
Novel open education platform for innovative learning and knowledge management

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Structured Abstract

Purpose – In today’s globalized, networked and fast-changing environment, knowledge became invaluable asset for everyone – students, workers, and organizations. Life-long learning became crucial to the future of our society. In order to foster more effective and collaborative learning and knowledge exchange it is necessary to utilize modern information technologies and services. If used in the right way, information technology can transform and energize educational process, stimulate learning in anyplace and anytime, promote creative thinking, and make better use of existing individual and organizational resources. The rationale of this paper is to introduce the innovative open educational model and supporting software system which is capable to answer the major challenges of modern education.

Design/methodology/approach – Although modern web technologies and open educational resources (OER) have great potential to bring new opportunities for learning and knowledge exchange, at the same time, developing successful OER systems is very challenging. Design of an innovative and open learning software environments needs a holistic approach, which comprises specific methodology, software architecture, and various services, applications and tools. This paper describes methodological approach, software architecture, services and features of the innovative software solution, which address important issues that face organizations when designing and implementing OER systems. The modular design and composite architecture enable flexibility in terms of the infrastructure and platform, available services, scalability, and integration.

Originality/value – Traditional educational systems cannot completely meet current educational requirements. On the other hand, many of the existing OER and e-learning initiatives didn’t fulfil high expectations. The OER model proposed in this paper provides a novel approach to design and utilization of different cutting-edge technologies that are seamlessly combined to provide flexibility, scalability, personalization, collaboration, content management, searching, and social networking. The proposed OER model and software platform enables creation of agile and adaptable educational ecosystem that can

transform the learning experience, and connect individuals, educational institutions and companies.

Practical implications – The presented OER software architecture is multi-layered and seamlessly combines various services and technologies that enable creation of integrated and feature-rich open educational environments. It is a flexible, customizable, and extensible software environment that can support various OER scenarios. The new application model and software solution are architected and designed in such a way to provide the following advancements in terms of: alignment, agility, adaptivity, manageability, functionality, interoperability, performance, and security. This enables establishing flexible, adaptable, cost-effective and sustainable OER environment where individuals, educational institutions, companies and government collaborate, create, share and discover learning resources and knowledge.

Keywords – OER, Architecture, Web Portal, Learning, Knowledge.

Paper type – Academic Research Paper

1 Introduction

In today's globalized and knowledge-based economy, education became a critical part of any organizational and personal strategy. This new economy is based on entrepreneurship in knowledge creation and sharing, innovation and creativity, lifelong learning, and utilizing information technology for developing and selling new products and services (Carayannis et al., 2006). Consequently, organizations need skilled and knowledgeable workers from, and the new ways to train those workers, and to share knowledge both within the organisation and across organisational boundaries. The traditional model, based on mass production where competitive advantage was gained through decreasing production costs or increasing productivity, has given way to a need for organisations to adapt to changes in market conditions, seek new opportunities, enhance learning, embrace change and innovation, and create and share knowledge.

Information technology makes it possible to simultaneously coordinate training activities in many different locations and beyond traditional organisational boundaries. This has enabled organizations to create new structures, such as the networked e-learning organisation or the knowledge management system, that are more flexible and efficient, harness the best skills and experience of workers and eliminate many of the costs associated with running traditional educational and learning models.

Workforce in the new millennium is global, highly connected, technology-savvy, and demanding. Also, the critical skills are scarce and unevenly distributed around the world, so companies are forced to adopt innovative new ways to find people, develop capabilities, and share expertise. The traditional education and training model is being superseded with more agile and flexible user-centric learning models. Furthermore, there is an explosion of various learning content that is delivered via Internet or intranets across various platforms. One of the recent global surveys revealed that two-thirds of organisations are fully aware of these trends and see it as 'critical', however, only 6

percent of them think that they do not have the technological capabilities and know-how for effective realisation of the new learning models (Delloite, 2014).

Information technology serves as a catalyst and accelerator of knowledge creation, diffusion, and use in the process of economic development. The new economy put emphasis on higher education and life-long learning to make effective use of rapidly expanding knowledge base, and massive investments in research, training, education and software (Carayannis and Sipp, 2006).

