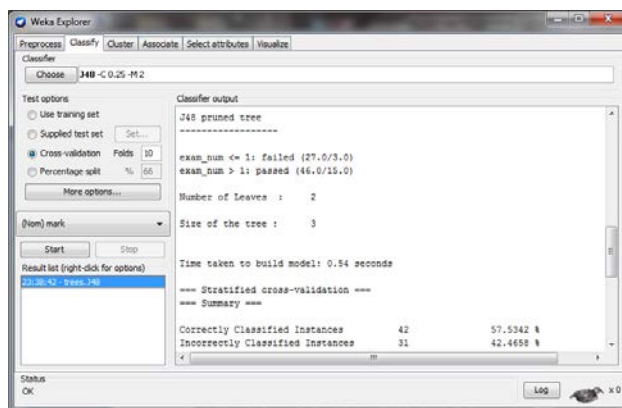

Image 1: J48 classification results

From Image 1 it can be seen that relatively low accuracy is obtained, 57,53% correctly classified instances. Generated tree is shown in Image 2.
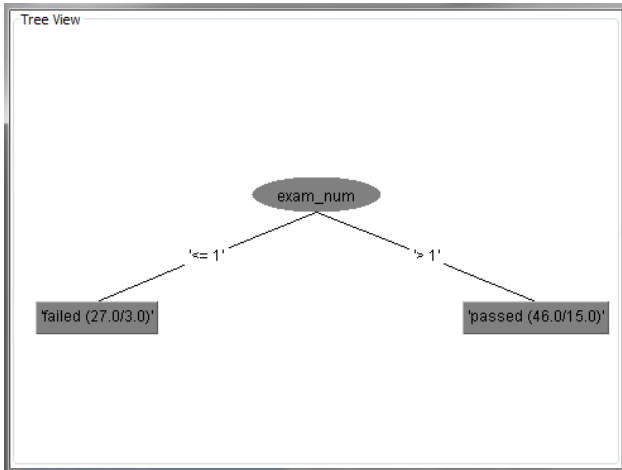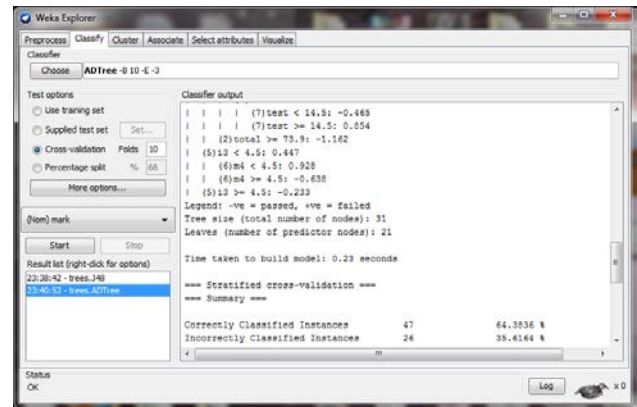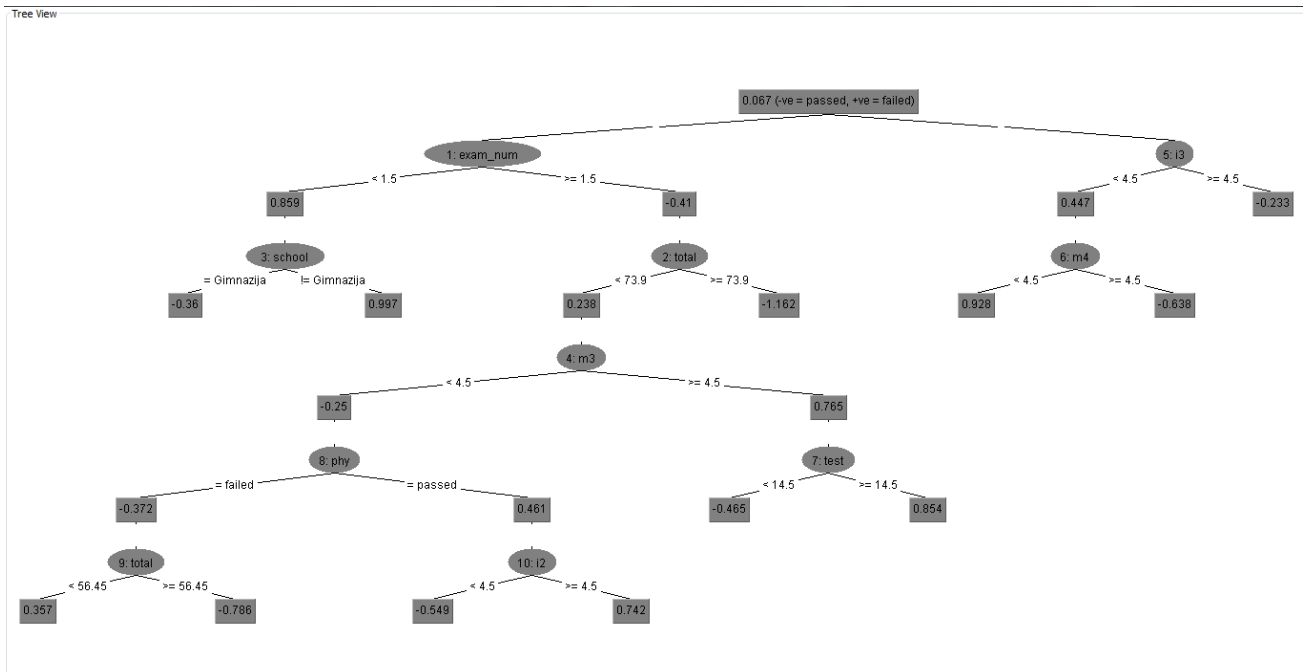
Image 2: J48 decision tree

From Image 2 it can be seen that attribute *exam_num*, the number of the exam passed until the beginning of the second semester is identified as a key tree splitting attribute. The numbers in the brackets present the total number of instances of that class/the number of misclassified instances of that class. It can be seen that the number of misclassified instances of passed class is pretty high. Even though obtained tree is very comprehensible the obtained result cannot be suitable for any further use.

Higher accuracy of classification model can be obtained using decision trees implemented using powerful boosting technique. One of Weka implementation of alternating decision tree is so called ADTree interpretable ensemble. The classification results obtained using ADTree is shown in Image 3.

Image 3: ADTree classification results

From Image 3 it can be seen that better accuracy is obtained, 64,38% correctly classified instances. Generated tree is shown in Image 4.

Image 4: ADTree alternating decision tree

From Image 4 it can be seen that alternating decision tree with splitter nodes and prediction nodes is created. This tree is not easily interpretable and to obtained classification result for every instance of data set it has to be filtered down the tree as it was mentioned above in this paper. To classify an instance we have to go down the tree according to the values of its attributes and sum up the numerical values from any prediction nodes that are encountered. The predicted class depends on the obtained sum value: if that value is positive the class is failed, and the class is passed if obtained sum is negative, as it was explained in the first, base prediction node shown in image 4. From Image 4 it can also be seen that the same splitting attribute *exam_num* is again chosen, but in this case, more attributes are includes in tree decision making process and that is why better classification results is obtained. Loss of interpretability is price for that.

