Conceptual design of the ICT solution for BAEKTEL OER framework

DEV 2.3

Blending Academic and Entrepreneurial Knowledge
in Technology enhanced learning – BAEKTEL

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Contents

1 Introduction

Development of the conceptual model of the ICT (Information and communications technology) solution for BAEKTEL OER network defines all the terms and concepts involved in the future software solution, their relationships and roles.

The model covers graphical representation and data model of all the entities required to develop BAEKTEL OER software solution.

University of Belgrade (UB) hosts a central repository, which will include:

- BAEKTEL Metadata Portal (BMP) with metadata for all OER content published within BAEKTEL network;
- Terminological web application for management, browse and search of terminological resources;
- Web services for linguistic support (query expansion, information retrieval, OER indexing, etc);
- Annotation of selected resources (not all);
- OER repository on local edX platform.

The ICT solution for BAEKTEL OER framework should also support the distributed OER system. Namely, other partner institutions can opt for publishing their OER at UB, or use their own OER repositories. However, regardless of the physical location of the resource, it is mandatory that the metadata are recorded in the central repository of metadata.

In addition, the BAEKTEL network can integrate OERs that are not created by partner institutions, regardless of their physical location. The only condition is that these resources are described by metadata in the central metadata repository.

Razvoj konceptualnog modela (Informaciono-komunikaciona tehnologija) IKT rešenja za BAEKTEL OER mrežu definiše sve termine i koncepte koji su uključeni u buduće softversko rešenje, njihove odnose i uloge.

Model obuhvata grafički prikaz i model podataka svih entiteta potrebnih za izgradnju BAEKTEL OER softverskog rešenja.

Univerzitet u Beogradu (UB) hostuje centralni repozitorijum koji će obuhvatiti:

- BAEKTEL portal sa metapodacima (BAEKTEL Metadata Portal - BMP) sa metapodacima o svim OER sadržajima publikovanim u okviru BAEKTEL mreže;
- Terminološku veb aplikaciju za rukovanje, prelistavanje i pretragu terminoloških resursa;
- Veb servise za lingvističku podršku (proširenje upita, pronalaženje informacija, indeksiranje OER, itd.);
- Anotaciju odabranih resursa (ne svih);
- OER repozitorijum na lokalnoj edX platformi.

IKT rešenje za BAEKTEL OER mrežu treba da podrži i distribuirani OER sistem. Naime, ostale partnerske institucije treba, imaju mogućnost da postavljaju OER na UB ili da koriste sopstvene OER repozitorijume. Bez obzira na fizičku lokaciju resursa obavezno je da metapodaci budu zabeleženi u centralnom repozitorijumu metapodataka.

Osim toga, u BAEKTEL mrežu se mogu integrisati i OER koje nisu kreirale partnerske institucije, bez obzira gde se nalazi fizički. Dovoljno je da takav resurs bude opisan metapodacima u centralnom repozitorijumu metapodataka.

2 IT platforms

2.1 Metadata platform

The approach to BMP development was to start from one of the existing open source software solutions, and customize it to the needs of BAEKTEL. To that end a review of most popular open source Digital Asset Management (DAM) systems was performed, and three of them were taken in consideration for BMP: NotreDAM, ResourceSpace and DSpace.

Pristup razvoju BMP je zasnovan na prilagođavanju nekog od postojećih softverskih rešenja otvorenog koda potrebama BAEKTEL-a. U tom cilju analizirani su najpopularniji sistemi za upravljanje digitalnim dobrima (Digital Asset Management - DAM) otvorenog koda, od kojih su tri uzeta u razmatranje za BMP: NotreDAM, ResourceSpace i DSpace.

Notre DAM (http://notredam.org/) has impressive set of features (http://notredam.org/overview/) and looks excellent, but it is still in the development stage, with modest documentation that is mostly unfinished and versions operating under specific operating systems. Documentation for the latest version of Notre DAM package is currently under construction, but the instructions for previous versions are also incomplete, as can be seen at the address http://notredam.org/documentation, with the remark that it works only on a limited number of operating systems.

Notre DAM (http://notredam.org/) ima impresivan skup svojstava (http://notredam.org/overview/) i veoma dobro izgleda, ali je još uvek u fazi razvoja, sa skromnom dokumentacijom koja je uglavnom nedovršena i verzijama koje rade pod specifičnim operativnim sistemima. Dokumentacija za poslednju verziju Notre DAM paketa je trenutno u izradi, ali su i prethodna uputstva takođe nepotpuna, što se može videti na adresi http://notredam.org/documentation, uz napomenu da radi na ograničenom broju operativnih sistema.

Notre DAM is working properly on Ubuntu 10.04, whereas on Ubuntu 12.04 it works only partially. The system is open source and developed in Python.

Notre DAM radi na Ubuntu 10.04, dok na Ubuntu 12.04 radi samo delimično. Sistem je otvorenog koda i razvijen je u jeziku Python.

DSpace is full featured, open-source solution for storing, indexing and retrieving digital resources. It is highly configurable and can support any metadata schema. DSpace is highly research/academically oriented with-numerous features, but hard to learn (by 'ordinary' users). It has not nice user interface and it has poor overall user experience.

DSpace je potpuno funkcionalna platforma otvorenog koda za skladištenje, indeksiranje i pronalaženje digitalnih resursa. Veoma je fleksibilna i podržava bilo koju šemu metapodataka. DSpace je izrazito usmerene ka istraživačkoj i akademskoj upotrebi, sadrži brojne funkcije, ali se teško savladava (za „obične" korisnike). Nema udoban korisnički interfejs i slabo je prihvaćen od korisnika.

ResourceSpace is an open source Digital Asset Management system originally developed for Oxfam by UK company Montala

Resourcespace je platforma otvorenog koda koja pripada grupi Digital Asset Management platformi, i koji je kompanija Montala iz Velike

Limited in 2006. Montala continued to manage the project in addition to providing commercial hosting, support and development services relating to the software. ResourceSpace has been released under a BSD-style license. It requires PHP, MySQL, and the GD Graphics Library, and works with most web server software such as Apache. (http://www.resourcespace.org/).

Britanije razvila 2006. godine za Oxfam. Montala je nastavila da upravlja projektom, i pored toga pruža usluge komercijalnog hostinga, podrške i razvija servise vezane za softver. Resourcespace je zaštićen *BSD* licencom. Za njegov rad potrebni su PHP, MySQL, i GD biblioteka (*Graphics Library*), a takođe, radi na većini softvera za veb servere, kao što je Apač (*Apache*). (http://www.resourcespace.org/)

After comparing and analysing the three selected candidates, ResourceSpace has been selected as the most suitable tool.

ResourceSpace je izabran kao najpogodniji alat, nakon poređenje i analize tri izabrana kandidata.

Main features of ResourceSpace:

- Intelligent search ordering by scoring resources against keywords on basis of user search activity
- Preselected groups of resources
- Resource access level permissions by user group
- Multilinguality, allowing the user to change the language, with most major languages supported
- Automatic thumbnail creation for resources
- Multiple file upload using SWF upload
- Possibility for geolocation searching
- Possibility for changing metadata input fields
- Platform: PHP, MySql
- Operating system: any
- License: BSD Open source license

Osnovne karakteristike ResourceSpace:

- Inteligentna pretraga – resursi se rangiraju prema svakoj ključnoj reči korišćenoj u pretrazi
- Mogućnost grupisanja resursa
- Prava pristupa svakom resursu prema korisničkim grupama
- Višejezičnost – omogućava korisniku da promeni jezik, pri čemu je podržana većina ključnih jezika
- Automatsko kreiranje ikonica za sve kurseve
- Istovremeno postavljanje više fajlova korišćenjem SWF upload
- Mogućnost pretrage po geolokaciji
- Mogućnost menjanja šeme metapodataka
- Platforma: PHP, MySql
- Operativni sistem: bilo koji
- Licenca: BSD softver otvorenog koda

2.2 OER platform

Within the academic environment the portal also provides for teachers the possibility to track the progress of students while using the learning resources. This would provide for an insight into how students are mastering specific concepts, especially those featuring entrepreneurial learning content. Based on this insight, especially motivated students

U okviru portala je predviđena i mogućnost da u akademskom okruženju nastavnici mogu da prate napredovanje studenata tokom korišćenja obrazovnih resursa. To bi obezbedilo uvid u to kako studenti savladavaju pojedine pojmove, naročito one sa preduzetničkim obrazovnim sadržajima. Na osnovu ovih rezultata bi mogli da se

could further be filtered out, and engaged in “peer to peer knowledge sharing”, namely in providing help and guidance to students who have problems in understanding some concepts. Motivated students could also be encouraged to become teacher assistants and publish their own educational materials within the network.

izdvoje posebno motivisani učenici koji bi potom bili angažovani da svojim vršnjacima ("peer to peer") razmenjuju znanja, odnosno koji pružali pomoć učenicima koji imaju problema sa razumevanjem pojedinih koncepata. Istaknuti učenici se takođe mogu ohrabriti da postanu asistenti nastavnicima i da objavljuju sopstvene obrazovne materijale u okviru mreže.

In the entrepreneurial setting, the portal provides similar opportunities for tracking the progress of graduate students who started to work in companies and are now pursuing the life-long learning approach. The same way university teachers in the academic environment monitor their students, supervisors within the enterprise can monitor how their employees are keeping pace with new knowledge offered within the learning content published by academic institutions.

U preduzetničkom okruženju, portal daje slične mogućnosti za praćenje napredovanja diplomiranih studenata koji su se zaposlili u kompanijama i sada se uključuju u proces celoživotnog učenja. Na isti načina na koji nastavnici mogu da prate napredovanje studenata u akademskom okruženju, supervizori u preduzećima mogu da nadgledaju kako njihovi zaposleni njihovi zaposleni drže korak sa novim znanjima koja su im ponuđena u obrazovnim materijalima kog su publikovale akademske institucije.

Two conceptual models of BAEKTEL network are under consideration. The first model includes creation of a single system sign on form. The button for registration on edX would lead to a new page hosted by the meta portal. The page would be adapted to the existing form on edX. During user registration all data would be entered into databases of all partners (UB, UNI, UNIKG, UNTZ, UBL, UNIM). In this way accounts would be created an all platforms within a single registration. During registration the system would check whether all databases have the same number of users, as one user must have the same ID in all databases. If a database is not in line with other databases it is temporarily excluded from single sign on, until it is synchronized with other databases by the person responsible. In this case the user can sign on all edX platforms except the one where the problem has occurred. After the synchronization of the database the user will

U razmatranju su dva konceptualna modela BAEKTEL mreže. Prvi model obuhvata kreiranje jedinstvene forme za registraciju na sistem. Dugme za registraciju na edX-u vodilo bi ka novoj stranici koja bi bila hostovana na meta portalu. Ta stranica bi bila prilagođena postojećoj formi na edX-u. Pri registraciji korisnika svi podaci bi se upisivali u baze svih partnera (UB, UNI, UNIKG, UNTZ, UBL, UNIM). Time bi se pri jednoj registraciji kreirali nalozi na svim platformama. Pri registraciji sistem bi proveravao da li u svim bazama ima isti broj korisnika, pošto jedan korisnik u svim bazama mora da ima isti ID. Ukoliko neka baza odstupa od ostalih ona se privremene isključuje iz jedinstvene registracije, dok je osobe zadužene za tu bazu ne sinhronizuje sa ostalima. Korisnik u ovoj situaciji može da se prijavi na sve edX platforme, osim platforme kod koje je nastao problem. Nakon sinhronizacije baze, korisnik će bez

be able to sign also on to the edX platform where the problem had occurred, without additional registration, The conceptual model is depicted in Figure 1.

Preconditions:

- Databases have to be empty or new platforms without users need to be launched
- It is necessary to redirect the registration button to the new page

dodatne registracije moći da se prijavi i na edX platformu kod koje je nastao problem. Konceptualni model je prikazan na slici 1.

