

Innovative Education Environment and Open Data Initiative: Steps towards User-Powered Society-Oriented Systems

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Abstract— The economy is not keeping pace with the increasing speed of technological evolution. The inadequacy of the current system of education is a possible reason for this. Evolution forces us to produce experts for tasks and businesses which do not yet exist, to teach them technologies which have not yet been devised. The best way to produce experts is to accentuate the learner's best abilities and skills, assess the learner's potential and develop it further. We badly need revolutionary methods to facilitate intelligent personalization of study processes and approaches to make innovative education content more attractive and motivational for the learner. Advanced information management services and platforms play a valuable role in education process development, enabling new generations of students and education-related content providers to create, share, search, combine and deliver reliable and competent information. Earlier learner involvement in study content co-creation or personalization processes might dramatically increase student motivation and speed up the study process. Like any other products or services, e-Learning services need marketing to attract customers and make them a valuable source. To achieve a vision of ubiquitous knowledge, the next generation of innovative education environments will apply the achievements of the Open Data initiative and move towards learner-driven society-oriented systems. Therefore, this paper touches on different aspects of co-creative innovative education environment and correspondent e-Learning marketing strategies.

Index Terms—Collaborative platform, education environment, e-Learning marketing, e-Learning service, Open Data, society-oriented system.

I. INTRODUCTION

SINCE the early 2000s we have seen a trend towards the increasing speed of technological evolution. Unfortunately, current economy does not keep pace with such fast development. One of the reasons for this is the inadequacy of the current system of education. Up to now, countries have had their own education system that is mainly oriented on its main industries, resources and capabilities. Such a system is designed to produce and support experts with respect to the demands and needs of the country's own economy. Under such conditions, prediction and planning are one of the main tasks

of education systems. For the majority of countries the process of producing a new expert takes an average of four or five years. Today's rapidity of development and technological breakthroughs means a delay of just four to five years must be considered as a crucial one, and results may not correlate with the demands of the economy after that period: future workers will not meet the expectations of industry, business and society. Therefore, we need an innovative education system that is able to produce an expert for the tasks and businesses which do not yet exist and to teach future experts technologies which are not yet elaborated. It means that on top of the basic level courses the system should provide courses with a high level of flexibility from the course content perspective. Such course content will require constant update by the person responsible for content provisioning. Course content should be monitored by industrial domain experts, and as a result should be enriched with pertinent suggestions, new use cases and up-to-date needs. The teacher (content provider) should be constantly involved in research activities and incorporate the latest achievements in the domain of the course. Unfortunately, very few non-IT specialized domain experts feel truly confident about utilizing services and features that the technological world provides for them. Usually, teachers lack the supportive tools that may mitigate the complexity of technologies and allow them to concentrate on domain-specific issues. One way to enhance content creation process and produce innovative study materials is to elaborate mashup-based platforms for a new content creation based on automated/semi-automated composition of content retrieved from external sources. At the same time, we should not forget the learner. The best way to produce experts is to accentuate the learner's best abilities and skills, assess their potential and develop it further. Similarly to psychologists, we need to find an automated way to catch such learner properties. The learner should be able to share his/her thoughts, needs and knowledge to allow other players to personalize and improve the further education process of the learner. Thus, the innovative content creation process should involve user/customer experience; students should be able to provide not only feedback but also relevant content for the course (examples, real-life situations,

media materials, etc.). Given the rapid evolution of social media, we should not neglect the huge amount of relevant and useful content produced by society.

Today's significant change in ICT-supported business is characterized by the globalization of business networks, and the dependence of organizations on their agility in terms of taking advantage of new business opportunities, new business models and new partners. The change is characterized by courage in adopting new technology solutions (service-oriented computing, business intelligence, social media and networks, open linked data, etc.) to support business needs. Sooner or later, changes in the ICT domain and new digital technologies will reach the education domain and lead to innovations in education process development. Traditional ways of studying must change. We live in a dynamic technological world, surrounded with a huge variety of information, data formats, social media and mobile technologies that require substantially different information-processing skills. Ignorance of new technological achievements leads to deterioration in the motivation and learning results of today's youth [1]. Fortunately, multimedia materials and digital education spaces enrich outdated printed media. New technology enables natural interaction with learning materials, utilizing the full sensory capabilities of the human learner. It is a time to create innovative education environments and elaborate advanced educational services that are not bound to location, time, or any other limitations, and interact in more suitable and personalized ways to learners' advantage. Advanced multimodal mobile and Web technologies provide a number of options for implementing solutions for pervasive learning. E-Learning and augmented reality offer high potential for interactive materials that could enrich the learning experience. Smart devices with location awareness and access to online information constitute excellent tools for obtaining educational information on our surroundings. Environment and context should be integrated into the learning process.