The third experiment is performed using another Weka interpretable ensemble classifier: even more powerful alternating decision tree performed using LogitBoost algorithm. The obtained results are now much better, Image 5.
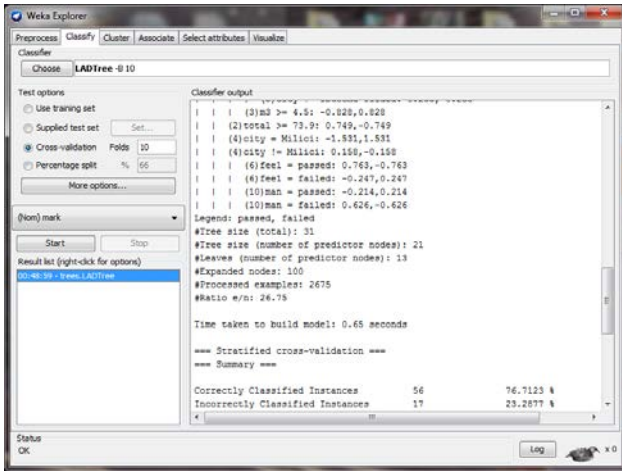

Image 5: LADTree classification results

High accuracy of 76,71% is now obtained, which present very good classification result, but method for computing the class of particular instances using this tree is even more complicated than for the standard alternating decision tree [9]. Generated tree is shown in Image 6.

From Image 6 it can be seen that again the same splitting attribute *exam_num* is chosen as the most important one for decision making. Comparing trees obtained performing ADTree and LADTree algorithms a few attributes are identified as very important for decision making in both methods (*exam_num, total, test* and *m3*). These attributes are important for early identification of different groups of students, especially the ones who have low possibility to pass the exam (*exam_num* < 1.5). This information can be very useful to the teacher in order to try to pay more attention to those students and try to adapt the teaching material to motivate them to study more. In addition, from generated trees it is obviuos that there are some attributes that never show up in decision making process. The futher experiments have to be performed in order to determine whether these attributes present unnecessary noise and to make a conclusion whether they need to be a part of input data set or not.

It is obvious that so called ensemble learning classifier are very powerful data minig tools. The lack of easy interpretation of their classification results is a serious obstacle to their massive use and focus of future research should be a way to translate their result in the form that will be easily understood by non-expert data mining users.

Image 6: LADTree alternating decision tree

5. CONCLUSION

The main goal of this paper was to investigate the possibilities for creation as much as possible more accurate predictive model for one educational data set. One of the advanced machine learning techniques, boosting and its algorithms has been analyzed. Performed experiments have shown that quite satisfactory predictive result can be obtained. The main drawback of analyzed algorithms is pretty hard interpretation of the obtained classification results. The main goal of future research should be seeking the ways to translate obtained results on some easily understandable formalism.

One of the goals is also to investigate what impact on created models could have their combining with some pre-processing techniques applied on input data like filtering or select attributes in Weka implementation.

All the performed experiments were conducted using default values of boosting algorithms' parameters. Changing the number of boosting iteration and their impact on accuracy of predictive model can also be the subject of future work.

LADTree is multiclass algorithm so that it can be applied on this input data set with more than two classes, and some guidance for more precise grouping of students could be obtained.

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SCORM VS COMMON CARTRIDGE - CASE STUDY AT UNIVERSITY GOCE DELCEV

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Abstract: Education is the driving force in every state and the most of the investments are directed towards improving the educational process and increasing the quality of education. University "Goce Delcev" in Stip also invests quite a lot in the education process and for 8 years the University has been using the Moodle platform for e-learning. Over the years the sharing of courseware and supplementary materials is becoming even more important, as open content and courseware initiatives are expanding worldwide (the University "Goce Delcev" in Stip also has needs to use those tools that enable greater interoperability and reuse of content). In this paper, our research and analysis are directed towards the: crucial part of the process of creating courses and learning objects (will use the courses for informatics from Moodle platform at the University) and solving one of the biggest problems in e-learning systems (possibility of re-use of content), using the specifications for packing – SCORM and Common Cartridge.

Keywords: Learning management systems, learning objects, "Goce Delcev" University, SCORM, Common Cartridge, packing tools

1. INTRODUCTION

Education is the driving force in every state and the most of the investments are directed towards improving the educational process and increase the quality of education. The main reason for the development of the new technologies in the education process was to facilitate the communication between teachers and students, to save money and time. In the past decade, the major investments were aimed at developing software for the management of complex databases that are combined with digital frames and objects for managing curriculum, working materials and testing students. This technology is known as a Learning management system LMS. As part of the University "Goce Delcev" in Stip there is a special center - Centre for E-Learning systems in which develops the E-learning education (use and maintain the LMS Moodle platform). Platform of Moodle at the University "Goce Delcev" has got 17,405 users, 2114 courses which are grouped into three main categories: undergraduate subcategories 15 (study programs), postgraduate studies with 14 subcategories and doctoral studies. This platform greatly facilitates the communication and work between teacher and students.

In this paper, our research and analysis are directed exactly towards the: crucial part of the process of creating courses and learning objects and solving one of the biggest problems in e-learning systems - possibility of reuse of content. In our case we use the Informatics course from Moodle to make our analyses and package. In order the created course to be implemented in different systems, LMS, we use special specifications that enable packaging of the courses and inclusion of all standards in a .zip document, which means greater flexibility and interoperability. In this research we will do a detailed analysis of the specifications of SCORM and IMS Common Cartridge that enable packaging of the courses and represent a long-term solution of the problems. Their main feature is interoperability, which enables reuse, less cost and greater flexibility. This functionality will be presented with practical testing of existing course in the Moodle platform by using the tools Mos Solo and eXe.

2. LEARNING MANAGEMENT SYSTEMS AND LEARNING OBJECTS

A learning management system (LMS) is a software application or Web-based technology used to plan, implement, and assess a specific learning process. Typically, a learning management system provides an instructor with a way to create and deliver content, monitor student participation, and assess the student performance. A learning management system may also provide students with the ability to use interactive features such as threaded discussions, video conferencing, and discussion forums.

The main benefits from LMS are:

- Manage and track staff training with an LMS:
  Training administration can be time-consuming and difficult, particularly in medium to large organizations with many staff working in different roles across a variety of physical locations.
- Consolidate all training information into one system:
  There are significant benefits to having all your training information in a single, consolidated system. At a glance you can review and report on the status of

company-wide training programs, identify staff who have completed certain qualifications, and much more.

- Facilitate e-learning with an online learning platform: Much has been written about the benefits of e-learning, and while an LMS is not essential to implementing online learning it can often make it easier to manage and deploy.
- Reduce training costs with an LMS:
  While achieving the right training outcomes is critical for talent development and training programs, it goes without saying that cost is always top-of-mind.

A learning object is "a collection of content items, practice items, and assessment items that are combined based on a single learning objective". "The object must be complete unto itself to allow a user to easily apply it." - Art Zygielbaum, University of Nebraska, Lincoln. [13] [7] The Institute (IEEE) defines a learning object as "any entity, digital or non-digital, that may be used for learning, education or training". Most alternative interpretation is given by Stephen Downes: Learning object must be, at least, a digital resource. It must contain pedagogical intent. And finally, that what makes something a Learning Object is not what it is, but rather, how it is used. [13] It can be said that e-learning systems and learning objects represent a revolution in education and learning methodologies.