Preduslovi:

- Potrebno je da baze podataka budu prazne ili da se podignu nove platforme u kojima ne bi bilo korisnika
- Potrebno je preusmeriti dugme za registraciju na novu stranicu

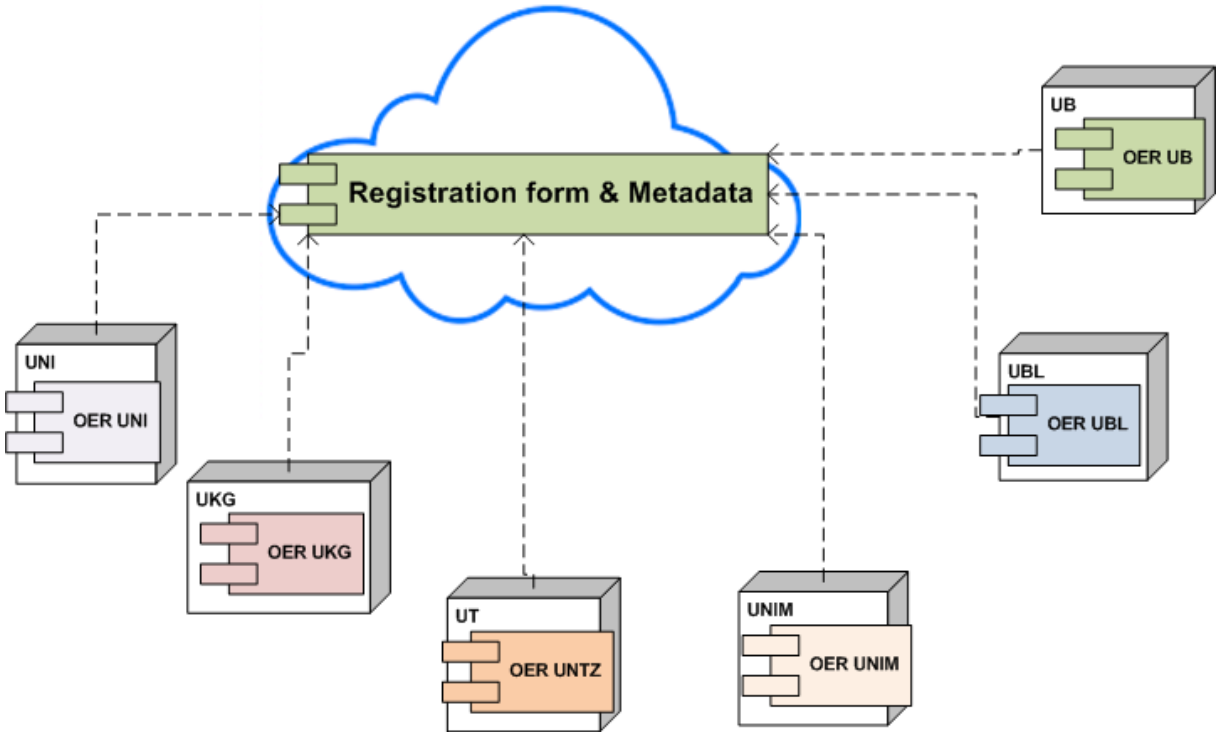

Figure 1. Conceptual map of BAEKTEL network first model

Slika 1. Konceptualna mapa BAEKTEL mreže prvog modela

The second conceptual model presumes that each institution uses one edX for course development and the necessary testing. Each platform would be available only to the institution that develops resources on it. When a resource is ready for production it would be moved to production edX on the edx.baektel.eu address. Meta data would be entered only for resources on the production

Drugi konceptualni model podrazumeva da svaka institucija koristi jedan edX za razvijanje kurseva i potrebna testiranja. Svaka platforma bi bila dostupna samo instituciji koja na njoj razvija resurse. Kada resurs bude spreman za produkciju prebacio bi se na produkcioni EDX koji bi bio na adresi edx.baektel.eu. Meta podaci bi se unosili samo za resurse koji se nalaze na

platform. Only one sign on to the system would be required from the learners and resources under development would not be displayed to them. This conceptual model is depicted in Figure 2.

produkcionoj platformi. Od polaznika bi se zahtevalo jedno prijavljivanje na sistem i ne bi im se prikazivali resursi koji su u fazi izrade. Ovaj konceptualni model je prikazan na slici 2.

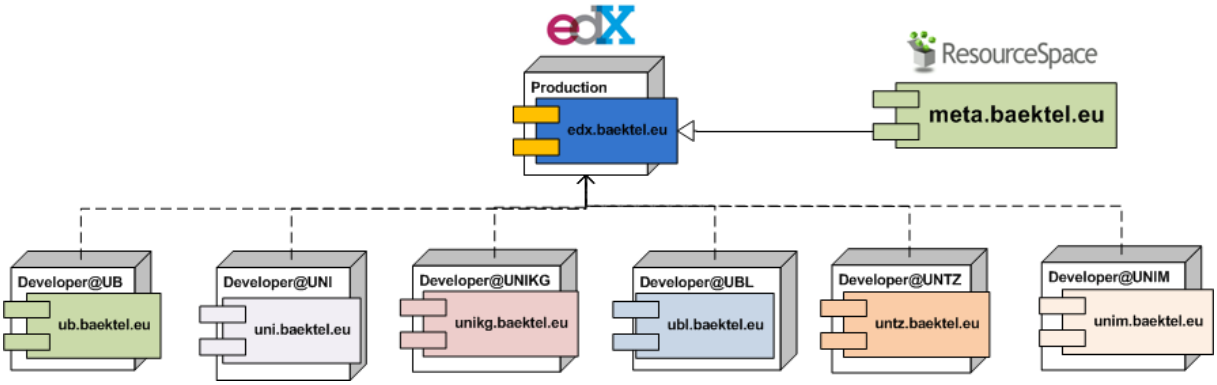

Figure 2. Conceptual map of BAEKTEL network second model

Slika 2. Konceptualna mapa BAEKTEL mreže drugog modela

All partners will develop and publish their OER independently using edX, an open-source online learning platform, which includes both a Learning Management system (LMS) and the authoring tool, Studio. Although edX has been selected as the common LMS, other LMS are not excluded. Thus, for example, all partners already use Moodle, few are using Adobe Connect for e-Learning and Webinars. Besides, some of them have developed in-house course MS as, for example, the University of Belgrade Faculty of Mining and Geology. (Stanković, Obradović, Kitanović, Prodanović, & Ilić, An approach to implementation of blended learning in a university setting, 2011)

Svi partneri će da kreiraju i publikuju svooje otvorene resurse samostalno koristeći edX, platformu za elektronsko učenje otvorenog koda. Pored sistema za upravljanje učenjem (Learning Management system - LMS), edX uključuje alat Studio za kreiranje, uređivanje i publikovanje kurseva. Iako je edX izabran kao najpogodniji LMS, to ne isključuje druge LMS. Recimo, svi partneri već koriste Moodle, neki koriste Adobe Connect za e-učenje i vebinare. Uz to neki su razvili sopstvene sisteme za upravljanje kursevima, kao npr. Univerzitet u Beogradu, Rudarsko-geološki fakultet. (Stanković, Obradović, Kitanović, Prodanović, & Ilić, An approach to implementation of blended learning in a university setting, 2011)

The edX platform, used in BAKTEL nodes for publishing OER content was recently (2012) conceived by MIT and Harvard University. Its basic goal is to support massive open online university courses. The platform has been developed as open-source software, and is available to other academic institutions under edX Terms of Service.

edX platforma koja će se koristiti u BAKTEL čvorovima za objavljivanje OER sadržaja je nedavno (2012) razvijena na univerzitetima MIT i Harvard. Njen osnovni cilj je da podrži masovne otvorene onlajn univerzitetske kurseve. Platforma je razvijena kao softver otvorenog koda i dostupna je akademskim institucijama pod edX uslovima korišćenja.

Among its main features, edX offers interactive online learning software, which provides for production of multimedia educational materials, combining text, images and videos, followed by exercises where students can immediately check their understanding of the concepts introduced by the appropriate educational content.

Neke od osnovnih svojstava edX-a su interaktivni onlajn softver za učenje, koji omogućava kreiranje multimedijalnih obrazovnih materijala, koji kombinuju tekst, slike i video snimke, kao i vežbi kroz koje studenti mogu odmah da provere svoje razumevanje pojmova uvedenih odgovarajućim nastavnim sadržajima.

The platform also offers creation of online textbooks, as well as discussion forums for student-student interaction. Finally, edX provides for online laboratories, as for example in its first MOOC, a course on circuits and electronics, where students were able to build virtual circuits in an online lab (Breslow, Pritchard, DeBoer, Stump, Ho, & Seaton, 2013). The tool is user friendly, easy to use and allows publishers of educational materials to master it without much effort.

Platforma takođe nudi kreiranje onlajn udžbenika, kao i diskusione forume za interakciju između učenika. Konačno, edX omogućava kreiranje onlajn laboratorija, kao na primer u svom prvom MOOC kursu o kolima i elektronici, gde su studenti mogli da naprave virtuelna kola u onlajn laboratoriji (Breslow, Pritchard, DeBoer, Stump, Ho, & Seaton, 2013). Alat je udoban i jednostavan za korišćenje, tako da omogućava kreatorima obrazovnih materijala da ga savladaju bez mnogo napora.

An important issue is quality assurance within the BAEKTEL network. To that end the BMP platform will provide for feedback from network users, who will have the opportunity to evaluate both the quality and the accessibility of each particular OER.

Obezbeđenje kvaliteta u okviru BAEKTEL mreže je važno pitanje. U tom cilju će BMP platforma obezbediti prikupljanje povratnih informacija od korisnika mreže, koji će imati priliku da ocene kvalitet i dostupnost svakog pojedinačnog obrazovnog resursa.

3 BAEKTEL Metadata Portal

3.1 Basic characteristics

The aim of the BAEKTEL Metadata Portal is to provide structured access to information on open education resources within the BAEKTEL network.

Cilj BAEKTEL portala metapodataka je da obezbedi struktuirani pristup informacijama o otvorenim obrazovnim resursima u okviru BAEKTEL mreže.

To OER creators, the Portal will provide OER metadata management, and to learners, metadata search and direct access to learning resources, such as courses, training materials, guidelines, case studies, best

Kreatorima OER-a portal će da obezbedi unos metapodataka, a učenicima efikasnu pretragu metapodataka i direktan pristup obrazovnim resursima, kao što su kursevi, materijali za obuku, uputstva, studije slučaja, primeri dobre prakse, itd., na različitim

practices etc. available in any media, which can support education.

medijima, a kojima se unapređuje proces učenja.

One of the main goals of this document is to define a metadata schema which consists of data elements drawn from one or more namespaces. Thus, the BMP contains elements taken from existing standards with guidelines for metadata creation.

Jedan od osnovnih ciljeva ovog dokumenta je da definiše šemu metapodataka koja se sastoji od elemenata preuzetih iz jednog ili više prostora imena. Stoga BMP sadrži elemente koji su preuzeti iz postojećih standarda, uz smernice za kreiranje metapodataka.

In metadata specification, the standard nomenclature is used enabling learning resources to be described and shared in a common way and, therefore, allowing for increased accessibility of the resources from other OER portals.

Specifikacija metapodataka sledi standardnu nomenklaturu, koja omogućava opis i deljenje obrazovnih resursa na jedinstven način, čime se povećava dostupnost resursa is sa drugih OER portala.

3.2 The need for metadata

In order to broaden the usability of OER within the learning environment, they need to be shared, accessible and discoverable by potential users. It is not easy to find anything in a large distributed online environment like the World Wide Web or a large intranet. The solution is to store not only learning objects but also descriptions of the learning objects.

Da bi se proširile mogućnosti korišćenja otvorenih resursa u okviru obrazovnog okruženja, oni treba da budu dostupni, da se informacije o njima razmenjuju i da budu vidljivi potencijalnim korisnicima. Nije lako pronaći nešto u velikom distribuiranom online okruženju kakav je World Wide Web ili veliki intranet. Rešenje je u skladištenju ne samo obrazovnih resursa, već i opisa tih resursa.

To that end, they must be annotated in such a manner that users can easily grasp what a specific learning object is about, what is the essence of its learning content, as well as what are the prerequisites needed for its use, without even seeing the resource itself (Velichová, 2008).

Da bi se to postiglo, oni moraju biti označeni tako da ih korisnici mogu lako shvatiti temu i suštinu obrazovnog materijala, kao i šta su preduslovi potrebni za njegovu upotrebu. Sve ovo informacije treba korisnicima da budu na raspolaganju i bez uvida u sami resursa (Velichová, 2008).

As the amount of OER reaches a considerable size, it becomes important that each learning resource is well described and tagged in a standard way, and in machine readable form. This makes resources more

Sa značajnim porastom broja otvorenih resursa raste i potreba da svaki obrazovni resurs bude dobro opisan, označen na standardan način u mašinski čitljivoj formi. To omogućava lakše pronalaženje resursa

easily located by search engines, and results returned by them more relevant.

pretraživačima, a dobijeni rezultati postaju relevantniji.

Both educators and learners can find and compare described and tagged learning materials more efficiently, and select the ones that best suit their current needs.