Thus, the achievements of the technological world, applied to e-Education domain, could bring education to a totally new level. Evolution in the ICT domain has already reached a high enough level to support a revolution in the education domain and raise it to an adequate level for the current demands of society. Web and web-based solutions will dramatically change the way people produce, provide and consume knowledge and skills. Augmented reality, real-life objects, the internet of services & things, more interlinked providers and consumers, all these will require more sophisticated and intelligent management and control via appropriate collaboration services and platforms in the e-Education domain. At the same time, the education system should benefit from fast-growing Open Data and e-Government initiatives. Open Data will drive growth, ingenuity and innovation in domains which will properly use and support it. Data are the new capital of the global economy, and as organizations seek renewed growth, stronger performance and more meaningful customer engagement, the pressure to exploit data is immense. It is time to utilize the power of open data and human

resources to develop learner-oriented innovative environments for co-creation in the education domain.

This paper tackles the issues that confront the technological world, society-oriented systems and the education domain. It brings a society orientation to the new generation of e-Learning services that will allow learners to be part of the e-Education process through co-creation and personalization of innovative education content. The paper highlights benefits and challenges in the journey towards innovative ubiquitous education through the adoption of the latest achievements of web technologies and the Open Data initiative. Finally, the Crossroad on Demand service is presented as an example of a mashup-based supportive platform for co-creation and reuse of collaborative study content.

II. CO-CREATIVE EDUCATION ENVIRONMENT

Topics around innovative learning environments have become very popular in Europe and many other countries in the world. Corresponding integration of achievements in education science with innovative web technologies (semantic web, augment reality, gamification, social media, etc.) could have very promising and unexpected results. To achieve a vision of innovative ubiquitous education environment, we need to develop and integrate innovative digital educational tools, solutions and services for learning and teaching. They should aim at reducing the current restrictions of time and physical space in learning and teaching. They should foster greater connection between formal and informal learning and remove barriers to ubiquitous learning. The maturity of information technologies means we are moving towards e-Education. Various learning management systems (LMS), which were developed for managing the personal education process, are now enriched with tools and features to support e-Learning and m-Learning initiatives for managing open education content. Unfortunately, current tools are not smart enough and do not provide automated intelligent support in the sense of substituting for a teacher. As before, humans (teachers, creators of study content) are responsible for selection of appropriate education methods and content for teaching others. Open education content, the wide spread of the internet, and the rapid evolution of ICT technologies and communication channels have created an environment with a huge number of potential students which cannot be managed by the limited number of professionally educated teachers. We urgently need revolutionary methods to facilitate intelligent personalization of the study process and innovative approaches to create new education content. We need a digital learning ecosystem in the form of an adaptive socio-technical system consisting of interactive digital entities (tools, services, platforms, etc.) and communities of users (learners, teachers, content providers, etc.).

A. Open Data in Education Process

Advanced information management services and platforms could also play a valuable role in education process development, enabling the new generation of students and education-related content providers to create, share, search,

combine and deliver trustworthy and competent information easily. Recent developments in the domain of free access to quality information on the internet have made possible massive sources of information such as Wikipedia, YouTube (YouTube's EDU Portal), etc. A lot of study content is available through various interactive study sites at the high-school level (Piazza, Blackboard, Quizlet, etc.). At the college level there are massive open online courses and seminars from Harvard, Stanford, Georgia Institute of Technology, MIT and many other universities as well as online courses provided by academic and industrial professionals through their own companies. Studies show that tutorial-style teaching is more effective than lecturing (as Oxford and Cambridge have known for centuries), even when pre-recorded. In the near future, the current education process could be pushed out of lecture halls and the process become more flexible and manageable by students. It is very important to have supportive tools that allow learners to create a personal study plan and follow study content in the right order with respect to the personal learning context (current level of knowledge in the domain/subject, learning skills and abilities, the goal and needs of a learner, etc.). The intelligence of such a supportive suggestion system will depend on the quality of semantic annotations of various heterogeneous distributed education content, the personal study profiles of the learners, and the corresponding study model. Therefore, we must acknowledge an absolute need for technical support for such integrated content creation and management.