Moodle is one of the LMS platforms that is popular worldwide and we use this platform in the University „Goce Delcev"- Stip, Republic of Macedonia. Moodle (acronym for Modular Object-Oriented Dynamic Learning Environment) is a free software e-learning platform, also known as Learning Management System, or Virtual Learning Environment. There are quite a few different types of tools on the market ranging from web-based or installed screen recorders to PowerPoint plug-ins, right up to full-featured content authoring tools (in many cases LMSs include a primitive authoring tool for basic content manipulation. LCMS technology can either be used in tandem with an LMS, or as a standalone application for learning initiatives that require rapid development and distribution of learning content. In the section below we make an analysis of two techniques and we will make a particular example of the objects for e-learning, (in our case the specifications of SCORM and IMS Common Cartridge), using the Mos Solo and eXe tools (in order to make a comparison between them and to determine the basic functionalities).

LMS has the following features:
- *Accessibility*: The ability to locate and access instructional components from one remote location and deliver them to many other locations.
- *Adaptability:* The ability to tailor instruction to individual and organizational needs.
- *Affordability:* The ability to increase efficiency and productivity by reducing the time and costs involved in delivering instruction.
- *Durability:* The ability to withstand technology evolution and changes without costly redesign, reconfiguration or recoding.

- *Interoperability:* The ability to take instructional components developed in one location with one set of tools or platform and use them in another location with a different set of tools or platform.
- *Reusability:* The flexibility to incorporate instructional components in multiple applications and contexts.

3. WHAT IS SCORM

SCORM is the acronym of "Shareable Content Object Reference Model" and is a widely-used reference model for e-learning content. SCORM is a set of standards and protocols that make sure that a given training content is classifiable, traceable and reusable in various LMS training environments or platforms. SCORM was created in 2000 in its 1.0 version by ADL (Advanced Distributed Learning), a department of the American Ministry of Defence.

A SCORM training object includes META information which describes its content and its functions in such a way that the platform or environment that hosts it is able to index and catalogue it within a training library or a search system. The SCORM organizational structure is composed of several components: Assets, SCOs, Aggregations, and Organizations. The possibility of testing and sequencing the content is an additional feature and advantage in SCORM. The professor can have a detailed overview of the student's work progress, evaluate his knowledge, engage in discussion forums, and also the student receives feedback about his activity in the course.

SCORM does not provide any guidance on any functional or instructional elements that make up and define the content, like learning objectives, assessments, or knowledge checks, and it does not dictate the formatting or look and feel of screens and the elements on them. Also, it does not dictate any particular organization of content information. All of these design decisions are still completely up to the instructional designer.
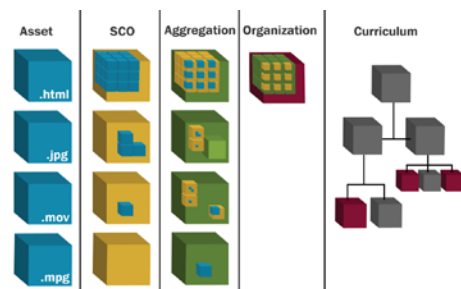

Image 1: SCORM course structure

The SCORM Run-Time Environment (RTE) handles requirements for launching content objects, establishing communication between learning management systems (LMSs) and shareable content objects (SCOs), and managing the tracking information that can be communicated between SCOs and LMSs. SCORM provides technical standards for the structure of e-learning courses. The purpose of these standards is to facilitate interoperable reusability and individualization that SCORM affords. ISDs need to pay attention to how to

structure SCORM learning modules (aka Sharable Content Object or SCO; described in Assets, SCOs, & Aggregations).

Sequencing is similar to the ISD term "branching" in a way that it describes and prescribes the manner in which learners receive content. In SCORM, the "branching" is directed by the sequencing rules your programmer creates, based on your design. Based on these rules, the learning management system (LMS) sequences are all shareable content objects (SCOs).

Image 2: Sequencing in SCORM

The easiest and recommended way to create a SCORM content package is by using a template. A template is a conformant SCORM 2004 content package (zip file) consisting of a simple course structure with HTML files that can be modified and extended to create your course. It typically includes a helper JavaScript file, sometimes called the API Wrapper, which makes using the SCORM API (see Understanding the SCORM API) easier for the programmer to use.

Templates are typically provided by the community and may implement instructional design patterns. For the purposes of this document we will use a simple starter template provided by ADL located. The structure of the starter template is simple. It contains a single SCO followed by an aggregation of 2 SCOs. There are tools available to create content packages or you may choose to create them from scratch. Some authoring tools will create the entire content package after you load your SCOs and assets into the tool. The ADL version of the RELOAD is an example of such a tool. RELOAD provides a graphical interface for creating a content package and managing sequencing and other values contained in the manifest file that is described below. Ensure that the tools you select match the knowledge, skill, and ability levels of the team members who will use them. This guide will not go into much detail on tools as there are many variations in functionality.

4. WHAT IS COMMON CARTRIDGE

Today, a publisher has little motivation to put their content into the format of a new, emerging platform. In addition, sharing of courseware and supplementary materials is becoming even more important, not less so, as open content and courseware initiatives are expanding worldwide. Exchange and customization of quality course materials in a way that is efficient for teachers and faculty is a key need to improving education opportunities worldwide. Common Cartridge has the ability to enable

that scenario. Common Cartridge is a set of open standards developed by the IMS member community that enables interoperability between content and systems Common Cartridge solves two problems. The first is to provide a standard way to represent digital course materials for use in online learning systems so that such content can be developed in one format and used across a wide variety of learning systems (often referred to as course management systems, learning management systems, virtual learning environments, or instructional management systems). The second is to enable new publishing models for online course materials and digital books that are modular, web-distributed, interactive, and customizable (Image 3). Common Cartridge was designed to provide a standard way to package and protect content, as opposed to each publisher or each learning management system creating a proprietary method of protection and enforcement.
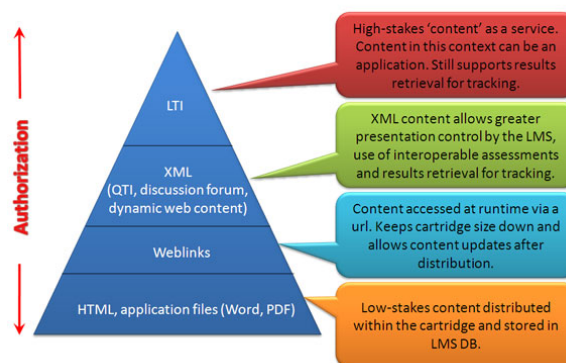

Image 3: Common Cartridge Content Hierarchy

Complementary materials in Common Cartridge are available as .zip files that can be created or downloaded from the publisher's site. Cartridge allows a standard way to represent the digital learning materials. The Learning objects are created in a way that they can be: reused, interoperable, durable, affordable, easy to maintain and adaptive. Common Cartridge was designed explicitly to obtain much higher levels of interoperability than SCORM. This was done by removing the run time component associated with SCORM and by achieving agreement on specific subsets (often referred to as application profiles) of widely used specifications. Because of the previously discussed native understanding of questions and tests, the content of a Common Cartridge is not a "black-box" as in SCORM, and therefore does not need a run time interaction for tracking or sequencing. Common Cartridge, therefore, enables learning platforms to "compete" the sequencing and reporting options they can support, based on the sophistication of the assessments.