Time se obezbeđuje da kreatori i polaznici kurseva efikasnije pronalaze i porede opisane i označene obrazovne materijale, a biraju one koji najbolje odgovaraju njihovim trenutnim potrebama.

Metadata is defined as “data that describes other data” or “data about data”. Thinking of the learning objects as *data*, their descriptions are *data about the data*, or *metadata.* Metadata for open education resources are important to facilitate search, acquisition, use and reuse of learning objects, for instance by learners or instructors. Learning object metadata potentially includes information about the title, author, version number, creation date, technical requirements and educational context and intent. Learning Object Metadata standard (IEEE & IMS Global Learning, 2002) is compatible with the metadata used by the digital and online library community.

Metapodaci se definišu kao „podaci koji opisuju druge podatke“ ili "podaci o podacima". Ako posmatramo obrazovne celine kao *podatke*, onda su njihovi opisi *podaci o podacima* ili *metapodaci*. Metapodaci koji se odnose na otvorene obrazovne resurse su važni da bi se olakšala pretraga, prikupljanje, korišćenje i ponovno korišćenje objekata za učenje, od strane učenika ili profesora. Metapodaci obrazovnih celina mogu da sadrže: naslov, autore, broj verzije, datum kreiranja, tehničke zahteve i obrazovni kontekst i cilj. Standard Learning Object Metadata (IEEE & IMS Global Learning, 2002) je kompatibilan sa metapodacima koji se koriste u digitalnim i online bibliotekama.

As a rule, OER with related metadata are stored in the so called Learning Object Repositories (LOR). Metadata schemas describing the OER differ depending on the needs addressed by the LOR. Given this variety of schemas, a lot of effort is needed in order to secure interoperability among metadata records, thus enabling federated searches and facilitating metadata management (Chan & Zeng, 2006).

OER sa metapodacima se po pravilu skladište u takozvanim repozitorijumima obrazovnih celina (Learning Object Repositories, LOR). Šeme metapodataka kojima se opisuju OER se međusobno razlikuju u zavisnosti od potreba LOR. S obzirom na raznovrsnost šema, potrebno je uložiti dosta napora da bi se osigurala interoperabilnost zapisa metapodataka i time omogućili pretraga kroz federaciju servera i upravljanje metapodacima. (Chan & Zeng, 2006)

The central repository with metadata for all published OER within BAEKTEL network is named BMP (BAEKTEL Metadata Portal). BMP is hosted by UB, in addition to its own OER in edX and other LMS. BMP features a

Centralni repozitorijum sa metapodacima za sve publikovane OER u okviru BAEKTEL mreže je nazvan BMP (BAEKTEL Metadata Portal). BMP je hostovan na UB, zajedno sa OER na edX platformi i drugim LMS. BMP je

web application for management, browse and search of metadata, but also 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 classification, and the like.

To enable interoperability and easy sharing of resources, the use of common standards and specifications is essential. The following section describes some of the standards used in educational settings.

veb aplikacija za rukovanje, prelistavanje i pretragu metapodataka, ali koristi i veb servise za terminološku i lingvističku podršku. Imajući u vidu da OER sadržaji u mreži mogu biti publikovani na različitim jezicima, veb aplikacija i prateći veb servisi podržavaju višejezičnost u mreži, ali takođe pružaju različite mogućnosti proširenja upita, pronalaženja informacija, indeksiranja OER-a, klasifikacije itd.

Da bi se omogućila interoperabilnost i jednostavna razmena resursa, upotreba zajedničkih standarda i specifikacija je neophodna. Naredni odeljak opisuje neke od standarda koji se koriste u obrazovnim okruženjima.

3.2.1 Standards for describing educational resources

Generic metadata specifications, such as the Dublin Core (DC) exist, which fulfil the general requirements for documenting web-distributed objects. However, educational resources demand a more specialized treatment and characterization. To that end a combination of the IEEE 1484.12.1-2002 Learning Object Metadata (LOM) standard elements (Barker P. , 2005) to DC is proposed, as a basis for delivering web services for educational resources (Koutsomitropoulos, 2010).

The LOM Standard is the leading educational metadata specification (IEEE & IMS Global Learning, 2002). The standard is provided by the Institute of Electrical and Electronics Engineers and it groups data elements for describing a learning resource into nine categories: general, lifecycle, meta-metadata, technical, educational, rights, relation, annotation and classification. It has more than 70 available elements, and they are widely used in educational context and applied in several learning object repositories (Friesen, 2004).

Postoje generičke specifikacije metapodataka, kao što je Dublin Core (DC), koje zadovoljavaju opšte potrebe dokumentovanja objekata distribuiranih na vebu. Međutim, obrazovni resursi zahtevaju specifičan tretman i karakterizaciju. U tom cilju preporučuje se kombinacija elemenata standarda IEEE 1484.12.1-2002 Learning Object Metadata (LOM) i DC (Barker P. , 2005), kao osnova za publikovanje veb servisa za obrazovne sadržaje (Koutsomitropoulos, 2010).

Standard LOM je vodeći standard za definisanje metapodataka u obrazovanju (IEEE & IMS Global Learning, 2002). Standard je kreirao Institute of Electrical and Electronics Engineers i on grupiše podatke za opisivanje obrazovnih resursa u devet kategorija: opšti, životni ciklus, meta-metapodaci, tehnički, obrazovni, prava, relacije, anotacija i klasifikacije. Na raspolaganju je preko 70 elemenata koji su u širokoj upotrebi u obrazovnom kontekstu i koji se primenjuju u repozitorijumima obrazovnih celina (Friesen, 2004).

Recognizing the specific needs of educational resources, the Education Working Group of the Dublin Core Metadata Initiative (DCMI, 2014) developed supplementary DC elements for their description, and proposed the addition of a number of LOM elements to further enhance the DC model. Several metadata initiatives, such as GEM (GEM, 2010) and EdNA (EDNA, 2003), follow the recommendations provided by the DC Education Working Group.

Prepoznajući specifične potrebe obrazovnih resursa, Radna grupa za obrazovanje Dublin Core Metadata inicijative (DCMI, 2014) razvila je dodatne DC elemente za njihov opis i predložila dodavanje jednog broja LOM elemenata kako bi se dodatno poboljšao DC model. Nekoliko inicijativa vezanih za metapodatke, kao što su GEM (GEM, 2010) i EdNA (EDNA, 2003) slede preporuke DC Radne grupe za obrazovanje.

One of the federated search project is the Global Learning Objects Brokered Exchange (GLOBE) (http://www.globe-info.org). GLOBE is an international consortium of institutions from Australia, Canada, Europe, Japan and the United States of America dedicated to providing access to shared online learning resources to educators and students around the world. While metadata help users locate relevant resources, at the same time enabling them to make informed decisions regarding the specific relevance of each resource to their needs, the visibility of the resources is additionally increased when metadata are shared with external portals.

Jedan od projekata pretrage kroz federaciju servera je Global Learning Objects Brokered Exchange (GLOBE) (http://www.globe-info.org). GLOBE je međunarodni konzorcijum institucija iz Australije, Kanade, Evrope i SAD čiji je cilj omogućavanje pristupa deljenim obrazovnim resursima instruktorima i studentima širom sveta. Dok metapodaci pomažu korisnicima da lociraju relevantne obrazovne resurse, i istovremeno im omogućavaju da donesu utemeljene odluke u pogledu relevantnosti svakog pojedinačnog resursa u odnosu na njihove potrebe, vidljivost resursa se dodatno povećava kada se metapodaci dele sa eksternim portalima.

The International Standards Organization (ISO) sub-committee on "Information Technology for Learning, Education and Training" (ISO/IEC JTC1 SC36) is developing a metadata standard for learning resources. The group published a first draft of the standard towards the end of 2005. They focus on existing standards and technical reports and conducted a survey on the use of LOM.

Podkomitet Međunarodne organizacije za standarde (ISO) za „Informacione tehnologije u učenju, obrazovanju i obuci“ (ISO/IEC JTC1 SC36) razvija standard za metapodatke koji se odnose na obrazovne resurse. Grupa je objavila prvi nacrt standarda krajem 2005. godine. Fokusirali su se na postojeće standarde i tehničke izveštaje i sproveli su istraživanja o upotrebi LOM-a.

The Learning Resource Metadata Initiative (LRMI) proposed an extension to the Schema.org metadata vocabulary addressing the needs of the educational community. It was, launched in 2011, as a joint initiative of Google, Yahoo, Microsoft

Inicijativa Learning Resource Metadata Initiative (LRMI) predlaže proširenje Schema.org rečnika metapodataka koji se odnosi na potrebe obrazovane zajednice. LRMI je pokrenut 2011, kao zajednička inicijativa Google, Yahoo, Microsoft Bing,

Bing, Yandex and W3C. Increasingly, businesses are realizing that tagging their content with LRMI metadata can contribute to their bottom line by increasing the discoverability of their materials among potential users (http://www.lrmi.net)

Yandex i W3C. Institucije sve više shvataju da označavanje obrazovnog sadržaja LRMI metapodacima može doprineti njihovom osnovnom cilju povećanjem prepoznatljivosti i dostupnosti njihovih materijala među potencijalnim korisnicima (http://www.lrmi.net)

The Schema.org initiative was the result of the exponential growth of data on the web and large intranets, which made the location of web pages containing data of interest more and more difficult. Schema.org provides a collection of schemas for HTML pages markup in ways recognized by major search providers and used for structured data interoperability (Barker & Campbell, 2014.). The main rationale for the approach fostered by IMS GLC (IMS Global Learning Consortium) is that the choice of a standardized learning object metadata vocabulary has valuable and beneficial institutional and pedagogical implications. 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 published paper is:

Schema.org inicijativa je pokrenuta kao odgovor na eksponencijalni rast količine podataka na vebu i velikim intranet mrežama, što je otežalo pronalaženje veb stranica sa traženim podacima. Schema.org nudi kolekciju šema za označavanje HTML strana na način koji prepoznaju glavne pretraživačke mašine i koji se koristi za struktuiranu interoperabilnost podataka (Barker & Campbell, 2014.) Glavni razlog ovakvog pristupa, koji promoviše IMS GLS (IMS Global Learning Consortium) je da korišćenje standardizovanog rečnika metapodataka obrazovnih resursa unapređuje i institucioni i pedagoški aspekt repozitorijuma. U tom cilju, kreatori sadržaja unose mašinski čitljive informacije u kod veb stranica, što pomaže pretraživačima da semantički tumače tekst na tim stranicama. Jedan primer takvog označavanja stranice koja sadrži publikovani rad je:

```
<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>
```

One of the main tasks within the development of the ICT solution for the BAEKTEL metadata portal was to define an appropriate metadata schema, drawing its data elements from one or more namespaces (DC or LOM). Namely, the BMP schema contains elements taken from

Jedan od glavnih zadataka u okviru razvoja IKT rešenja za BAEKTEL portal metapodataka je definisanje odgovarajućeg modela (šeme) metapodataka, kroz izbor elemenata iz jednog ili više imenovanih prostora (DC ili LOM). Naime, BMP šema sadrži elemente uzete iz standardnih

standard namespaces with guidelines for metadata creation.

imenovanih prostora sa uputstvima za kreiranje metapodataka.

3.3 Metadata requirements for BMP

The following points were considered in development of the BMP metadata model:

- Conformance to standards and specifications.
- Usefulness in the bigger context. It should assure that metadata can be shared with recognized educational repositories.
- The number of mandatory elements has to be balanced (added- value vs. effort to tag)
- Selected elements have to meet the needs of search and browse functions of the Portal.
- Allow for collection level description.

Tokom razvoja modela metapodataka za BMP je uzeto u obzir sledeće:

- Usaglašenost sa standardima i specifikacijama.
- Primenljivost u širem kontekstu. To bi trebalo da obezbedi da metapodaci mogu da se delle sa poznatim obrazovnim repozitorijumima.
- Broj obaveznih elemenata mora da bude izbalansiran (dodata vrednost naspram etiketiranja po svaku cenu)
- Odabrani elementi treba da zadovolje potrebe funkcija pretrage i prelistavanja portala.
- Omogućiti opis kolekcija po nivoima.

Given the above requirements, for each of the aforementioned standards, a cost-benefit analysis was carried out and is summarized below.

Imajući u vidu gorenavedene zahteve, za svaki od prethodno navedenih standarda izvršena je analiza odnosa troškova i dobiti i sumirana je u nastavku teksta.

The PROs and CONs of LOM and DC are analysed in order to define appropriate metadata set for BAEKTEL.

Analizirane su dobre i loše strane LOM-a i DC-a kako bi se definisao odgovarajući skup metapodataka za BAEKTEL.