By empowering workers (and potential workers) to become equal partners in the learning process, organizations can foster a culture of continuous learning and growth—driving performance, engagement, and career development.

Individuals (students, unemployed, and workers) have realized the importance of life-long learning and they seek new ways to access quality learning content, collaborate, and develop their competencies.

On the other hand, education institutions are also becoming aware of these trends and they are making efforts to adopt new teaching and learning methods supported by the latest information technology (IT) advancements. The main challenge is to create an approach that is agile, adaptable and in tune with learners habits outside of the classroom and their future employability (Microsoft, 2015). This requires a holistic approach to integrating technology to support pedagogical goals.

Educational institutions are faced with two main challenges – first, there is a growing global demand for quality and cost-effective education, and secondly, as careers become longer and more diverse, the half-life of skills also becomes shorter and shorter, placing the focus on continuous training and development. What is needed is an innovative IT platform and open learning model that provide quality, flexibility, and personalization, with services such as collaboration, social networking, search, content management, course management, assessment, analytics, and security. The new open educational model requires adequate technological infrastructure: hardware, networks, software and services. Technologies such as cloud computing, web 2.0, content management systems, multimedia databases, search engines, and social networking are the key enablers for realization of modern open educational systems.

The paradigmatic shift from the current system is moving away from classical educational institutions towards learning environments where individuals are encouraged to create, publish, share, and learn online. Information technology allows educators around the world to digitally create, share, and remix their course materials in so-called Open Educational Resources (OER) (Senges et al., 2008).

Even though educational resources and accumulated knowledge are traditionally considered as strategic intellectual properties, more and more individuals, schools and organizations are sharing digital educational resources and knowledge. Consequently, initiatives such as Open Educational Resources and Massive Open Online Courses (MOOC) combined with modern web technologies will play an important role in the educational revolution.

The remainder of the paper is organized as follows: first we provide background research related to OER initiatives, models and information technologies, and give critical

analysis of existing research. Then, we introduce a novel open educational IT infrastructure model capable to meet demands of modern education and learning. Finally, we provide example of the real-world OER system which is based on the proposed model, and discuss the main advantages and benefits.

2 Background research

Information technologies, and particularly Internet and Web technologies, had a profound impact on education. This redefined the way people learn, collaborate and exchange knowledge. On the one side, there is an increasing demand for education (students, unemployed, and employees), and on the other side, there are enormous amount of information and knowledge available on the Internet, educational institutions' internal systems and companies. Each party in this process has its own interest, being students, teachers, schools, government, or companies.

Open Educational Resources offer higher education governance leaders a cost-efficient method of improving the quality of teaching and learning, while at the same time reducing costs imposed on students related to tuition fees and the purchase of expensive commercial textbooks and learning materials. Many scholars around the world are already participating in the OER movement even without support from the government or educational institutions (Plotkin, 2010).

OER movement that was brought to the awareness of the educational community by United Nations Educational, Scientific and Cultural Organization (UNESCO) in 2002 (D'Antoni, 2009). The movement began in 2001 when the William and Flora Hewlett and the Andrew W. Mellon foundations jointly funded MIT's OpenCourseWare (OCW) initiative, which today provides open access to undergraduate- and graduate-level materials and modules from more than 1,700 courses (Smith and Casserly, 2006)]. This initiative has inspired hundreds of other colleges and universities throughout the world to join the movement and contribute their own open educational resources. In general, there are four categories of OER, namely, open textbooks, open courseware, open online courses, and open-source software and tools to support teaching and learning (Cheung et al., 2013).

OER initiative is also supported by several European Union initiatives and projects. One of the project is BAEKTEL (Blending Academic and Entrepreneurial Knowledge in Technology Enhanced Learning) whose objective is to establish an OER framework for fostering technology enhanced learning within higher education institutions and life-long learning within enterprises in Western Balkan countries (Beaktel, 2013).