The manifest is composed of four sections: metadata, organizations, resources and authorizations. The Metadata section is used to store the cartridge metadata restricted to a loose binding of LOM elements based on the Dublin Core (DC) specification.
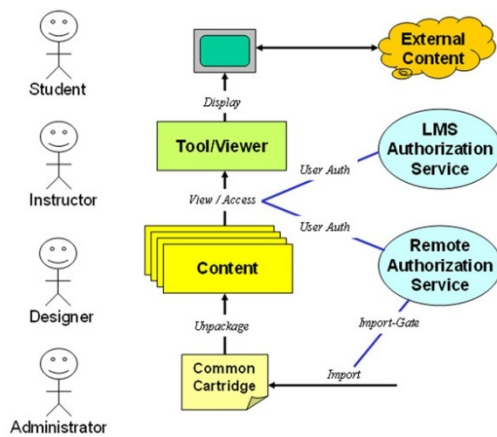
Image 4: Common Cartridge Benefits

Advantages of common cartridge:

- Greater choice of content: Enables collections of learning resources of various types and sources to be accessed with greater ease to enable the personalization of learning experiences.
- Reduces vendor/platform lock-in: Establishes course cartridge native formats endorsed by educational publishers, and supports a wide variety of established content formats, thus eliminating platform lock-in.
- Greater assessment options: Explicitly supports the Accessible Portable Item Protocol and Question & Test Interoperability standards for exchanging assessment items.
- Increases flexibility, sharing and reuse: Fits within the educational content of enabling instructors to assemble lesson plans of various resources.

5. CONTENT PACKAGING TOOLS: MOS SOLO AND EXE - RESULTS

An authoring system is a program which has preprogrammed elements for the development of interactive multimedia software titles. There are various tools that can be used to create a digital content for e-learning. These tools will be analyzed in order to facilitate the work of professors at the University "Goce Delcev" in Stip and enable them to reuse the content.

The Professors in our University, can use the created curse in different environments and for different purposes. Unfortunately, most of them are not free software and the user or the company should buy the entire package to be able to use and create digital content. But there are also tools that are open source and also provide users a choice of features, capabilities and different interface. With these tools, the created content becomes more functional, interoperable and reusable. In the previous research, we analyzed more than 40 tools that are most frequently used for creating a digital content.

Special attention is given to the possibility of testing and different options offered by these tools. Planning the assessments is a key part of any design process. This year

the University "Goce Delcev" in Stip started a new project where all university courses will be tested with these tools through Moodle platform. In this paper we will practically test two tools: Mos Solo that is used to create SCORM packages and eXe that is used to create Common Cartridge packages. Their functionality will be shown through the existing course of informatics (course is part of the platform for e – Learning system at University "Goce Delcev" - Stip - the contents will be packed with both tools). Comparison will be made of the two tools - differences in content and interface.

5.1 MOS Solo

Mos Solo is a simple yet powerful authoring tool and content editor: it requires none or minimal training but offers the power of a sophisticated multimedia tool. It lets you create highly interactive, graphically appealing, and media-rich eLearning modules, with ease and efficiency: courses, quizzes, evaluations, demos. The content created and edited in MOS Solo can be uploaded with just one click onto a SCORM 2004 compatible LMS / LCMS platform. Designed by trainers for trainers, MOS Solo is ideal for travelling authors who are interested in creating and editing content, even when they are offline.

5.2 eXe

eXe is a eLearning XHTML editor, and it is a freely available authoring application that assists teachers in the publishing web content without the need to become proficient in HTML or XML markup. Resources authored in eXe can be exported to the web or LMS. The eXe project developed a freely available Open Source authoring application to assist teachers and academics in the publishing of web content without the need to become proficient in HTML or XML markup. Resources authored in eXe can be exported in IMS Content Package, SCORM 1.2, or IMS Common Cartridge formats or as simple self-contained web pages.
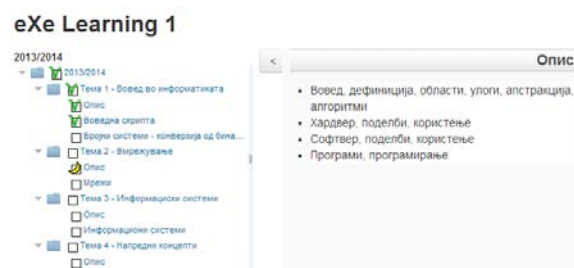

Image 5: eXe in Moodle

5.3 RESULTS

In our case we have the University "Goce Delcev", we use the Moodle platform and the courses for computer science (Computer science is a mandatory subject for all departments, except for the Faculty of Computer Science) to perform the packaging of content. Courses for informatics are divided into 11 different chapters that have different content and articles. The content is built from: 5 discussions, 5 PDF documents, 7 power point presentations, three open-solving exercises, a glossary of

IT terms, a list of blogs, and online testing. Students have special access for login participants, and lessons are divided according to the examination session. On the right panel student can see the latest news and changes in the course. (Image 8) The interface is very simple and easy to use and you can also do navigation on the content.

Table 1: Mos Solo vs. eXe in Computer Science course

Components of content	Mos Solo R1 040	eXe learning 1.04
Platform	Windows	Linux, Windows, Mac
Documents (Word, Excel, Power Point, PDF), RSS, Wiki Article	Yes	No
Images (jpg, png, gif), Media, Video (flash, mp3)	Yes	Yes
Java Applet	No	Yes
Windows Media, QuickTime, Iframe	Yes	Yes
Add Activity, Add Page, Quiz	Yes	Yes
Search and Replace, Media Browser, Tree Structure	Yes	No
Lesson, Single Question, Multiple Questions, Text Entry	Yes	Yes
Popup, Sequence, Hotspots, Drag and Drop, Slider	Yes	No
Virtual Classroom, message, blog, forum, chat, call	No	No

The table is presented: the tools were enclosed in content are marked with YES, and those that are not available are marked with NO. As you can see from the image, the content can be divided in chapters, and the chapters have separate lessons. In the left panel there is ability to perform navigation in content. We have included: all PDF files, word documents and power point presentations. Also the creator can add additional materials such as lessons, charts and other content images.

MOS Solo offers quizzes, testing and sequencing. The creator has a several options: multiple questions, single question, deferent choice, drag and drop, slider. Questions are portrayed randomly, and the students can play a quiz in real time. For any particular issue the students receives notifications if the answer is correct or not, and the program ultimately provides a set of points of the total score of the test.
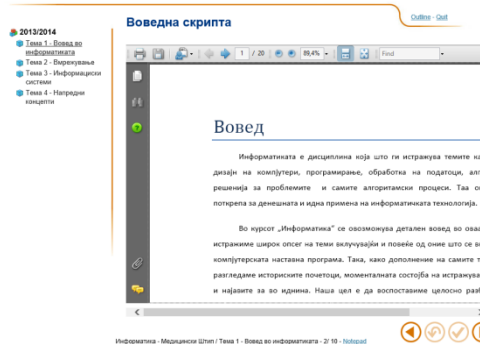

Image 6: Mos Solo in Moodle

As weaknesses of this tool we can specify the options that is used in the course of Moodle: possibility of discussions, forums, glossary, list of blogs, but in this version they are not available. Those characteristics and functionalities we can find in the version of Mos Chorus, link: http://www.mindonsite.com/en/produits/mos-chorus/ and the creator can use this program if he pays package.