In favour of LOM was the fact that it is the leading educational metadata specification, widely used in Learning Object Repositories (e.g. CGIAR, SILO on ARIADNE) that allows easy mapping to COL and MERLOT (MERLOT, 2014), and finally that it is recommended for SCORM.

Na strani LOM-a je činjenica da je to vodeća specifikacija za obrazovne metapodatke, da se široko koristi u repozitorijumima obrazovnih resursa (npr. CGIAR, SILO u ARIADNE), da omogućava lako mapiranje na COL i MERLOT (MERLOT, 2014), i konačno preporučena je za SCORM.

The critics of LOM argue that it has too many elements and it is too complicated, therefore not practical for everyday use. In practice, most communities use just few elements from LOM schema and, therefore, there is

Kritičari LOM-a ističu da ima isuviše elemenata i da je komplikovana, tako da nije praktična za svakodnevnu upotrebu. U praksi, većina zajednica koristi samo nekoliko elemenata iz LOM šeme i stoga

not a big difference to simpler standards such as DC.

zapravo ne postoji velika razlika u odnosu na jednostavnije standarde kao što je DC.

The favourable DC characteristics are that it is compact, well explained and used by several projects to describe learning resources.

Dobra svojstva DC su kompaktnost, dobro opisana specifikacija i primena u brojnim projektima za opisivanje obrazovnih resursa.

The critics of DC argues that it lacks elements for fully describing learning resources.

Kritičari DC tvrde da nedostaju elementi za kompletno opisivanje obrazovnih resursa.

4 Proposed metadata set

When metadata for BAEKTEL learning resources were being considered, the FAO (Food and Agriculture Organization of the United Nations) Learning Object Resources Metadata Application Profile, which combines DC and LOM Standard, was taken as it basis (FAO, 2007).

Prilikom razmatranja metapodataka za BAEKTEL obrazovne resurse za osnovu je korišćen FAO (Food and Agriculture Organization of the United Nations) Learning Object Resources Metadata Application Profile koji kombinuje DC i LOM standarde (FAO, 2007).

Compliance with these standards was chosen in order to enable sharing of BMP metadata with other OER repositories. However, the mandatory elements had to be selected very carefully, as metadata must not become the bottleneck of the entire system.

Saglasnost upravo sa ova dva standarda je izabrana da bi se obezbedila razmena BMP metapodataka sa drugim OER repozitorijumima. Međutim, obavezni elementi su morali veoma obazrivo da se biraju, kako metapodaci ne bi postali usko grlo celog sistema.

As a result of an in-depth analysis of metadata requirements for BMP in view of the existing standards, a metadata model was defined based on DC with addition of some elements from LOM. The selected metadata set is expected to describe the resources sufficiently well for the user to be able to locate and access them easily. Furthermore, it is expected to facilitate exchange with other OER systems.

Kao rezultat temeljne analize specifikacije zahteva za BMP metapodatke, a imajući u vidu postojeće standarde, definisan je model metapodataka zasnovan na DC uz dodatak nekih elemenata iz LOM-a. Očekuje se da izabrani skup metapodataka dovoljno dobro opiše resurse, tako da korisnik bude u mogućnosti da ih pronađe i da im pristupi na jednostavan način. Uz to, razmena sa drugim OER sistemima bi takođe trebalo da bude omogućena.

The abovementioned requirements, analysis of existing standards comparisons and the challenges and costs for a LOM implementation resulted in an Application Profile which is based on DC and DCTERMS

Navedeni zahtevi, uporedna analiza postojećih standarda, izazovi i troškovi implementacije LOM-a imali su za rezultat Profil aplikacije koji se zasniva na DC i DCTERMS-u sa nekim elementima preuzetim

with some elements taken from LOM. The elements from LOM are important to describe learning resources and facilitate exchange with other LORs. To identify the additional elements from LOM needed, it was necessary to evaluate the most commonly used LOM elements in other Application Profiles. The obtained results are described in the text that follows.

iz LOM-a. Elementi preuzeti iz LOM-a su važni zato opisivanje obrazovnih resursa i olakšavanje razmene sa drugim LO repozitorijumima. Da bi se odredili dodatni elementi LOM-a koji su potrebni, bilo je neophodno da se ocene elementi LOM-a koji se najčešće koriste u drugim profilima aplikacija. Dobijeni rezultati su prikazani u daljem tekstu.

4.1 Overview of proposed elements for BMP

Within the BMP metadata model there are seven subsets: General, Lifecycle, Technical, Educational, Rights, Classification and Relation. Another element of the model is the Controlled vocabulary, an external multilingual termbase, aimed to support attribute domain control. The Controlled vocabulary mandates the use of predefined, that is, preselected terms. Language support for the BAEKTEL portal will be described in more detail in Dev 3.3.

Model metapodataka BMP se sastoji od sedam celina: opšti metapodaci, životni ciklus, tehnički podaci, obrazovni, prava, klasifikacija i relacije. Dodatni elemenat modela je Kontrolisani rečnik, eksterna višejezična terminološka baza, koja omogućava kontrolu domena atributa. Kontrolisani rečnik propisuje korišćenje unapred definisanih, prethodno odabranih termina. Detalji jezičke podrške BAEKTEL portalu će biti detaljno opisani u Dev 3.3.

The following table provides an overview of the proposed elements to be included in the Application Profile. It also includes brief information about the elements of the controlled vocabulary used, the cardinality and if the element is mandatory or not.

Sledeća tabela daje pregled elemenata koji treba da budu uključeni u Profil aplikacije. Takođe, tabela sadrži kratke informacije o elementima kontrolisanog rečnika, kardinalnostima, kao i informacije o tome da li je neki element obavezan ili ne.

No.	Proposed Elements	Vocabulary	Mandatory/ Optional	Cardinality
General				
1	Title	-	Mandatory	Not-Repeatable
2	Contributor	-	Mandatory	Repeatable
3	Description	-	Optional	Repeatable
4	Language	Vocabulary (Serbian, English, Italian, Bosnian, Romanian, Croatian, Slovenian, Russian, Macedonian, German)	Mandatory	Repeatable
5	Date	-	Mandatory	Not-Repeatable
6	Type	Vocabulary (Best practice, Case study, Exercise, Guidelines, Lesson, Module, Portal, Promotional material, Reference material, Training manual)	Mandatory	Repeatable

7	Identifier		Mandatory	Not-Repeatable
8	Version	-	Optional	Not-Repeatable
9	Status	Vocabulary (Pending submission, pending review, active, waiting to be archived, archived, deleted)	Mandatory	Not-Repeatable
10	Format-	Vocabulary (Electronic Document, Paper only Document, Slides, Website, CD-Rom / DVD, Audio, Video)	Mandatory	Repeatable
11	Size	Automatic/Editable	Optional	Not-Repeatable
12	Location	Automatic/Editable	Mandatory	Not-Repeatable
13	Interactivity Level	Vocabulary (very low, low, medium, high, very high)	Optional	Not- Repeatable
14	Context	Vocabulary (School, Higher Education, Training, Lifelong learning)	Optional	Repeatable
15	Intended End User Role	Vocabulary (Learner, Teacher, Manager, Supervisor, Employees, Students)	Optional	Repeatable
16	Typical Learning Time	-	Optional	Not- Repeatable
17	Publisher	Vocabulary (USB, UB, UNIKG, UNI, UBL, UNITZ, UNIM,UL, TUIASI,ACMP,NIS)	Mandatory	Not- Repeatable
18	Rights	-	Optional	Not- Repeatable
19	Cost	Automatic No	Optional	Not- Repeatable
20	Keywords	-	Mandatory	Repeatable
21	Coverage	Vocabulary (Countries / Regions)	Optional	Repeatable
22	Subject	Vocabulary (OECD Frascati)	Mandatory	Repeatable
23	Relation		Optional	Repeatable

4.2 Elements for BMP: Description and cataloguing guidelines

The following section provides details about the proposed elements to be used for full description of OER on BMP, with the BAEKTEL metadata model depicted in Figure 3.

Naredni odeljak sadrži detalje predloženih elemenata kojima će se u potpunosti opisivati obrazovni resursi na BMP, pri čemu je model BAEKTEL metapodataka prikazan na slici 3.

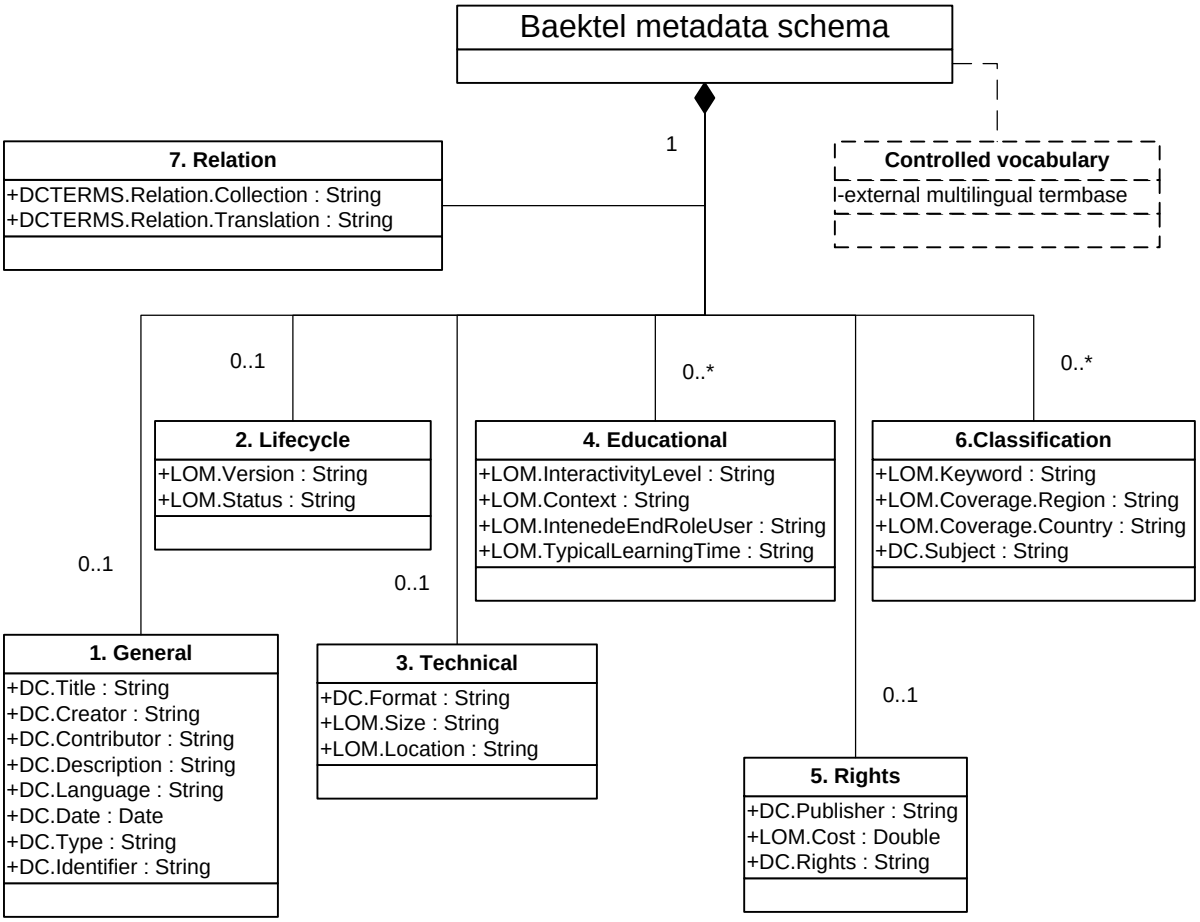

Figure 3. BMP metadata model

Slika 3. BMP model metapodataka

4.2.1 General

The title, creator, contributor, description, language of the resource content, date when the resource was made available to the public and type of resource are general data originating from the DC[1] standard. Within general data a unique code is defined to provide unambiguous identification and access to the resource.

Naslov, kreator, saradnik, opis, jezik na kom je publikovan resurs, potom datum publikovanja i tip resursa su opšti podaci koji potiču iz DC standarda. Među opštim podacima definisana je i jedinstvena šifra koja treba da obezbedi jednoznačnu identifikaciju i pristup resursu.