Following on from the development of Open Education Resources and the Open Education movement (Yuan, et al., 2008), the term Massive Open Online Courses (MOOCs) was first introduced in 2008. The original aim of MOOCs was to open up education and provide free access to university level education for as many students as possible. In contrast to traditional university online courses, MOOCs have two key features (Wikipedia, 2012):

1. Open access - anyone can participate in an online course for free
2. Scalability - courses are designed to support an indefinite number of participants

Key developments of MOOCs-style initiatives include: Coursera, Udacity, Khan Academy, edX, etc.

The latest evolution of the Internet, the so-called Web 2.0, has blurred the line between producers and consumers of content and has shifted attention from access to information toward access to other people. New kinds of online resources—such as social networking sites, blogs, wikis, and virtual communities— have allowed people with common interests to meet, share ideas, and collaborate in innovative ways. Indeed, the Web 2.0 is creating a new kind of participatory medium that is ideal for supporting multiple modes of learning (Brown and Adler, 2008).

Such an infrastructure supports diverse ecosystems of people and learning resources that could have profound implications for preparing people for a rapidly evolving knowledge-based world, one demanding creativity, innovation, and entrepreneurialism. The OER initiative has been a vehicle for building a culture of sharing. Now OER should be leveraged within a broader initiative—an international Open Participatory Learning Infrastructure (OPLI) initiative for building a culture of learning. The OPLI should provide participatory architectures for emerging visions and concepts such as the meta-university, the university in and of the world, “learning to be” sooner rather than later, and global-scale massification of higher education. It also extends across level and age: K–12, higher education, and lifelong learning (Atkins et al., 2008).

The movement toward openness and transparency has increased as teachers and students have started adopting social software for both formal and informal education (Lai and Chen, 2011). One of the recent developments toward social software in knowledge management involves tools that are applied by both educators and students to manage international collaborations and networking (Ha et al., 2012). The services and environments around OER have lately been moving toward collaborative functionalities and supporting the creation of teacher and learner communities (Sotiriou et al., 2013). Many initiatives are basing their OER services and environments especially on social software-like functionalities that place educators and learners as key users to share, discuss and work collaboratively on OERs (Ha et al., 2011; Sotiriou et al., 2013).

Although importance of information technologies in modern open education is widely recognized, there is no a holistic approach to information infrastructure and services capable to answer challenges of today’s education. Most of the existing IT related efforts for OER do not take into account many important aspect of education or the needs of different participants – schools, students, workers and companies.

In this paper, we introduce a novel OER IT infrastructure model that is based on cloud computing and service-oriented architecture.

3 Architecture of the OER 2.0 platform

Many innovative efforts to establish student-centred, problem-based learning and technology-rich learning environments have not succeeded because they did not take a holistic approach. This includes taking into consideration different groups of users (students, teachers, unemployed people, and workers) and their various needs when it

comes to education and learning. In this section we introduce a novel IT open education platform capable to support these requirements.

We describes methodological approach, software architecture model, along with services and features of novel open education platform named OER 2.0, which address important issues when designing and implementing next-generation open education systems.

OER 2.0 is cloud-based, multi-tiered, multi-layered and composite web system which comprises various technologies, tools and applications. Figure 1 shows the architecture of the system, including the platform stack, main services and functionalities, as well as the specific education services.

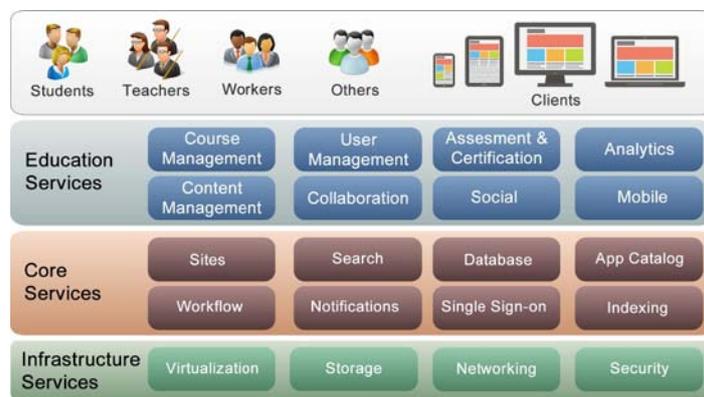


Figure 1. OER 2.0 platform architecture

In order to provide better manageability, performance, flexibility and consolidation, OER 2.0 utilizes virtualization technologies. The networking services provide private networking, load balancing, and hybrid networks. This approach can support various education scenarios, and enables deployment of wide range of solution in an agile way. Storage services provides the flexibility to store and retrieve large amounts of structured, as well as unstructured data, such as documents (i.e. course materials) and media files (i.e. video lectures).