Finally, we say that the Mos Solo has a very easy interface for use and just with a click on the desired lesson or article, the content appears on the screen.

We also tested the eXe of the existing course on informatics, but in contrast to Mos Solo, the eXe has less features and tools. This tool Content is divided in chapters, and the creator can put the appropriate materials. The lectures are divided as Activity and Case Study. This program can't directly import word document or PDF, but existing items can be created as a new item in the content. So all of the content in IT course we created in new articles. This program works on Windows, Mac and Linux operating systems.
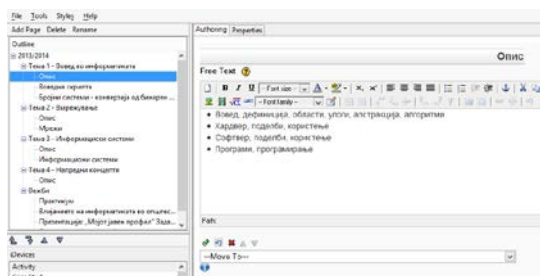

Image 7: eXe tool

eXe offers quizzes, testing and sequencing. The creator has a choice and options: multiple question, single question, deferent choice, drag and drop, slider. Other features are not enabled- this program is open source and we can create Common Cartridge and SCORM packages.
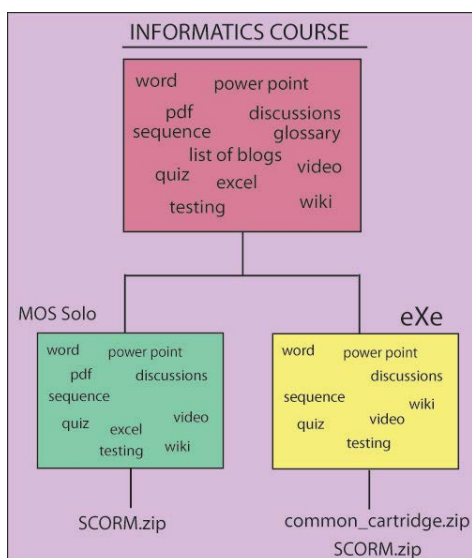
Image 8: Results of packing

6. CONCLUSION

As a conclusion of the analysis I would say that SCORM and Common Cartridge have their own advantages and disadvantages. SCORM can best be used in environments where students are communicating only through the computer, and the presence of the teacher is minimal (students often "work" in virtual classrooms, and communication with the teacher is online). SCORM has limited specifications and did not take account of the pedagogical aspects. There are various tools that can be used for packed, and they offer a high level of interoperability and functionality. The focus of Common Cartridge is interactive collaborative learning situations, typically with a teacher, professor, or instructor involved in guiding a cohort. The learning materials can be online, offline, or both - a situation often referred to as hybrid or blended learning. Common Cartridge may be used to facilitate self-paced online learning as well, but Common Cartridge was developed specifically to enable support the online or blended interactive and collaborative courses. Finally, I will say that our tools of Common Cartridge will find much more use (including elements of traditional education) in our University. Cartridge offers greater security and data protection. Common Cartridge was designed explicitly to obtain much higher levels of interoperability than SCORM. Because of the previously discussed native understanding of questions and tests, the content of a Common Cartridge is not a "black-box" as in SCORM. Common Cartridge provides more functionality than SCORM, but does so in a different way, enabling greater simplicity while increasing the functionality and learning scenarios that can be supported. In our educational environment - University "Goce Delcev", Common Cartridge will be much easier to implement and apply the curriculum.

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APPLYING SLOODLE VIRTUAL ENVIRONMENT FOR MEDICAL COURSE PREPARATION

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Abstract: The paper provides a new approach of using Sloodle environment in medical education through SPINE – FUNCTION AND DEFORMITIES course preparation. Some steps of course design, such as preparation and creation of 3D vertebra models are briefly described.

Keywords: e-learning, Second Life, moodle, sloodle, medical education, spine.

1. INTRODUCTION

Everyday activities such as orthopedics prediction, prevention, diagnostic and therapeutic involve existence of available data on the patient's condition, experience of the physicians and available resources (instruments, devices, fixators, implants, software, etc.) in order to be successful.

However physician is often not able to carry out these activities in the best possible way because the lack of information required for decision-making and/or planning the surgery.

Problem can be overcome by introducing course within Sloodle (Simulation-Linked Object Oriented Dynamic Learning Environment) environment [1], a software package which connects the web-based environment of Moodle [2] with the three-dimensional virtual world of Second Life [3]. It can be said that Sloodle connects Moodle system with Second Life virtual world into one Internet based three-dimensional tool for learning. Second Life comprehensive capabilities can significantly improve online courses of Moodle. Using Sloodle the world of Second Life can be used as alternative, three-dimensional Moodle client, which makes classic websites much more interesting [4].

Sloodle provides complete suite of tools that make the management of educational activities in Second Life much easier. Educators can use Sloodle to deliver educational materials or to collect feedback and assignment related to Second Life activities [5].

Sloodle provides two categories of tools:
- Educational tools:
  o Tools that allow users to work with Moodle activities in Second Life such as: Chat, Quiz, Choice, Glossary, Blog, etc.
  o Second Life specific tools, such as Sloodle Presenter which presents set of tools for creating mixed media Second Life presentations, Prim Drop tool for distribution and collection of Second Life objects.
- Enrollment tools: tools that checks users access permission for a virtual classroom, help in the registration process on Moodle site and enrollment in the appropriate Moodle course.

Regarding the above mentioned educational possibilities of Sloodle, it has been noticed the possibility of its application for the creation of the course for training of medical professionals who deal with pre-clinical and clinical practice in the field of orthopedics, concerning the spine and its deformity.

2. RELATED WORK

There are a large number of researches dealing with use of Second Life in education, but just few are treating the spine.

At the University of Auckland in [6] Second Life is used to simulate the emergency room where small teams of students can learn about appropriate ways to diagnose and treat patients whose condition requires urgent intervention. This project is presented to students in the third or fourth year of study.

The purpose of using Second Life at this university refers to the acquisition of skills of students in diagnostics, in situations that are simulated adequately and where students have to react in real-time. The advantage can be seen in reducing costs in the sense that students do not

need to travel to different locations. In addition, Second Life provides predefined cases, which in practice are not always available, as well as the collaboration of participants in problem solving, diagnosis and determining treatment. Image 1 shows an example of using Second Life in this university, where vital signs of patients can be seen.

Image 1: View of the vital signs of the patient [6]

Similarly, in [7] is shown an example of Second Life application in medicine education. A pioneer in the use of virtual environments for learning medicine is Ann Myers Medical Center. The center now includes a number of students, animators who invest time in the development of virtual scenarios.