As regards open data in the education process, we tend to talk about freely available materials and on-line courses and usually forget about the availability of open data that might be used as a source for those courses and study materials. Usually, students are very happy about visiting lecturers and their courses, especially if lecturers are from industry/business (from the field, let us say) or at least do some research in various on-going projects. Their lectures are full of content relevant to today's real-life problems. At the same time, there are not so many possibilities for other teachers to update their materials with respect to fresh real data because of its unavailability. There are no supportive tools and infrastructures which address the actual problems and needs of industry and businesses or facilitate easy sharing and use of the latest statistical data or any other useful data collected in appropriate formats for innovative education materials.

One of the initiatives from which innovative education might benefit is the "Open Data" initiative. Open Data is the idea that certain data should be freely available for use. The goals of the open data movement are similar to those of other "open" movements such as open source, open hardware, open content, and open access [2]. The philosophy behind open data has long been established, but the term "Open Data" itself is recent, gaining popularity with the rise of the internet and World Wide Web and, especially, with the launch of open-data government initiatives such as Data.gov. The purpose of Data.gov is to increase public access to high value, machine-readable datasets generated by the executive branch of the government [3]. Data.gov.uk intends to increase the use of

Linked Data [4][5] standards, to allow people to provide data to data.gov.uk in a way that allows for flexible and easy reuse. The published data can be downloaded by everyone interested to facilitate reuse, linkages and the creation of innovative services. Nowadays, many countries support the Open Data movement on a governmental level and open up a lot of data, making them available for third parties to develop useful applications and services for citizens. It would be natural to use officials to make data available for education services, because the data were produced with taxpayers' money. Unfortunately, a lot of useful data that might be very beneficial are not always owned by government, or are owned only partially (the rest belong to private companies). The real difficulties we face are in getting data opened up by the private sector. Companies are not willing to spend their own resources to make data public if they do not see any benefit to them. This again shows the need for an appropriate business model to get behind the Open Data initiative. Open Data is a promising initiative for use in innovative education environments, but it is still an initiative. It still requires a lot of work and needs an appropriate ecosystem, sophisticated frameworks and supportive tools.

Open Data will drive growth, ingenuity and innovation in countries which genuinely support it. Data are the new capital of the global economy, and as organizations seek renewed growth, stronger performance and more meaningful customer engagement, the pressure to exploit data is immense. Publicly available resources contributed by the government and a growing number of businesses and citizens have reached the critical mass necessary to trigger a step-change in business attitudes towards open data. It is time to apply successful achievements of Open Data initiatives to the education domain. We can use open data to significantly improve e-Learning products and services. Allowing anyone to use and redistribute data freely, we may build a basis for creating new enriched education content and services mashed up with augmented reality and social lives of learners.

B. Learner-Driven Content Co-Creation

Like many businesses nowadays, the innovative education environment requires the involvement of end-users in the process of e-Learning service creation and further development. Being involved in the service and content creation process, the user brings various areas that (s)he is interested in, and therefore makes the service essential for them and other users.

It is well known that a student learns faster if (s)he is motivated and has a direct interest in the subject. The student shows a real intention to adopt the study process when knowledge obtained solves her/his problems and needs, and answers the questions relevant at the time. If students do not see a connection between what they are learning and their actual life, they can easily become uninterested, paying little attention to the information given to them. Thus, earlier student involvement in the process of study content creation or its personalization might dramatically speed up his/her education process.