Security services provide identity and access management with a robust set of capabilities to manage users and groups and help secure access to on-premises and cloud OER systems. With SSO (Single Sign-On) support, it is possible to integrate various services and third-party systems without requiring users to authenticate with each system.

Database services include services for data storage, processing, and security. Database server stores all the data associated with the system - configuration settings, administration information, service applications data, and user content. This approach facilitates data integration, improves data consistency, security, and makes backup/restore jobs easier.

OER 2.0 architecture is modular and service-oriented which enables composition of flexible, powerful, and customized solutions according to specific business needs. Core services are specialized and independent services which can be shared across sites or even across servers. They can be mapped to web applications, allowing for a more scalable configuration. Each web application can select only the services it needs.

Site services provide functionalities like site creation, management and taxonomy. Sites can have a range of features and functionalities. Each site can use specific core services and contain specific modules, pages and web parts. Web parts are the basic composition blocks of each web page; they are stored in the system database and available through the online gallery. Each user can introduce himself via a personal MySite that shows his skills, interests, area of expertise, current projects and colleague relationships.

This modular structure enables customization and design of composite learning environments which blend course materials, user data, documents, collaboration tools, and workflows in a more creative and useful way by assembling, connecting, and configuring the basic building blocks of functionality available in OER 2.0 web system.

Existing sites can be saved as templates and used for creating new sites. This way, new OER sites can be quickly created and customized if needed. Together with the taxonomy support, these functionalities enable creation of various hierarchical site collections that reflect particular organizational structure (both for the schools and companies) and learning processes.

Notification services provide management and delivery of alerts via email or SMS (Short Message Service). Users can subscribe to modules (i.e. courses) or items (i.e. presentations) in order to receive alerts about certain actions (uploading, deleting or updating data).

Indexing services provide content indexing (structured, unstructured, internal and external data sources and services) that is used for searching.

On top of the core services, are the specialized educational services that support many of the learning and training activities. Having both content management and learning management system integrated within one system makes uploading training material that much easier. Version control and approval workflows also ensure a better managed compliance system.

Course management services provide course overviews, target audiences, search tags, training timeframes, and learning goals. They also support inclusion of standard SCORM (Sharable Content Object Reference Model)-based courses and content. It is possible to specify course categories, make courses mandatory, and decide which courses to publish into the online course catalogue. This catalogue give learners an efficient, dynamic way to find the education that's most relevant to their needs.

Having in mind the increasing demand for collaboration and coordination of activities related to learning management, collaboration service layer is added to OER 2.0 architecture. Collaboration and social services connect and empower teachers and learners to better coordinate their activities through the blogs, communities, wikis, RSS feeds,

notes and group discussion boards. Collaboration features enable users to share information and work together on documents, projects, and other content.

User management and assessment services enable enrolment, assessment, grading, and learning path management. This way, learners can join courses, take tests and quizzes, and track their personal performance and learning activities.

Real-time analytics and reporting services deliver a clear picture of learner performance and program effectiveness. This includes personal progress dashboards, management tracking dashboards for learners, groups, and courses, SCORM completion tracking, Event participation, task execution, and so on.

Mobile services deliver a mobile experience which allows users to easily access content from any mobile device. This broadens the accessibility of content and social networking tools beyond the capabilities of traditional desktop-based web sites.

The presented OER 2.0 architecture is multi-layered and seamlessly combines various services and technologies that enable creation of integrated and feature-rich open educational solutions. The following section presents a real-world OER system and describes main features.