Currently, the center has emphasis on the medical history of patients, examinations, and the specific situation in which students train. Image 2 provides an overview of part of the virtual training.

Image 2: Showing part of the virtual training [7]

According to [8], these application examples are categorized in the top 10 of the cases. Some of the most interesting are related to neurology shown in image 3, as well as the virtual space for people with disabilities shown in image 4.

Figure 3: Examples of virtual possibilities of Second Life (neurology) [8]

Image 4: Showing examples of virtual possibilities of Second Life (part for disabled people) [8]

There have been a small number of descriptive case-studies published on the use of Sloodle,

In [9] is shown Sloodle application, its main features, but it is presented in the manner of use of the above mentioned solutions in the areas of algorithms and programming. In contrast to this research, this paper describes Sloodle application in the field of medicine. Regardless of where the field is applied, it is necessary to use Sloodle in accordance with technological, didactic-pedagogical and social critical Training, as outlined in [10].

Although there are a large number of published research relating to the use of Second Life in medicine, few of them relates to the use Sloodle in medicine, and the authors did not find any work that would thereby related to orthopedics. The paper presents a new approach to application Sloodle environment that combining Moodle and Second Life allows users to systematically go through the area that is treated, in this case the functions and deformities of the spine.

3. OVERVIEW OF THE COURSE STRUCTURE

The course "Spine – functions and deformities" (image 5) has been created for the purpose of training medical staff

in pre-clinical and clinical practice. The topics are designed to systematically guide users through specific topics. Firstly, users are introduced to Second Life virtual world, secondly they recall their knowledge of the detailed structure of the spinal column, and finally through series of activities are focused on the different spinal deformities from which the emphasis is on scoliosis, kyphosis and lordosis.

The course is set within Moodle platform of e-lab system which belongs to Faculty of technical science Cacak, University of Kragujevac [11]

Image 5: Course "Spine – functions and deformities"

Second Life Island *College of Scripting, Music, and Science, Horsa* [12] is chosen to be the starting point for the course, noteing that purchasing or renting a land is planned for further course maintainance.

Within the "Spine – functions and deformities" course, the following topics are created:

- Second Life – introducing to virtual world
- Spine column – basic concepts
- Cervical vertebrae – review of their position and role
- Thoracic vertebrae – review of their position and role
- Lumbar vertebrae – review of their position and role
- Sacrum and Coccyx – review of their position and role
- Scoliosis – diagnosis, types, treatment
- Kiphosis – diagnosis, types, treatment
- Lordosis – diagnosis, types, treatment
- Comprehensive self evaluation

With the assumptions that medical staffs are not familiar with virtual worlds, first topic of the course gives basic guidelines for existence in Second Life. If the user is already familiar with the virtual world he/she can skip first topic. Users have to create avatars (a virtual

representation of themselves) and to acquire appropriate skills necessary to navigate through Second Life.

After successful accommodation to virtual world, user can access specific topics related to spinal column. User is expected to link his avatar to his Moodle account. This process is called "avatar authentication" or "avatar registration". There are different ways of doing this. In this course it is used Sloodle tool "RegEnrol Booth".

Each topic is organized in three sections: *learning materials, practice* and *additional materials.* Through *learning materials* users will renew their knowledge in the relevant field. Within these materials, beside text and video media, there are links to Second Life locations where 3D models of particular vertebrae (image 7), as well as 3D models of different spine deformities (in later topics) are placed.

Models are developed in CATIA software. Unlike most of other common models that can be created and easily imported to Second Life, models such vertebrae, consist of large number of areas which when uploading can lead to huge number of triangles and vertices in Second Life which cannot be linked in one model. This issue is resolved by introducing program Blender. When the model is inserted in program, through series of steps its number of triangles and vertices were reduced (image 6).
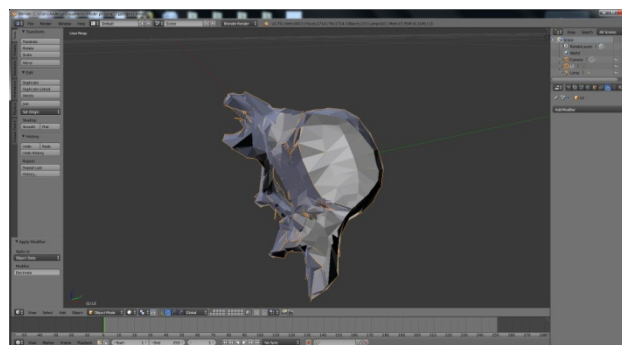

Image 6: Vertebrae model in Blender program

Process of uploading edited vertebrae model to Second Life than is same as any other object (image 7).
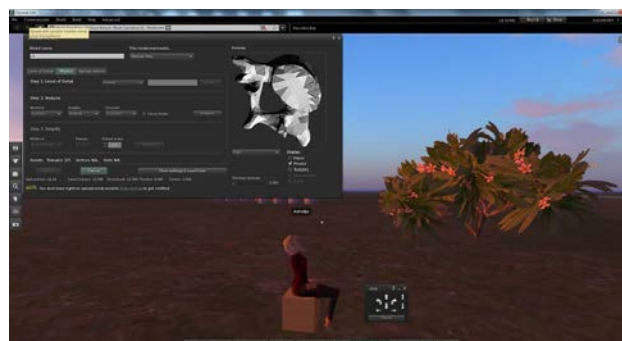

Image 7: Uploading vertebrae model from Blender to Second Life

Also, using Linden Scripting Language, which is Second Life programming language, models were given appropriate name (such, lumbar vertebrae – L5, etc), and they can be rotated and moved, which additionally enhance visualization.
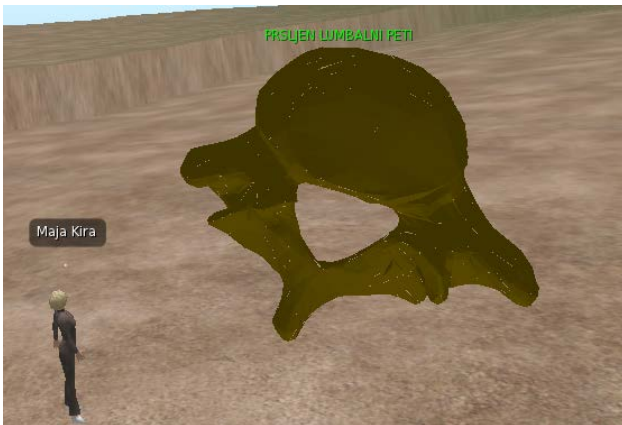
Image 8: Overview of fifth lumbar vertebrae in SL

Practice section contains tests and practical tasks that help users to test their knowledge. *Additional materials* contain useful links, terms and other assistance to the appropriate topic.