The MBA (Master of Business Administration) study program is a case that validates this vision. Many MBA programs recommend or even require that the applicant has a certain number of years of work experience. Some programs even specify that students should have held a responsible post or one that was managerial in nature. The criterion of work experience ensures that the student knows the domain area and has experienced problems already. It makes him/her more interested in obtaining concrete knowledge and finding answers to problem questions and challenges. Thus, the outcome of the study process is much better than that of the passive perception of knowledge. To be more attractive to the learner, education content must be connected to reality. At the very least examples and use cases can present real-life scenarios and should solve the learner's everyday problems. Very often today's students study the same materials that their older siblings or friends studied five or even ten years ago. Of course, the basics (theorems, axioms and other such knowledge) stay the same and should not aspire to change, but how they are presented to a learner could be more personalized with respect to time, subject, location, needs and other contexts.

Another positive aspect of the involvement of a learner in study content creation/personalization is the emotional one. Emotions have a valuable impact on learning. They influence our ability to process information and to understand what we encounter. According to expert Priscilla Vail in "The Role of Emotions in Learning" [6], "Emotion is an on/off switch for learning...the emotional brain, the limbic system, has the power to open or close access to learning, memory, and the ability to make connections." Students feel better emotionally when they can influence a process, and may personalize case studies to better understand a subject. Our emotional state has the potential to influence our thinking. Students learn and perform more successfully when they feel excited about the subject matter. For these reasons, it is important to create an emotionally positive environment for the optimal learning of students.

The best learning takes place when a positive feeling toward a task enables us to use what we know, while motivating us to extend that knowledge and build on it. Motivation is a strong internal drive to pursue and achieve goals. Students who are self-motivated have a strong drive to keep learning and a positive self-concept. Thus, innovative education environments should provide the opportunity for learners to take an active role in the study process, to define achieved knowledge, and to highlight desired knowledge and unsolved problems through involvement in the process of study content creation/personalization. The way in which we involve learners in the co-creation process must be simple and attractive. To develop successful collaboration in the e-Education environment, we need to maximize utilization of existing technologies that learners are familiar with and usually use in their daily life. Thus, various social media and social networking techniques should find appropriate application within the collaborative education environment.

C. Human-Powered Society-Oriented Environment

Increasing numbers of individuals and organizations are contributing to the huge information flow by sharing their data with others, including web-native companies (such as Google, Amazon, Facebook and other social networks, Twitter, YouTube, etc.), newspapers, public government bodies, various research initiatives, etc. In turn, third parties are consuming these data to build new businesses, provide new services and accelerate scientific progress. The change in ICT-supported business is characterized by increased courage in terms of adopting new technology to support business needs. Changes in the ICT domain and new digital technologies are reaching the healthcare domain, mass media and data journalism, new city and government ecosystems and lead to innovations in these areas. Development of internet and web technologies together with human-powered and human-centric services has already made people managers of their health and social life, and an active part of city life, etc. Healthy and responsible people are the kernel of the next-generation society. We are moving from the industrial era to the era of ubiquitous society-oriented services. Therefore, we have to consider new architectures, new infrastructures, new managing models and new ecosystems. Transition from an industrial welfare society to a sustainable human-centric services society requires elaboration of corresponding modern infrastructure and tools to allow people to add value to the processes in which they are involved.

Taking into account the current state of the art in the field of innovative research and development, we see a lack of people-oriented systems and services. Quite a number of useful and necessary services for ordinary people are not supported by vendors and their business models. Approaching the era of open data and interoperable services, we face a negative attitude from private businesses. "Open" means that nobody owns something and gets benefits out of it; therefore, nobody will invest. People constitute a great asset to be utilized in servicing, service support and creation processes. In the context of open solutions and free services development, people (as end-users) are the most interested party. Therefore, people should take an active role and be a part of the service they want to utilize, making it smarter, more personalized, and able to provide appropriate data, features and capabilities. Humans should not be considered only as users (service consumers) anymore. Humans should be involved in the co-creation process as experts – a valuable part of a service ecosystem that provides own ideas, needs, knowledge and expertise, and adds value to the technology evolution in the approaching era of society-oriented systems.

To minimize investments and use the power of people who are interested in service, we need to concentrate our efforts on elaboration of an appropriate user benefit model, develop user-oriented tools and techniques that involve people in the co-creation process, teach and help people to access and manipulate information and capabilities, and utilize people's knowledge and expertise for the common good. The present generation (especially youth) is smart enough to become a part of the technology revolution and extend the ecosystem for

future technologies. Therefore, the shift from professional to unprofessional use of ICT technologies requires new infrastructure and tools to be developed to make the whole process human-oriented, trustworthy and competent.