Title is the resource name given by its creator, namely a person, a group of people or an organization that generated the resource content. In the description data field a summarizing description of the resource is given. Another important feature of the

Naslov je naziv samog resursa koje mu daje kreator, odnosno osoba ili grupa autora ili organizacija koja je generisala obrazovni sadržaj. U polju opis se daje koncizni opis datog resursa. Još jedno važno svojstvo resursa se definiše poljem tip, koje određuje

[1] http://dublincore.org/documents/2012/06/14/dcmi-terms/

resource is defined by the type field, which specifies whether the content of the resource refers to best practice, case study, exercise, guidelines, lesson, and the like.	da li sadržaj resursa predstavlja primer dobre prakse, studiju slučaja, vežbu, uputstvo, preporuke, lekciju i slično.

DC.Title (Mandatory / Not-Repeatable)

Definition: A name given to the resource.	**Definicija**: Naziv pridružen resursu.
Guidelines: When titles are too general, title enrichment is recommended at the end of the original title, enclosed in square brackets.	**Uputstvo**: Ukoliko je naslov suviše uopšten, preporučuje se da se proširenje naslova vrši na kraju izvornog naslova u okviru uglastih zagrada.
Examples: Blasting in towns	**Primeri**: Miniranje u gradovima

DC.Creator (Mandatory / Repeatable)

Definition: Person, group of people or organizations responsible for making the content of the resource	**Definicija**: Osoba, grupa ljudi ili organizacija odgovorna za izradu sadržaja resursa.
Guidelines: Names of persons are in the following sequence: ***name surname***.	**Uputstvo**: Imena osoba su u obliku: ***ime prezime***.
Examples: Ivan Obradović, Giovanni Schiuma	**Primeri:** Ivan Obradović, Giovanni Schiuma

DC.Contributor (Optional / Repeatable)

Definition: Person, group of people or organizations who has made significant contributions to the resource but whose contribution is secondary to any person or organization specified in a CREATOR element (for example, editor, translator, and illustrator)	**Definicija**: Osoba, grupa ljudi ili organizacija koji su značajno doprineli resursu ali čiji je doprinos sekundaran u odnosu na bilo koju osobu ili organizaciju specificiranu u elementu kreator (npr. urednik, prevodilac, ilustrator).
Guidelines: Names of persons are in the following sequence: ***name surname name***.	**Uputstvo**: Imena osoba su u obliku: ***ime prezime***.
Examples: Miladin Kotorčević, Gabriela Schiuma	**Primeri:** Miladin Kotorčević, Gabriela Schiuma

(DC) Description (Mandatory /Not-Repeatable)

Definition: Concise description of resources

Guidelines: An abstract is not mandatory but should be supplied whenever possible.

Examples: This module focuses on the...

Definicija: Sažet opis resursa.

Uputstvo: Iako rezime nije obavezan, trebalo bi da se unese kad god je to moguće.

Primeri: Ovaj modul se fokusira na ....

(DC) Language / Mandatory / Repeatable

Definition: A language of the content of the resource.

Guidelines: Use ISO639-2 codes for language codes. Value is selected from the Vocabulary.

Examples: English: eng, Russian: rus, Serbian: srb

Definicija: Jezik sadržaja resursa.

Uputstvo: Koristi se ISO639-2 standard za kodove jezika. Vrednost se bira iz rečnika podataka.

Primeri: Engleski: eng, Ruski: rus, Srpski: srb

(DC) Date (Mandatory / Not-Repeatable)

Definition: Date when the resource was made available to the public.

Guidelines: Use three fields to select a date: day/month/year

Examples: 07/09/2013

Definicija: Datum kada je resurs postao dostupan javnosti.

Uputstvo: Koristite se tri polja za odabir datuma: dan/mesec/godina.

Primeri: 07/09/2013

(DC) Type (Mandatory / Repeatable)

Definition: Type identifies the nature of the content of the resource.

Guidelines: Type should be selected, from the Vocabulary.

Vocabulary:

Best practice: Best practice is defined as a process, technique or methodology which has been adopted successfully in delivering a particular outcome and recognized as improving performance and efficiency in specific areas.

Case study: A detailed description and analysis of a single project in a specific area. It

Definicija: Tip definiše prirodu sadržaja resursa.

Uputstvo: Tip se bira iz rečnika podataka.

Rečnik podataka:

Primer dobre prakse: Primer dobre prakse se definiše kao proces, tehnika ili metoda koja je uspešno prihvaćena jer daje dobre rezultate i unapređuje performanse i efikasnost u određenim oblastima.

Studija slučaja: Detaljan opis i analiza jednog projekta u specifičnoj oblasti. Može da sadrži iskustva od kojih se očekuje da

may contain lessons learned which are likely to help modify and improve future activities.

pomognu u modifikovanju i unapređivanju budućih aktivnosti.

Exercise: Exercise is a task which is performed as part of the learning plan or other larger unit of instructions aimed at developing or assessing particular skills and knowledge. For example, test, quiz, exam, experiment, activity.

Vežba: Vežba je zadatak koji se izvršava u okviru nekog plana za učenje ili druge veće nastavne jedinice sa ciljem razvoja ili procene određenih veština i znanja. Na primer: test, kviz, ispit, eksperiment, aktivnost.

Guidelines: Guidelines provide instructions and advice for performing a task and suggest possible approaches. Examples of guidelines include installation guides, planning guides, curriculum, syllabus, hand books etc.

Smernice/Uputstva: Smernice sadrže instrukcije i savete za obavljanje zadataka i sugerišu moguće pristupe. Primeri smernica/uputstava su uputstva za instalaciju, uputstva za planiranje, nastavni plan i program, priručnici, itd.

Lesson: Lessons are designed to teach a specific topic and include resources for direct student use ranging from printable text to interactive online activities. Use for any audio or video recording that may include a demonstration, presentation or a lecture.

Lekcije: Lekcije se kreiraju za učenje na određenu temu i sadrže resurse za neposrednu upotrebu studenta, koji se mogu kretati od teksta za štampu do interaktivnih *online* aktivnosti. Koriste se za bilo koji audio ili video snimak koji može da obuhvati demonstraciju, prezentaciju ili predavanje.

Module: Collection of materials for teaching that aims to provide a wide range of information/knowledge, often for extended periods.

Modul: Skup materijala za predavanje koji ima za cilj da pruži širok spektar informacija/znanja, često na duži vremenski period.

Portal: A Web site that acts as a "gateway" to multiple services, which could include links to useful learning materials, discussion groups, listservs, reference materials and other services.

Portal: Veb sajt sa kog korisnik može da pristupi većem broju servisa, koji mogu da obuhvate linkove ka korisnim obrazovnim materijalima, grupama za diskusiju, list serverima, referentnim materijalima i drugim servisima.

Promotional material: Any material or communication created for public awareness with educational purpose. This normally includes publication in any newspaper, magazine or similar medium, or material created for broadcast over television, radio, or other electronic medium. Some common examples are flyers, posters, fact sheets and newsletters.

Promotivni materijal: Bilo koji materijal ili saopštenje edukativnog karaktera namenjeno javnosti. Može biti novinski članak, materijal za prikazivanje putem televizije, radija, ili drugih elektronskih medija. Neki najčešći primeri su flajeri, posteri, prospekti i bilteni.

Reference material: A comprehensive and systematically organized collection of information such as a dictionary, encyclopaedia, or almanac.	**Referenti materijal:** Sveobuhvatna i sistematski organizovana kolekcija informacija, kao što su rečnici, enciklopedije ili almanasi.
Training manual: A training manual is a resource designed to teach the reader how to do something, such as use a software, behavior in the mine, manage an activity etc.	**Priručnik za obuku:** Priručnik za obuku je resurs namenjen da obuči korisnika kako da uradi nešto, kao što je korišćenje softvera, ponašanje u rudniku, upravljanje nekom aktivnošću, itd.
Examples: "Training manual for behavior in a mine"	**Primer**: „Priručnik za obuku ponašanja u rudniku“

(DC) Identifier (Mandatory / Not-Repeatable)

Definition: Identifier is a unique code that provides unambiguous access to the resource. Identifier is composed of the code of the partner institution and a resource code: course ID in the case of edX courses, or automatically generated by the system for other resources.	**Definicija**: Identifikator predstavlja jedinstveni kod koji omogućava jednoznačan pristup resursu. Identifikator se sastoji od koda partnerske institucije i šifre resursa: za edX kurseve to je ID kursa, dok je za ostale resurse sistem automatski generiše.
Guidelines: Assignment of a code that will include code of partner institution that publishes the resource.	**Uputstvo**: Dodela šifre koja će obuhvatiti šifru partnerske institucije koja publikuje resurs.
Examples: UB-0015, UNIM-0003	**Primeri**: UB-0015, UNIM-0003

4.2.2 Lifecycle

Data within the lifecycle subset are related to the steps in the development of the learning object and its current state, and originate from the LOM Standard. The version field designates the edition of the learning object, whereas the status field shows whether the resource is already active or pending submission, or maybe archived or even deleted.	Podaci u okviru kategorije životni ciklus vezani su za korake u razvoju obrazovne celine, kao i trenutno stanje, a potiče iz LOM standarda. Polje verzija označava izdanje obrazovne celine, dok polje status pokazuje da li je resurs već aktivan ili čeka publikovanje, ili je eventualno arhiviran ili čak obrisan.

(LOM) Version (Optional / Not-Repeatable)

Definition: The edition of a learning object.	**Definicija**: Izdanje resursa.
Guidelines: Version indicates the version of the software (e.g. alpha, beta), as well as published documents (e.g. first edition).	**Uputstvo**: Verzija ukazuje na verziju softvera (npr. alfa, beta), kao i publikovanog dokumenata (npr. prvo izdanje).

(LOM) Status (Mandatory / Not-Repeatable)

Definition: Status indicates the stage of development where the resource is located.	**Definicija**: Status ukazuje na fazu razvoja u kojoj se resurs nalazi.
Guidelines: Refers to the text resource, not a multimedia or software. Indicates whether the resource development is completed and ready for publication. Select from the Vocabulary.	**Uputstvo**: Odnosi se na tekstualne resurse, a ne na multimedije ili softvere. Ukazuje na to da li je razvoj resursa završen i spreman za publikovanje. Bira se iz rečnika podataka
Examples: Pending submission, pending review, active, waiting to be archived, archived, deleted.	**Primeri**: Čeka na publikovanje, čeka na pregled, aktivan, čeka za arhiviranje, arhiviran, obrisan.

4.2.3 Technical

The main element of technical data is the resource format, indicating whether it is an electronic document, a set of slides, a website, or a cd-rom/dvd, audio, or video. Other technical data are the resource size, given in bytes for digital resources, and resource location, namely its URL.	Osnovni tehnički podatak predstavlja format resursa, koji govori da li je u pitanju elektronski dokument, skup slajdova, veb sajt, audio ili video zapis. Ostali tehnički podaci su: veličina resursa, data u bajtovima za digitalne resurse, lokacija odnosno URL.

(DC) Format (Mandatory / Repeatable)

Definition: The format is the layout of a file in terms of how the information contained in the resource is organized.	**Definicija**: Format je izgled datoteke u smislu načina organizacije informacija sadržanih u resursu.
Guidelines: Select from the following list:	**Uputstvo**: Izabrati iz sledeće liste:
Electronic Document: Use for any kind of electronic text or spreadsheet, e.g. Microsoft Word, Adobe Acrobat PDF, or Microsoft Excel.	**Elektronski dokument**: Koristi se za bilo koju vrstu elektronskog teksta ili tabele, kao što su Microsoft Word, Adobe Acrobat PDF, ili Microsoft Excel.
Slides: Use for slide presentation, e.g. in Microsoft PowerPoint format.	**Slajdovi**: Koristi se za prezentacije, npr. u Microsoft PowerPoint formatu.

Website: Collection of web pages.	**Veb sajt:** Skup veb stranica.
Audio: Use for any type of audio files. Example file formats are: ".mp3", ".wav", ".mp4", ".midi", ".ram", ".mpga", etc.	**Audio:** Koristi se za bilo koji tip audio datoteke. Primeri formata su: ".mp3", ".wav", ".mp4", ".midi", ".ram", ".mpga", itd.
Video: Use for any type of video files. Example file formats are: ".avi", ".wmv", ".mpeg", ".mov", ".ram" etc.	**Video:** Koristi se za bilo koji tip video datoteke. Primeri fromata su: ".avi", ".wmv", ".mpeg", ".mov", ".ram" itd.
other	**ostalo**

(LOM) Size (Optional/ Repeatable)	
Definition: The size of the digital resource in bytes.	**Definicija**: Veličina digitalnog resursa izražena u bajtovima.
Guidelines: Automatic generation with possibility of editing.	**Uputstvo**: Automatski se generiše uz mogućnost izmene.