4 Example realization of the OER 2.0 system

OER 2.0 web system is based on the presented architecture model and utilizes various services and features. It represents a composite web application consisted of different structural elements. These elements can be viewed at four levels: presentation, collaboration, business logic, and data. The central component of OER 2.0 web system is the web portal. It is modular, which means that each module can be customized and personalized, and existing or new modules can be combined thus assembling composite applications that suit the learner's specific needs.

Structure, modules and services are designed and composed in a way which supports most of the activities related to education and learning.

In order to overcome the shortcomings of the existing OER systems, we have designed a specialized web portal that enables users to find, learn, teach, assess, collaborate and analyse educational activities. It has been successfully implemented at the university level (both for private and open education), as well as at the automotive company.

The central component is the course management system that contains several learning management apps: include course catalogue, assignments, grading, SCORM player, language (translations), certificates, and reports. These apps are built on top of the OER 2.0 core services, so learners can benefit from the standard collaborative features.

Course catalogue provides learners an efficient, dynamic way to find the education that is most relevant to their specific needs. Courses can be browsed by category or searched by several course attributes. Figure 2 shows the course creation form.

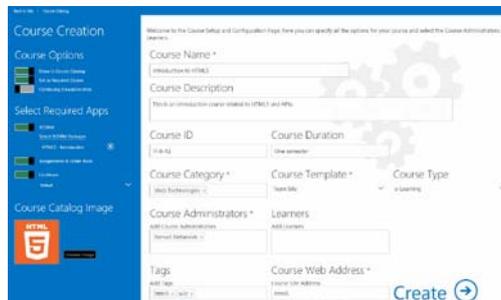


Figure 2. Course creator

It is also possible to upload SCORM packages to instantly create formalized courses, enable enrolment and take advantage of OER 2.0 web portal collaborative features.

Figure 3 shows an example of the course web portal with a range of modules and features. It consists of several specialized document management modules with support for document creation, editing, versioning, sharing, workflows and retention. These include lectures, exercises, additional materials, students' homework, etc.

The Notebook app enables teachers to create course notebooks with preassigned classroom permissions. Class notebook is organized into three sections:

- Student Notebooks – Private notebooks that are shared between the teacher and each individual student.
- Content Library - A place where teachers can distribute course materials to students.
- Collaboration Space - A space for any course member to share, organize and collaborate.

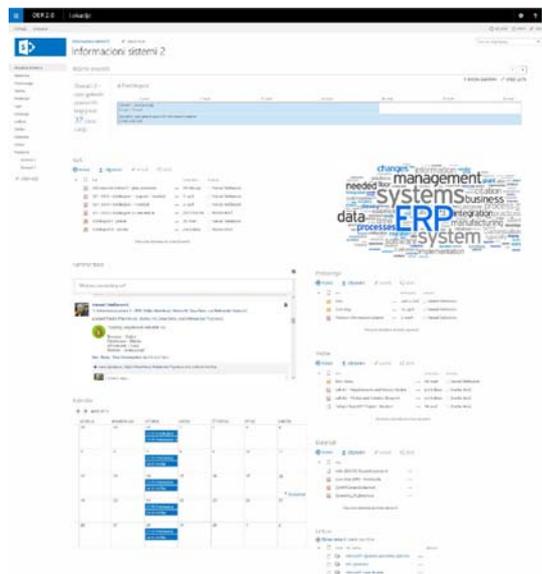


Figure 3. Example of the course web portal

Another important feature is a task management. Here, teacher can create task for students (with due dates, priority, description, etc.) and track visually realization of these tasks. Students are notified automatically if certain task is assigned to them and can see all their tasks in a special My Tasks view.

Course web portal also includes a calendar app which enables creating events with attendees. The meetings can be scheduled in a classic way (i.e. classrooms) or as an online meetings. All the invited students can accept invitation (or propose alternative time) and join the online meeting (with chat, audio and video support). All these services can be used on any platform (desktop, tablet, or phones). Lectures or discussions can be saved and upload online on the specialized video service.