III. INNOVATIVE E-LEARNING MARKETING

A. *e-Learning Service Marketing Strategy*

Research is money turned into ideas. This is good. But innovation is even better. It is ideas turned into money. Ideas and innovation help us increase productivity and make the economy grow. Like any other products or services, e-Learning services need marketing to attract customers, get them to buy into them, and keep them coming back for more. The previous approach adopted in education was to provide study content planned in advance. Thinking about the marketing of innovative e-Learning services, we need to apply existing marketing techniques which are used in the services provisioning domain. According to [7], market orientation can be reactive or proactive. The former involves a company discovering, understanding, and satisfying the expressed needs of customers, whereas the latter involves discovering, understanding, and satisfying the latent needs of customers. Thus, to build successful innovative education environment, we should practice both forms of e-Learning service market orientation to attract and retain learners. The current education system is reactive market-oriented already. Teachers interact with students, prepare various questionnaire forms and collect students' feedbacks, trying to improve study content. Here the student plays a largely passive role, merely answering questions (if answering at all) or allowing observations. Proactive market orientation of education environments, on the other hand, entails the learner taking part as a collaboration partner, jointly co-creating value with the study content provider or teacher. While learners are collaborating with the study content and service providers they can share their experiences. Thus, the co-creation of value occurs as the learner jointly discovers latent needs with the provider. User involvement is suggested as one type of practice whereby the co-creation of innovations takes place via the generation of knowledge of latent needs [8]. From the very beginning we have to recognize who stands to benefit from the e-Learning solution (directly or indirectly) and answer the question: what are the perceived benefits for them, what problems does it solve for them and what will they be able to do better as a result?

One of the main strategies for making the learner interested in the provided service is to give her/him what (s)he wants. There are several factors that usually influence learner interest, but the most valuable is the relevance of the service (or content) to what the learner is doing now, what (s)he currently needs. In this case learners can immediately focus on the content they need the most, saving valuable time. On the other hand, marketing e-Learning does not stop with the learner. The person who has the most influence on whether learners complete e-Learning is the teacher or line manager. Thus, line managers are the new best friends of the e-Learning service

provider. As a learner, the teacher should also see the benefit of the service. Teachers should also be involved in the process of service (or content) provisioning. Teachers should be supported by appropriate tools and data infrastructure to create (co-create) new attractive education content.

All the above-mentioned marketing strategies imply certain requirements for new innovative e-Learning services. Thus, dynamism of the learning content and its reflection of the learner's and teacher's needs are crucial factors in the e-Learning system.

B. *Open Data Business Models for e-Learning*

As well as businesses in all industries, education environments should increasingly open up their data (education content) to revolutionize the way they compete. Opening up education content will enable new content-as-a-service business models within the education domain. Education institutions may experiment with opened up discreet quantities of education content and use best-student competitions as a way of attracting and selecting talent. At the same time, education environments will be able to find relevant open data and use them to improve their education products and services. For this purpose, education systems should have a strategy to exploit the rapidly growing estate of open data. The rapidly increasing commercial significance of open data and the growing amount of public and private sector data becoming available will demand a strategic response. Education environments will open up data to collaborate more effectively with partners and suppliers. They will use open data to inspire learner engagement. Content providers will draw on the resources of the crowd not only to clean their data and improve their accuracy, but help them to collaboratively co-create customer-driven education content.

(1) *Sponsorship*: The reverse of cost avoidance is finding sponsors for open data publication. If there are people who strongly believe that a particular dataset should be open and available to all, they may be prepared to sponsor its publication (which is not the same as licensing it; the consequence is that the data are open to all, not just to those who pay). How can we persuade others to sponsor opening up data? If it is something that they would otherwise license, perhaps they are better placed than their competitors to address any disruption that arises from the data being freely available. In this context the provider of e-Learning solutions may play two roles. First of all it might play the role of a sponsor, a party that uses its own resources to make certain data open. In this case, coming first to the market with a number of e-Learning services and solutions based on these data, making the data fully open to third parties and providing appropriate tools and infrastructure for the data use, the e-Learning provider could become a very attractive partner for third parties and active users who are interested in using the open data for further cooperation, co-creation and general use. This scenario gives a competitive advantage in terms of a bigger market share to the e-Learning provider who opens data than to those who just license them privately and try to compete some other way. On the other hand, the e-Learning

provider may play the role of a third party and collaborate with an organization that sponsors data opening to help this organization to get onto the market, find good learners and potential employees, and share the benefits.