(LOM) Location (Mandatory / Not-Repeatable)	
Definition: The uniform resource locator, abbreviated as URL (web address), is a specific character string that constitutes a reference to a resource.	**Definicija**: URL (veb adresa), je specifična niska znakova koja predstavlja referencu na resurs.
Guidelines: Automatically generated by the OER portal.	**Uputstvo**: Automatski se generiše na OER portalu.

4.2.4 Educational

Educational set of elements originates from the LOM standard. They indicate the user type the resource is intended for, the characteristics of the learning environment, estimated time frame needed to master the learning resource and the level of its interactivity. The intended end user role field indicates the general profile of the expected user: learner, teacher, manager or supervisor.	Skup obrazovnih elemenata potiče iz standarda LOM, i upućuje na tip korisnika kome je resurs namenjen, karakteristike obrazovnog okruženja, procenjeno vreme potrebno da se savlada obrazovni resurs i nivo njegove interaktivnosti. Polje očekivane korisničke uloge govori koji je opšti korisnički profil očekivanog korisnika: učenik, učitelj, menadžer ili supervizor.
Context describes the environment within which the use of the learning object is expected to take place: school, higher education, training or other. As for typical	Kontekst opisuje okruženje u kom se planira korišćenje obrazovne celine: škola, fakultet, trening ili nešto drugo. Što se tiče tipičnog vremena učenja, to je procenjeno vreme

learning time, it is the approximate time needed for an average learner to study the content of the educational resource. The interactivity level specifies the degree to which the resource can be influenced by the learner, ranging from "very low", e.g. for documents that can only be printed to "very high", such as a virtual 3-D environments, offering various options for exploring.

potrebno prosečnom učeniku za savladavanje sadržaja obrazovnog resursa. Nivo interaktivnosti upućuje na stepen u kome učenik može da utiče na resurs, u rasponu od "veoma nizak", npr. za dokumenta koja se mogu samo štampati do "veoma visok", kao što je virtuelno 3-D okruženje, koje nudi razne opcije za istraživanje.

(LOM) Interactivity Level (Optional / Not-Repeatable)

Definition: Represents the degree of interactivity.

Guidelines: Indicate the degree to which the learner can influence the aspect or behaviour of the component. Select from the following list: very low, low, medium, high, very high

Examples: "very low": e.g. documents intended for printing "low": e.g. video clip with play and pause controls, "medium": e.g. hypertext, "high": e.g. lesson with multiple-choice exercises providing feedback, "very high": e.g. virtual environment (3-D) enabling exploring

Definicija: Predstavlja stepen interaktivnosti.

Uputstvo: Ukazuje na stepen mogućeg uticaja učenika na prikaz ili ponašanje komponente. Bira se iz ponuđene liste: vrlo nizak, nizak, srednji, visok, vrlo visok.

Primeri: "vrlo nizak": npr. dokumenta namenjena štampanju, "nizak": npr. video klipovi koji se mogu ručno pokrenuti i pauzirati, "srednji": npr. hipertekst, "visok": npr. sa mogućnošću višestrukog izbora lekcija i povratnim informacijama, "vrlo visok": virtuelno 3-D okruženje sa mogućnostima istraživanja

(LOM) Context (Optional / Repeatable)

Definition: The principle environment within which the learning and use of this learning object is intended to take place.

Guidelines: By selecting the appropriate audience and level for the material, users conducting searches will be able to narrow in on the materials appropriate for those they are teaching. Select from the following list:

School: A school is "an establishment in which boys or girls, or both, receive instruction" (OED).

Higher education: Postsecondary education at colleges, universities, junior or community colleges, professional schools, technical institutes, and teacher-training schools.

Definicija: Osnovno okruženje u okviru koga će se odvijati učenje i korišćenje ovog obrazovnog materijala.

Uputstvo: Definisanjem obrazovnog nivoa i ciljane grupe za materijal, korisnici koji vrše pretragu će lakše pronalaziti materijale koji odgovaraju onima koje obučavaju. Izabrati iz sledeće liste:

Škola: Škola je „ustanova u kojoj se dečacima ili devojčicama ili i jednima i drugima održava nastava“ (OED).

Visoko-obrazovanje: Treći nivo obrazovanja na višim školama, univerzitetima, profesionalnim školama, tehničkim institutima i školama za obuku nastavnika.

Life long learning: adult education or the acquisition of formal qualifications or professional skills later in life, continuing education which often includes extension or not-for-credit courses offered by higher education institutions, professional development and on-the-job training, self-directed learning	**Celoživotno učenje:** obrazovanje odraslih ili sticanje formalnih kvalifikacija ili stručnih veština kasnije u životu, kontinuirano obrazovanje koje često obuhvata produžne ili neobavezne (fakultativne) kurseve koje nude visokoškolske ustanove, stručno usavršavanje i obuka na poslu, samostalno učenje
Training: Training is the teaching of vocational or practical and relates to specific useful skills.	**Obuka:** Obuka je praktična i stručna nastava koja se odnosi na usavršavanje određenih veština.
Other: Any material that cannot be categorized as any of the above.	**Druga:** Bilo koji materijal koji ne može da se svrsta u neku od prethodno navedenih opcija.

(LOM) IntendedEndUserRole (Optional / Repeatable)

Definition: Principle user(s) for which this learning resource was designed	**Definicija**: Osnovna grupa korisnika za koje je obrazovni resurs namenjen
Guidelines: Represents the principal user(s) for which resource was designed. Select from the following list:	**Uputstvo**: Predstavlja osnovne korisnike za koje je resurs kreiran. Odabrati korisnika iz sledeće liste:
Student: A student is a person who learns or receives instruction within the educational system. A student works with a learning resource in order to learn something.	**Učenik:** Učenik je osoba koja uči i koja prima instrukcije u okviru obrazovnog sistema. Učenik radi sa obrazovnim resursom sa ciljem da nauči nešto.
Employee: An employee is a person who learns or receives instruction within the life-long learning process. An employee works with a learning resource in order to learn something.	**Zaposleni:** Zaposleni je osoba koja uči i koja prima instrukcije u okviru procesa celoživotnog učenja. zaposleni radi sa obrazovnim resursom sa ciljem da nauči nešto.
Teacher: A teacher is a person who teaches or instructs; an instructor.	**Nastavnik:** Nastavnik je osoba koja podučava ili daje instrukcije; instruktor.
Manager: A manager is a person who manages an enterprise.	**Supervizor:** Supervizor je osoba koja upravlja preduzećem.
Non specific: Does not have an intended end user role.	**Nespecifičan:** Nema specifičnog krajnjeg korisnika.

(LOM) TypicalLearningTime/ Optional / Not-Repeatable

Definition: Approximate or typical time it takes to work with or through this learning object.

Guidelines: If possible, indicate duration using days, hours and minutes.

Examples: 3 hours 30 minutes, 5 days x 4 hours

Definicija: Procenjeno ili tipično vreme potrebno za savladavanje sadržaja ovog obrazovnog materijala.

Uputstvo: Ukoliko je moguće treba prikazati trajanje u danima, satima i minutima.

Primer: 3 sata 30 minuta, 5 dana x 4 sata

4.2.5 Rights

The rights category is a combination of DC and LOM. The publisher, a person, group, or organization responsible for publication of the resource, and rights specifying property rights related to resource, especially intellectual property rights (type of license) originate from DC. Cost is derived from LOM to indicate whether the learning object can be used free of charge or requires some sort of financial contribution.

Kategorija Prava kombinuje DC i LOM. Polja Izdavač, u kome se navodi osoba, grupa ili organizacija koja publikuje resurs, kao i Prava, u kome se navode autorska prava vezana za resurs, naročito pravo intelektualne svojine (tip licence) potiču iz DC. Cena je izvedena iz LOM i ukazuje na to da li je korišćenje resursa besplatno ili se zahteva neka vrsta finansijske nadoknade.

(DC) Publisher / Mandatory / Not-Repeatable

Definition: A publisher is the individual, group, or organization named in the document as being responsible for that document's publication, distribution, issuing, or release.

Guidelines: Enter the name of the publisher in the form found on the item.

Examples: Faculty of Mining and Geology, Laguna

Definicija: Izdavač je osoba, grupa ili organizacija koja je navedena u dokumentu kao odgovorna za objavljivanje, distribuciju, izdavanje ili puštanje u opticaj tog dokumenta.

Uputstvo: Uneti ime izdavača u formular koji se nalazi u ovoj stavci.

Primeri: Rudarsko-geološki fakultet, Laguna

(DC) Rights / Optional / Not-Repeatable

Definition: Information on the rights of resource use.

Guidelines: Contains information on intellectual property rights, rights of protection of copyright and the property rights.

Definicija: Informacije o pravima korišćenja resursa.

Uputstvo: Sadrži informacije o pravima intelektualne svojine, autorska prava i imovinska prava.

Examples: creative commons

Primeri: creative commons

(LOM) Cost / Optional / Not-Repeatable)

Definition: Whether use of this learning object requires payment.

Guidelines: As all resources are free for use, this field will automatically contain the value "*no*".

Definicija: Da li korišćenje ovog obrazovnog materijala zahteva neko plaćanje.

Uputstvo: Pošto je korišćenje svih resursa besplatno, polje se automatski popunjava sa "*ne".*

4.2.6 Classification

The classification category is aimed at grouping resources into classes, on basis of their common features, resulting in their systematic arrangement for browsing purposes. The subject field indicates the main topic of the resource, while keywords give more specific resource features, and enable indexing and information retrieval, while coverage specifies the country of jurisdiction for the resource.

Klasifikaciona kategorija je namenjena grupisanju resursa u klase, na osnovu zajedničkih svojstava, kako bi se omogućilo sistematično prelistavanje resursa. Polje subjekat upućuje na glavnu temu resursa, dok ključne reči daju preciznije karakteristike i omogućavaju indeksiranje i pronalaženje informacija. Polje pokrivenost označava zemlju pravno nadležnu za taj resurs.

(DC) subjectClassification (Mandatory / Repeatable)

Definition: The systematic arranging into classes (classifying), according to common characteristics or affinities, things, topics, themes or notions which are the subject of any branch of science or of a methodical inquiry.

Guidelines: Classification allows for systematic arrangement and browsing of resources. The taxonomy based on the recommendations of the OECD Frascati classification will be used. (OECD & Development)

Examples: Quality Control, Information Technology in Education

Definicija: Sistemsko organizovanje u klase (klasifikacija), u skladu sa zajedničkim karakteristikama ili zajedničkim afinitetima, sadržajem, temama ili pojmovima koji su deo jedne grane nauke ili metodičkog istraživanja.

Uputstvo: Klasifikacija omogućava sistematsko uređenje i pretraživanje resursa. Koristiće se taksonomija zasnovana za preporukama OECD Frascati klasifikacije. (OECD & Development)

Primeri: Kontrola kvaliteta, Informacione tehnologije u obrazovanju

(LOM) Keywords / Mandatory / Repeatable

Definition: List of terms or keywords, in a particular field, for use in indexing and information retrieval.	**Definicija**: Skup termina ili ključnih reči, u nekom određenom polju, koji se koristi za indeksiranje i pretragu informacija.
Guidelines: Establish its own independent set of keywords.	**Uputstvo**: Formirati sopstveni skup ključnih reči.
Examples: Community development, Geology, Mining.	Primeri: Razvoj društva, Geologija, Rudarstvo.

(DCTERMS) Coverage spatial / Optional / Repeatable

Definition: Spatial characteristics of the intellectual content of the resource. Defined region and country.	**Definicija**: Prostorna karakteristika intelektualnog sadržaja resursa. Definiše se region i zemlja.
Guidelines: Choose one or more regions/countries from the provided list. In case the learning resource has a global coverage, do not indicate the region or coutry.	**Uputstvo**: Izabrati jednu ili više regija/zemalja iz ponuđene liste. U slučaju da je obrazovni resurs globalnog karaktera ne treba navoditi regiju ni zemlju.
Examples for region: Europe, Balkan	**Primeri za region:** Evropa, Balkan
Examples for country: Serbia, Montenegro, Bosnia and Herzegovina, Italy, Slovenia	**Primeri za zemlju:** Srbija, Crna Gora, Bosna i Hercegovina, Italija, Slovenija

4.2.7 Relation

The relation category is mostly used for course translations, namely, when the same course is published in more that one language. Other relations, besides translation, can be implemented among resources, for example, the whole/part relation in case of a complex course that can be subdivided into smaller ones. When languages and skills are concerned, courses are often classified by their level as entry, intermediary, higher, and thus the relation previous/following can be implemented.	Kategorija relacije se koristi prvenstveno za prevode resursa, ako se recimo isti kurs publikuje na više jezika. Osim prevoda se može implementirati i neki drugi tip relacije među resursima, recimo relacija celina/deo kada imamo neki kompleksan resurs koji može biti podeljen u više manje. Kada su u pitanju jezici ili veštine, često se kursevi pos svom nivou dele na početni, srednji, viši tako da se može implementirati relacija prethodi/ sledi.