OER 2.0 video is a specialized video portal and streaming service that allows users to consume, share and manage video content such as lectures, tutorials, training sessions, etc. It also handles metadata and search for videos. Technical delivery services, such as transcoding, thumbnails and secure streaming, is provided via cloud services. Figure 4 shows a video channel of the particular course.

Having in mind the importance of communication between teacher and students and among peers, we have included a specialized module that is connected to a Yammer business social network. This way, all the participants can stay in touch with the latest news. They can use various social networking features, such as personal profiles, messaging, discussions, chatting, file exchange, tagging, searching, and following colleagues. Also, these services are available from any device and platform.

Finding quickly the right information or document is very important for the successful online educational system. OER 2.0 web portal includes a search functionality which is built upon the search core service. Besides standard search capabilities, it contains advanced features, such as thumbnail previews, click-through relevance, and automatic metadata tagging. Search can be carried out by many criteria such as by site, author, or language.

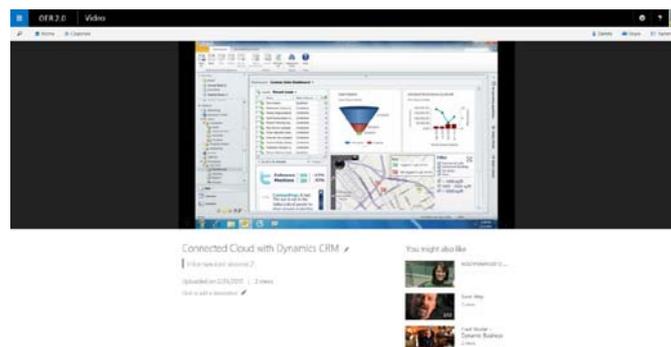


Figure 4. OER 2.0 video service

OER 2.0 also support multilingual features since users can be from different language speaking areas of the world. Multilingual capabilities are built into the system architecture

and realized through the web front-end portals. They include support both for user interface translation and content translation.

Additional important aspects of OER 2.0 web system are security features and models. The security model is realized through managed accounts, core service applications such as Single Sign-On (SSO), authentication mechanisms (like Multi-Factor Authentication or claims-based authentication) and fine-grained authorization. This makes possible to integrate various services within the OER 2.0 system, but also to seamlessly integrate external services and content. For example, companies can integrate their own user accounting system for authentication, or individuals can use their own social networks accounts (i.e. Facebook, LinkedIn, etc.).

5 Conclusions

As the world becoming increasingly “flat”, competitiveness increases not only in terms of technology, know-how and resources, but above all in terms of individual skills and knowledge. To be competitive, companies must not only provide the best workforce, but also provide support for continuous learning and for ongoing creation of new ideas and skills.

In order to achieve this goal all participants in this process (educational institutions, companies, government, and individuals) need to be involved and work jointly to create a knowledge-based ecosystem that is based on innovative learning, teaching and knowledge-transfer framework that is supported by the latest information technologies.

Initiatives for open education such as OER and MOOC are the main drivers toward more flexible, adaptable, and cost-effective educational system. These initiatives aim to remove technical barriers (communication and collaboration), price barriers (subscriptions, licensing fees, pay-per-view fees), geographical barriers (different languages and culture), and legal barriers (copyright and licensing restrictions) for the end-user.

However, most of the existing OER and learning management systems failed to answer the challenges of today’s education. They do not incorporate current pedagogical principles and best practice, and have certain technological constrains. Main issues with existing OER approaches include disconnection and separation of regular and organisational learning. On the other hand, OER software solutions are typically rigid, difficult to customize or extend, and they do not support the whole suite of educational activities, thus reducing the positive effect of OER approach and not making the most out of available capacities.

This paper introduces a novel OER web platform capable to support demands of the current and future educational needs. Its architecture is open, service-based, multi-layered, scalable, and modular, which enables composition of feature-rich learning environments tailored according to specific users’ needs.

The presented OER 2.0 web-based cloud solution provides services, applications, and tools for the new way of teaching, learning, collaboration and knowledge management. This should ultimately open the road toward next-generation educational systems.

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