Within each topic following Sloode tools are used:

▪ WebIntercom which connects chat in Second Life to Moodle chatroom, thus allowing users who are in Second Life to communicate with those who are in Moodle, which is useful for those users who do not have access to Second Life at that moment. Given that WebIntercom-chat is synchronous activity, users can have chat sessions where they can discuss on particular issue.
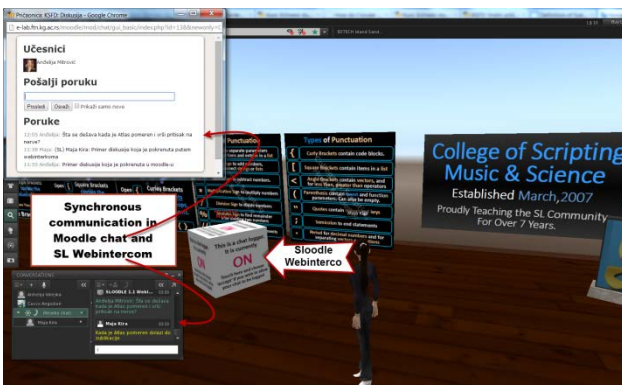
Image 9: Application of Webintercom tool

▪ MetaGloss is also one of useful Sloode tool, which allows access to Moodle glossary. Each topic has glossary which contains terms used in that topic.
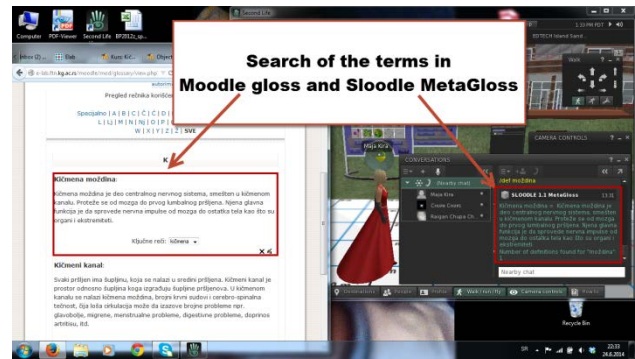
Image 10: Application of MetaGloss tool

▪ Quiz is Sloodle tool used for testing. Quiz can be accessed from Second Life or Moodle. Sloodle Quiz Chair is used for this purpose. Once the quiz is done in Second Life, the score can be seen by clicking on the quiz below (or even to re-attempt to give answers in Moodle instead of Second Life).
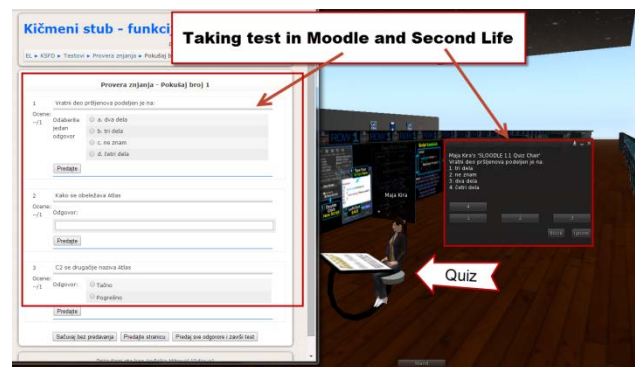

Image 11: Example of questions in Moodle and Second Life

It should be noted that it is planned to use some more Sloodle tools, which requires ownership or renting land, as envisaged in the near future. One such tool is Sloodle Presenter. Using this tool, participants will be able to view presentations and videos that are related to the spinal cord in Second Life, which were previously posted on Moodle.

Image 12: Preview of Sloodle Presenter

5. CONCLUSION

Over the last few years, there has been growing interest in the medical and public health communities in using virtual environments for education, and training. According to Sloodle potential for better understanding and visualization of three-dimensional models of the spine and vertebrae by interns who work in the field of pre-clinical practice *"Spine – functions and deformities"* course is designed.

In this paper we provided the following:

- Gave some basic description of Sloodle tool and its applications
- Referred to some related work of virtual environment application in medicine education and training.
- Described "Spine – functions and deformities" course designed and implementation by using appropriate Sloodle tools.
- Described implementation of complex 3D vertebrae models to Second Life. The process required several steps.
- Use Linden Scripting Language to give name and appropriate actions to model, such rotation and movement which would help users to better understand 3D models.

The importance of proposed approach is reflected in innovation of existing course in this area, as well as enabling users to practice and review cases that are currently not available in real world practice. Future work will be related to application of implemented solution and its evaluation.

ACKNOWLEGMENT

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IMPLEMENTING PEER ASSESSMENT TOOLS TO ENHANCE TEACHING WRITING

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Abstract: *Collaborative work has become increasingly important; however, many teachers do not include it in teaching writing since they regard writing as an individual act. The aim of this paper is to show a new approach in teaching academic writing. It is based on the sociocultural theory, constructivism and the developed process writing model. The idea is that students go through the process of collaboration by using peer assessment activities (through workshops on Moodle). This approach is very demanding and time-consuming in a traditional classroom setting, but it is not the case in an eLearning environment. There are many advantages why teachers should use online peer assessment tools and one of the possible modes of such instruction is presented in this paper.*

Keywords: teaching writing, peer assessment, SLA, E-Learning, Moodle

1. INTRODUCTION

"*It's not about the tool, it's using the tools to facilitate learning*"

(Churches, 2009)

Writing is one of the most important basic skills that belongs to the three Rs (*r*eading, *wr*iting and a*r*ithmetic). Developing writing skills is a very demanding and difficult task both for teachers and students. It becomes even more difficult when it comes to developing writing skills in a foreign language. Traditional classroom setting and paper based tasks make this process complicated. Moreover, it needs time to go through the whole process of writing, revising, evaluating and re-writing. On the other hand, if eLearning tools are implemented when teaching writing, this process becomes simpler and shorter in time. The results are better in the end, too. The aim of this paper is to show a new approach in teaching academic writing where online tools for peer assessment are used. This approach is based on the research that took place in 2013 with students at the Faculty of Political Sciences in Belgrade. The theoretical background can be found in the theory of socioculturalism and constructivism. The model for developing writing skills is the model for process writing (The Hayes-Flower writing model 1981), but revised and adapted for this approach.

2. THEORETICAL BACKGROUND

Sociocultural theory and constructivism are rich soil for explaining peer learning and peer assessment. Vygotsky stated that "with collaboration, direction, or some kind of help the child is always able to do more and solve more difficult tasks that he can independently" (Vygotsky, 1987: 209). He explained that there is the zone of actual development and the zone of proximal development which he defined as "the distance between the actual developmental level as determined by the independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978: 86). When applied to second language acquisition, sociocultural theory sees learning as dialogically based, i.e., "acquisition occurs *in* rather than *as a result* of interaction" (Ellis, 2008: 526). Bruner continued in the same manner as Vygotsky and introduced the idea of "scaffolding". Scaffolding is the same concept as the zone of proximal development. It is "the dialogic process by which one speaker assists another in performing a function that he or she cannot perform alone" (Ellis, 2008: 527). This means that in peer learning children are more prone to make progress.

Peer learning, collaborative learning, cooperative learning, collaborative learning are synonymous and mean learning in a group in which all members of the group take responsibility not only for their own learning, but also for the learning of their peers, "Peer learning is a type of cooperative learning which fosters the value of interaction between students and results in a variety of successful outcomes " (Christudason, 2003). They have a common goal, which can be problem-solving, research or upgrade skills.

An important aspect of peer learning is peer assessment. In this section we will give a definition of peer assessment/evaluation, emphasize the benefits and provide a model on how it should be implemented.