(DC) Relation / Optional / Repeatable

Definition: The relationship of this resource to other resources.	**Definicija**: Veza resursa sa drugim resursima.

Relation: Collection, (DCTERMS) has part / (DCTERMS) is part of

Guidelines: Use to indicate collection the resource is part of, or to indicate related language versions.	**Uputstvo**: Koristi se za ukazivanje kojoj kolekciji pripada resurs i na kojim sve jezicima je dostupan resurs..

5 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 study the resources at their own pace. 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 also been provided (Obradović, Stanković, Prodanović, & Kitanović, 2013).

BAEKTEL platforma omogućava korišćenje OER materijala potpuno slobodno, svima i u bilo kom trenutku putem interneta. Pri tome, OER korisnici sa univerziteta i preduzeća su u mogućnosti da proučavaju resurse tempom koji im lično odgovara. BAEKTEL servisi bi trebalo da podrže formalne metode za opis učenja, kao i metode za opisivanje kognitivnog radnog opterećenja studenata i nastavnika. Postoje i mogućnosti za jednostavnu integraciju obrazovnog sadržaja iz različitih izvora (Obradović, Stanković, Prodanović, & Kitanović, 2013).

In order to ensure the abovementioned functionalities, BAEKTEL framework implements three user profiles or roles: resource creators, course participants and system administrators.

Da bi se obezbedile pomenute funkcije, u okviru BAEKTEL-a implementirana su tri profila korisnika: kreatori resursa, polaznici kursa i administratori sistema.

System administrators (Figure 4) manage and maintain the BAEKTEL Metadata Portal and OER platforms. Administrator manages user accounts, opens new accounts for teachers and assigns appropriate privileges to users. Modification of the initial set of metadata is also performed by the system administrator.

Administratori sistema (Slika 4) upravljaju BAEKTEL portalom metapodataka i OER platformama i održavaju ih. Administrator upravlja korisničkim nalozima, otvara nove naloge za nastavnike i dodeljuje odgovarajuće privilegije korisnicima. Sistem administrator po potrebi takođe modifikuje inicijalni skup metapodataka.

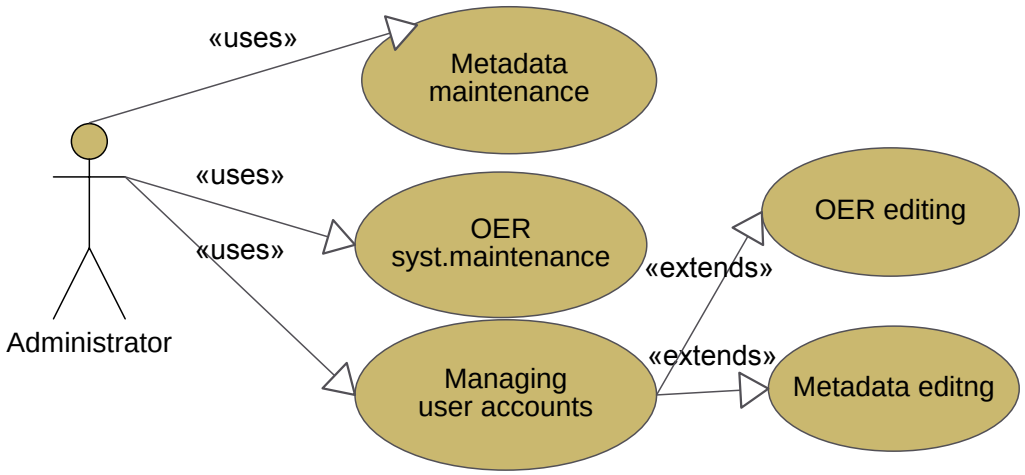

Figure 4: Administrator as the user of BAEKTEL

Slika 4. Administrator kao korisnik BAEKTEL-a

The resource creator (Figure 5) has to own an account with privileges for teacher profile. Since the BAEKTEL framework is composed of different types of software and several distributed repositories, it was desirable to provide single 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 (Authenticationworld.com).

Kreator kursa (Slika 5) mora da poseduje sopstveni nalog sa privilegijama nastavnika. Pošto se BAEKTEL okvir sastoji od raznorodnih softvera i više distribuiranih baza poželjno je obezbediti single sign-on (SSO). Single sign-on omogućava kontrolu većem broju povezanih, ali međusobno nezavisnih softverskih sistema. Korisniku je time omogućeno da se prijavi na jednom i da dobije pristup svim ostalim sistemima u okviru mreže bez zahteva da se ponovo prijavi na svaki od njih. (Authenticationworld.com)

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.

Kreatori resursa nakon postavljanja novog resursa moraju da popune metapodatke. Oni imaju mogućnost da koriste postojeće ili dodaju nove termine koristeći terminološku veb aplikaciju.

In the terminological dictionary, a definition is given for each term, with its synonyms and translation in English, Russian and other languages (Stanković, Obradović, Kitanović, & Kolonja, Building Terminological Resources in an e-Learning Environment., 2012).

Za svaki termin u terminološkom rečniku dati su njegova definicija, sinonimi i prevodi na engleski, ruski i ostale jezike (Stanković, Obradović, Kitanović, & Kolonja, Building Terminological Resources in an e-Learning Environment., 2012).

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, for textual resources entire texts or their parts can be annotated or classified using the bag-of-words approach (Bag-of-words).

Ukoliko je resurs kreiran kao HTML, postoji dodatna mogućnost da se ključni termini u tekstu putem web servisa povežu sa odgovarajućim pojmovima u rečniku i na taj način se učenicima omogućavaju dodatna pojašnjenja, odnosno prevodi na druge jezike. Sem toga, za tekstualne resurse može se uraditi anotacija celih tekstova ili odabranih delova teksta, ili se uraditi klasifikacija na osnovu izdvojene takozvane vreće reči (Bag-of-words).

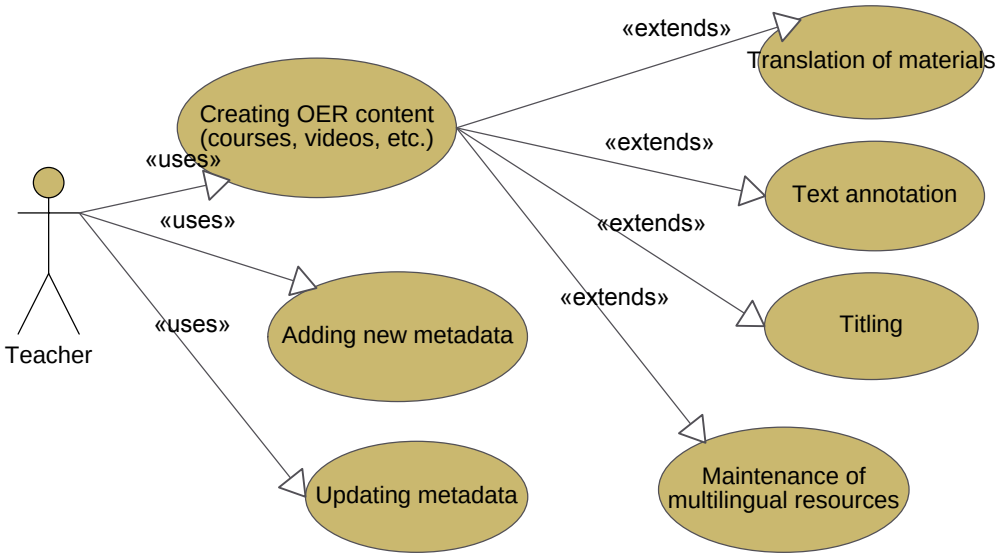

Figure 5: Teacher as the user of BAEKTEL

Slika 5. Nastavnik kao korisnik BAEKTEL-a

Metadata search and browse is publicly available without log-in, but for accessing OER content user registration is required. As multiple repositories exists the learners (Figure 6) will also have the SSO possibility, namely to log-in once and follow all the courses that are offered, regardless of particular physical OER location.

Pretraga i pregled metapodataka su javno dostupni bez prijavljivanja. Međutim, da bi korisnik mogao da pristupi nekom resursu potrebno je prethodno da se registruje. Pošto ima više repozitorijuma i učenicima (Slika 6) je omogućen single sign-on, tako da je dovoljno da se jednom prijave i mogu da prate sve kurseve koji su na raspolaganju, bez obzira na kojoj fizičkoj lokaciji se nalazi OER.

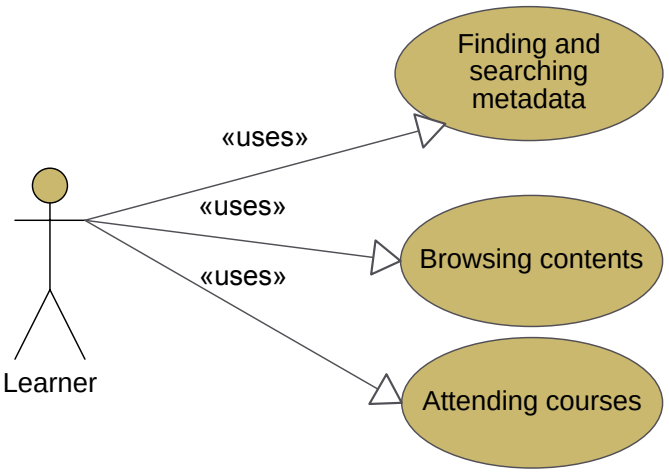

Figure 6: Learner as the user of BAEKTEL

Slika 6. Učenik kao korisnik BAEKTEL-a

6 The language support system

The BMP language support system, whose structure is outlined in Figure 7, is based on electronic language resources, namely, lexical resources, textual resources and grammars. The simplest multilingual lexical resources in general are bilingual dictionaries in electronic form.

However, for their full functionality in languages with complex morphology, such as Serbian, they need to be coupled with language specific morphological dictionaries and grammars that are implemented by the so called finite state automata, finite state transducers and compound inflection rules (Krstev, Processing of Serbian – Automata, Texts and Electronic dictionaries, 2008).

An important lexical resource offering support for multilingual terminology is the WordNet developed for Serbian and linked to English WordNet. In brief, a WordNet consists of sets of synonymous words representing specific concepts, called synsets, with a semantic network formed on basis of semantic relations between them. (Krstev, Pavlović-Lažetić, Vitas, & Obradović, 2004).

Sistem za jezičku podrška BMP portalu, čija je struktura prikaza na Slici 7, zasniva se na elektronskim jezičkim resursima, odnosno leksičkim i tekstualnim resursima i gramatikama. Najjednostavniji višejezički resursi su u načelu dvojezični rečnici u elektronskom obliku.

Međutim, da bi se obezbedila njihova puna funkcionalnost u jezicima kompleksne morfologije, kakav je srpski, oni se moraju kombinovati sa jezički specifičnim morfoloških rečnicima i gramatikama, koji se implementiraju konačnim automatima i transduktorima i pravilima za fleksije složenih reči (Krstev, Processing of Serbian – Automata, Texts and Electronic dictionaries, 2008).

Važan leksički resurs za podršku višejezičnoj terminologiji je WordNet razvijen za srpski i povezan sa engleskim. Ukratko, WordNet se sastoji od skupova sinonima kojima se predstavljaju koncepti, i koji se nazivaju sinseti, sa semantičkom mrežom zasnovanom na semantičkim relacijama između njih. (Krstev, Pavlović-Lažetić, Vitas, & Obradović, 2004).