Peer assessment is a process of assessment in which schoolmates, colleagues from the faculty or peers evaluate each other's work. Falchikov (1995) defines peer assessment as "the process through which groups of individuals rate their peers". Topping proposed a more detailed definition, "Peer assessment is defined as an

arrangement in which individuals consider the amount, level, value, worth, quality, or success of the products or outcomes of learning of peers of similar status" (Topping, 1998: 250). A similar idea is with the concept **peer editing**: it is a technique where students work together, review, correct and suggest changes or comment on the paper before the final version is submitted to the teacher.

It is obvious that there is a difference between traditional, deep-rooted ways of assessment only by teachers and alternative evaluation by and among the students. Traditional assessment views the student as a passive recipient of knowledge who can be assessed only by authorities such as teachers. Learning is an individual process and the evaluation is objective and neutral (Anderson, 1998, cited in Lee 2009). An alternative assessment expects from students to apply their knowledge and skills in order to read with understanding, analyze, criticize and evaluate the work of others. There is a mutual benefit in this interaction – both for the one who evaluates and for the one who is evaluated. The task assigned to the evaluator is cognitively demanding and meets the highest levels of Bloom's taxonomy. In the analysis and evaluation of the works of others, the evaluators become aware of their own work and develop critical skills.

While conducted our research, we insisted that the students from the beginning understand the importance of collaborative learning. They did not have the freedom to arbitrarily provide feedback, but the feedback was based on the peer review sheet. The questions from the sheet were used to create online peer review tool in the workshop.

Collaborative assessment, despite some shortcomings, which are largely culturally conditioned, has many advantages and should be implemented in the current model of the writing process and the creation of distance learning courses.

3. THE RESEARCH

The scope of this research was developing academic writing skills in English by means of electronic collaborative tools (workshop on Moodle). The workshop was used to facilitate peer assessment activities on the platform. It is worth mentioning that without eLearning tools such activity is very demanding and time consuming, almost impossible to be performed.

The research took place in 2013 at the Faculty of Political Sciences in Belgrade. 105 students participated in the research. The 10-week course "Introduction to Academic Writing" took place online on Moodle platform at globetrotter.rs. The research question was whether the

students who participated in various collaborative activities performed better in the final exam when compared to the students who did not participate or took small part in them. The main hypothesis is that the students who use e-learning collaborative tools have better results in the final exam. It is because they develop critical thinking skills in the process of collaborative/peer assessment which helps them with their own writing. Statistical analysis showed that there was correlation between participation in peer assessment activity and the grade in the final exam (r=0,502) and correlation between peer assessment activity and the grade for the essay organization in the final exam (r=0,522).

It was confirmed that the students who participated in collaborative activities showed continuous development in writing. Furthermore, they performed better in the final test when they had to write an argumentative essay. The students particularly showed good results in compositional organization, mainly in using the funnel introduction, formulating the topic sentence and controlling idea, providing good supporting details. After ten weeks of collaborative practice, the shape and internal pattern of their essays became clearer, and organizational skills were more adequately controlled.

4. E-TOOLS FOR PEER ASSESSMENT: WORKSHOP

Encouraging results after the final test point to the workshop as the most important tool when teaching writing. The workshop is one of the modules on Moodle platform. Moodle is an open-source learning management system used as a web application to help teachers create online lessons or courses (moodle.org). There are many advantages of Moodle over traditional lessons and one of them is surely assessing learners via workshop. Workshop is a very useful tool through which students can:
• get instructions for doing the task
• view the example solutions
• submit their paper in a set period of time,
• assess the teacher's example on the basis of set criteria,
• compare their assessment with grade teacher for the given example,
• evaluate other students.

Picture 1 Phases in workshop

The workshop has five stages which can be time-controlled and opened/closed as needed. When there is an active phase, it is painted in a different color (e.g. In picture 1 the fifth phase is painted green and it means that

no one can submit their work). The picture 1 shows the stages of:

Phase 1- set up phase: in this phase teachers introduce the task, explain the procedure for the submission of the task and create a list for evaluation.

Phase 2 – submission: in this phase students submit papers, can view a list of assessment criteria and teacher assigns work for collaborative assessment or self-assessment.

Table 1 Instruction for students

Write a paragraph about a special sport or activity that you are presently enjoying, have enjoyed in the past, or plan to do in the future. The paragraph should be up to 250 words, not longer. Please use Word/Open Office Writer, save a document as **Sport name surname** *, for example* **Sport Danijela Ljubojevic** *. Send the document by using this module. Your friend's work will be available to you after your own submission.*

Pay attention to everything you have read so far about topic sentence, supporting sentences and concluding sentences! Go through the Editing Checklist on your own before you submit your work.

Phase 3 – grading evaluation: students (and the teacher) evaluate assigned paper.

Phase 4 - evaluation score: if there were more participants in the assessment (the paper was assessed both by the teacher and the student), in this stage the platform automatically evaluates the grade and calculates a score (mean value or some strict/lax grading).
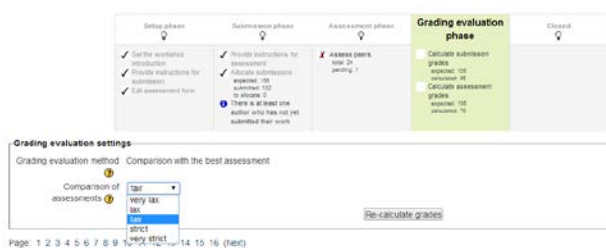
Picture 2 Grading evaluation phase in workshop

Phase 5 -closed: when this phase is on, no one can make changes in the workshop.

5. CONCLUSION

Workshop in this research was used as the main tool for developing writing skills. Workshop is connected to the concept of collaborative learning because students can evaluate their own work and compare their scores with the scores given to them by another participant (a teacher or a student). Self-assessment is an important aspect in the development of critical thinking and fosters the autonomy of students.

Also, an important aspect of this research is shifting the focus from the traditional concept of a teacher as an instructor and evaluator to the students' new role. Student become evaluators and give each other explanations. Collaborative learning has a major role in distance education and the tools enable students to perform tasks in teams. Besides group work, tools for collaborative learning achieve continuous learning, monitoring and evaluation, which is in line with modern concepts of formative assessment, i.e. assessment *for* learning instead of the traditional assessment *of* learning. Moreover, the advantages offered by the distance learning are reflected in the fact that a teacher alone does not participate in the evaluation process, but also the students themselves develop an awareness of assessing the knowledge and achieve autonomy in learning. The teacher in this approach becomes a moderator who directs and monitors the process.

Theoretical contribution of this research is redefining the existing cognitive processes writing model. It suggests adding collaborative elements both to the prewriting phase and first draft phase. Because of the great emphasis it puts upon collaboration and peer learning, this model is called socioconstructivist writing model of cognitive processes.

Practical aspects of the research refer to organizing classes for teaching writing skills: how to implement distance learning courses and how to apply socioconstructivist writing model of cognitive processes. Moreover, the valuable part is the designed ten-week Moodle course with SCORM created lessons, as well as one of the most detailed checklists for asssessing writing (both for paragraphs and essays).

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