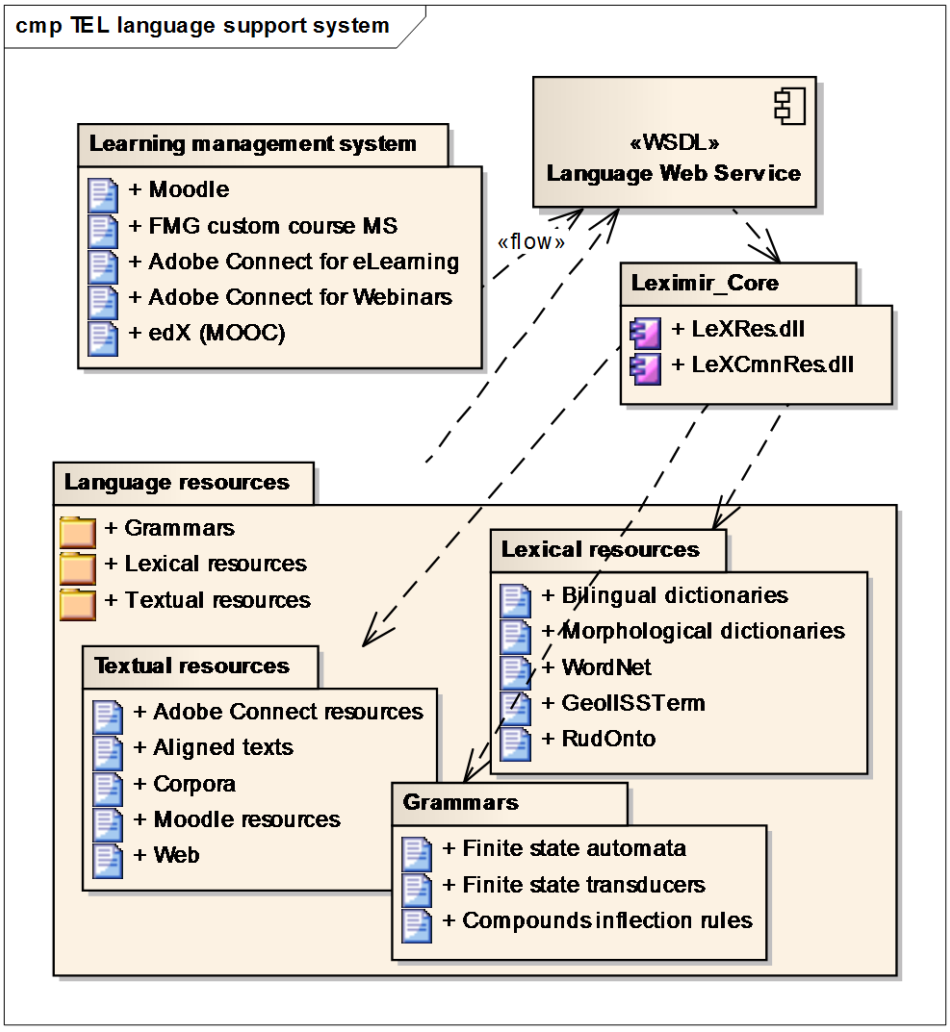

Figure 7: The BMP language support system

Finally, the language support system features domain specific terminological resources such as GeoIISSterm and RudOnto (Stanković, Obradović, Kitanović, & Kolonja, Building Terminological Resources in an e-Learning Environment., 2012). GeoIISS is a thesaurus of geological terms with entries in Serbian and English, (http://geoliss.mre.gov.rs), while RudOnto is related to mining terminology. Within RudOnto a bilingual thesaurus of OER is developed, comprising the core OER glossary of basic terms and metadata definitions as well as definitions and values of domains, available at: http://rudonto.rgf.bg.ac.rs/StabloOER.aspx

Slika 7. Sistem za jezičku podršku BMP

Konačno, sistem za jezičku podršku ima domenski specifične terminološke resurse kao što su GeoIISSterm i RudOnto (Stanković, Obradović, Kitanović, & Kolonja, Building Terminological Resources in an e-Learning Environment., 2012). GeoIISS je tezaurus geoloških pojmova na srpskom i engleskom, (http://geoliss.mre.gov.rs), dok se RudOnto odnosi na rudarsku terminologiju. U okviru RudOnto je razvijen dvojezični tezaurus OER-a, koji sadrži OER glosar osnovnih termina i definicije metapodataka, kao i definicije i vrednosti domena, što je dostupno na: http://rudonto.rgf.bg.ac.rs/StabloOER.aspx

The BMP language support system also offers the possibility of storing specific textual resources, such as aligned texts and corpora. Finally the World Wide Web itself represents a textual resource that BMP language support system makes use of.

Sistem za jezičku podršku BMP takođe nudi mogućnost čuvanja specifičnih tekstualnih resurse, kao što su poravnati tekstovi i korpusi. Konačno i sam World Wide Web predstavlja tekstualni resurs koji koristi sistem za jezičku podršku BMP.

The language support system handles various types of requests issued by users, usually in the form of a query. When handling a query, the Language Web Service uses a component of LeXimir, the software tool for lexical resources management and query expansion, developed at University of Belgrade (Stanković, Obradović, Krstev, & Vitas, 2011). During this processing the system can perform a morphological expansion of the query to improve recall, which is especially important for morphologically rich languages such as Serbian. In order to support the multilinguality of the BMP, the language support system can also expand the search in one language to another language, e.g. a query in Serbian to English or Russian, and vice-versa.

Sistem za jezičku podršku obrađuje različite vrste korisničkih zahteva, uglavnom u obliku upita. Pri obradi upita, jezički veb servis koristi komponentu programa LeXimir za upravljanje leksičkim resursima i ekspanziju upita, razvijen na Univerzitetu u Beogradu Belgrade (Stanković, Obradović, Krstev, & Vitas, 2011). Tokom obrade upita sistem može da morfološki proširi upit da bi za poboljšao odziv, što je posebno važno za morfološki bogate jezike kao što je srpski. U cilju podrške višejezičnosti BMP, sistem za jezičku podršku takođe može proširiti pretragu sa jednog jezika na drugi jezik, npr. upit sa srpskog na engleski ili ruski, i obrnuto.

With all the aforementioned features the language support system takes a prominent place within the BMP, offering invaluable support for better understanding and handling of the multilingual OER content.

Zahvaljujući svim prethodno navedenim karakteristikama sistem za jezičku podršku zauzima istaknuto mesto u okviru BMP, pružajući neprocenjivu podršku boljem razumevanju i rukovanju višejezičnim sadržajem OER-a.

7 Conclusions

This document outlines the conceptual design of the ICT solution for BAEKTEL framework. All the salient features of this design are discussed, starting with the metadata and OER platforms, and followed by a detailed description of characteristics and requirements of BMP, the BAEKTEL metadata portal.

U ovom dokumentu je izložen konceptualni dizajn IKT rešenja za BAEKTEL okvir. Raspravljena su sva ključna svojstva dizajna, počev od platformi za metapodatke i OER. Potom je dat detaljan opis karakteristika i zahteva koji se postavljaju pred BMP, BAEKTEL portal metapodataka.

A metadata set for BAEKTEL OER is proposed and elaborated, bearing in mind that further refinement of this set will occur in practice.

Predložen je i razrađen skup metapodataka za BAEKTEL otvorene obrazovne resurse, imajući u vidu da će u praksi oni biti dalje dorađivani.

The BMP use case model describes the three main roles of BMP users, administrator, teacher and learner. The language support system enabling multilinguality of the entire system is also outlined.

Model slučajeva korišćenja BMP opisuje tri glavne uloge korisnika BMP, administratora, nastavnika i učenika. Opisan je i sistem za jezičku podršku koji omogućava višejezičnost celog sistema.

Successful development of the ICT solution for BAEKTEL framework requires coordination of activities among partners with possibly different levels of IT skills. It also needs successful organization of public procurement and acquisition of appropriate equipment. As for its smooth operation, the hardware and software infrastructure and communication links must function flawlessly.

Uspešan razvoj IKT rešenja za BAEKTEL okvir zahteva koordinaciju aktivnosti među partnerima sa mogućim različitim nivoima IT veština. On takođe zahteva uspešnu realizaciju javnih nabavki i pribavljanje odgovarajuće opreme. Da bi se obezbedio njegov rad bez zastoja, hardverska i softverska infrastruktura i komunikacione linije moraju da funkcionišu besprekorno.

8 References

Atkins, D., Brown, J., & and Hammond, A. (2007). A Review of the Open Educational Resources (OER) Movement: Achievements, Challenges, and New Opportunities.

Authenticationworld.com. (n.d.). SSO and LDAP Authentication, Authenticationworld.com. Preuzeto sa http://www.authenticationworld.com/Single-Sign-On-Authentication/SSOandLDAP.html

Bag-of-words. (n.d.). Bag-of-words representation of text. Preuzeto sa https://inst.eecs.berkeley.edu/~ee127a/book/login/exa_bag_of_words_rep.html

Barker, P. (2005). What is IEEE Learning Object Metadata/IMS Learning Resource Metadata? *CETIS standards briefings series* .

Barker, P., & Campbell, L. (2014.). Learning Resource Metadata Initiative: using schema.org to describe open educational resources. *Proceedings of OpenCourseWare Consortium Global 2014: Open Education for a Multicultural World.*

Breslow, L., Pritchard, D. E., DeBoer, J., Stump, G. S., Ho, A. D., & Seaton, T. (2013). Studying Learning in the Worldwide Classroom: Research Into edX's First MOOC. *RPA Journal, 8, Summer 2013* , 13-25.

Cenoz, J., & Gorter, D. (2011). A holistic approach to multilingual education: Introduction. *The Modern Language Journal, 95(3)* , 339-343.

Chan, L., & Zeng, M. (2006). Metadata Interoperability and Standardization – A Study of Methodology Part I, Achieving Interoperability at the Schema Level. *D-Lib Magazine, Vol. 12(6)* .

DCMI. (2014). *The Dublin Core Metadata Initiative.*

EDNA. (2003). The EDNA Metadata Standard. (J. Millea, Ur.) Preuzeto sa http://clt.odu.edu/mabdous/eci731/weeks/week07/edna_metadata.pdf

FAO. (2007). Metadata Application Profile for FAO's Learning Resources. Preuzeto 2014 sa ftp://ftp.fao.org/gi/gil/gilws/aims/metadata/docs/learnap.pdf

Friesen, N. (2004). *Technical Evaluation Report, 40.* The International Learning Object Metadata Survey, CanCore Initiative. .

GEM. (2010). GEM metadata element set for the Gateway to Educational Materials.

GLOBE. (2012). *Global Learning Objects Brokered Exchange*. Preuzeto sa http://www.globe-info.org/

IEEE, & IMS Global Learning, C. (2002). IMS Meta-data Best Practice Guide for IEEE 1484.12.1-2002 Standard for Learning Object Metadata. *Learning Resource Meta-data Specification* . Preuzeto sa http://www.imsproject.org/metadata/

Koutsomitropoulos, D. A. (2010). The Use of Metadata for Educational Resources. *Digital Repositories: Practices and Perspectives, D-Lib Magazine, Volume 16, Number 1/2* .

Krstev, C. (2008). *Processing of Serbian – Automata, Texts and Electronic dictionaries.* Belgrade: Faculty of Philology, University of Belgrade.

Krstev, C., Pavlović-Lažetić, G., Vitas, D., & Obradović, I. (2004). Using Textual and Lexical Resources in Developing Serbian Wordnet. *Romanian Journal of Information Science and Technology, 7(1-2)* , 147-161.

Krstev, C., Stanković, R., Obradović, I., Vitas, D., & Utvić, M. (2010). Automatic Construction of a Morphological Dictionary of Multi-Word Units. U E. R. Hrafn Loftsson (Ur.). (str. 226-237). Reykjavik, Iceland: Lecture Notes in Computer Science 6233 Springer 2010.

MERLOT. (2014). Preuzeto sa Multimedia Educational Resource for Learning andOnline Teaching: http://www.merlot.org

Obradović, I., Stanković, R., Prodanović, J., & Kitanović, O. (2013). A Tel Platform Blending Academic and Entrepreneurial Knowledge. *Proceedings of The Fourth International Conference on e-Learning (eLearning-2013), Belgrade, Serbia.*

OECD, & Development, O. f.-o. (n.d.). REVISED FIELD OF SCIENCE AND TECHNOLOGY (FOS) CLASSIFICATION IN THE FRASCATI. *DSTI/EAS/STP/NESTI(2006)19/FINAL* . Preuzeto sa http://www.oecd.org/science/inno/38235147.pdf

Stanković, R., Obradović, I., Kitanović, O., & Kolonja, L. (2012). Building Terminological Resources in an e-Learning Environment. *Proceedings of The Fourth International Conference on e-Learning (eLearning-2012), Belgrade, Serbia, 2012*, (str. 114-119).

Stanković, R., Obradović, I., Kitanović, O., Prodanović, J., & Ilić, V. (2011). An approach to implementation of blended learning in a university setting. *Proceedings of the Second International Conference on e-Learning, eLearning 2011* , 61-66.

Stanković, R., Obradović, I., Krstev, C., & Vitas, D. (2011). Production of morphological dictionaries of multi-word units using a multipurpose tool. *Proceedings of the Computational Linguistics-Applications Conference, CLA '11, 77-84.*

Velichová, D. (2008). RLO in e-Learning Solutions. *Proceedings of 9th International Conference Virtual University Slovakia* .

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