(2) *Freemium*: Enriched with real-life and up-to-date fresh data, study content becomes more attractive for a learner. Unfortunately, such data are not always freely available. More often users buy the data or an extra fee is charged for advanced access options under the freemium agreement. Within the freemium model, an organization publishes open data in a basic form — perhaps with some limitations on formats and throttling of API calls — and offers advanced access to those who are willing to pay. There are many ways in which open data can be made more useful than static publication of spreadsheets or a basic API; under a freemium model some of these enhancements would only be offered to those who pay for them: availability of machine-readable formats; unlimited numbers of API calls; more sophisticated querying; access to data dumps rather than through an API; enhancement of the data with additional information .

In this case, basic study content might be based on initial freely available data and only some advanced and more specific examples and use cases might require an extra fee from a learner who is really interested in those particular data. As a result, extra investment for the required data will be shared among those interested learners and the individual cost will be minimized.

(3) *Learner-sourcing*: As mentioned before with respect to the concept of a society-oriented environment, in cases when nobody else (data provider, data publisher, service provider) except a potential end-user (learner, citizens, etc.) is interested in a certain service or when nobody (even the end-user) is willing to invest their own money in development/upgrade/maintenance of the service, crowdsourcing might be the only suitable model with which to proceed. In this case, potential end-users are involved in the process as crowdworkers. They might be able to invest their own time/experience/knowledge in the process of service creation instead of money investment.

Crowdsourcing is a process that involves outsourcing tasks to a distributed group of people. Crowdsourcing is different from ordinary outsourcing since it is a task or problem that is outsourced to an undefined public rather than a specific body, and enhances the quality of the result thanks to collective intelligence. Crowdworkers might be motivated in several ways: enjoyment-based motivation, community-based motivation, or free access to a service depending on their contribution level. Enjoyment-based motivations refer to motivations related to the fun and enjoyment that the contributor experiences through their participation. Another form of social motivation is prestige or status. In this case some gamification techniques are included in the model.

If a learner requires study content (example, use case, etc.) based on particular data that are not available but could be retrieved and added to the e-Learning service by the learner, the service should be supported with tools that allow the learner to retrieve/gather and add these missing data. In the

same way, the learner might be able to earn and collect “money” on a personal account (to be spent for chargeable content later) by gathering and adding data requested by other users of the service. From the content quality perspective, crowdworkers who frequently complete tasks in ways judged to be inadequate can be denied access to future tasks, providing motivation to produce high-quality work. A well-managed crowdsourcing model helps to clean data and improve their accuracy.

IV. CROSSROAD ON DEMAND SERVICE

This section presents an example of a co-creative mashup-based e-Learning platform [9]. The “Crossroad on Demand” service is a testbed and collaborative study content co-creation platform for driving schools. The main goal of the platform is to provide a toolset for domain experts (teachers as study content providers) and learners to create location-personalized learning and test materials, and use them as content of the e-Learning service. Applying mixed-reality and semantic information integration techniques, the platform provides an opportunity to mashup content from several information sources and services to use it as a basis for education content creation.

A. Motivation

There are a lot of factors that cause car accidents on the road, but the most usual factor is the experience and education level of the driver. To increase the quality of education and training level of drivers is one of the main goals of any society wishing to maximize traffic safety. At the same time prophylactic and constant training of drivers plays a very important role as well. Taking into account that crossroads (or passage of them) is one of the most important and significant parts of teaching by a driving school, it would be reasonable to concentrate efforts in this area and develop a service that allows driving school experts/instructors collaboratively to create education content and give more interactive opportunity for students and other drivers to test and train their skills on locally personalized crossroads. Thinking about traffic-related education on a large scale, we must acknowledge the lack of innovative study materials for pedestrians. We should also care about pedestrian education and safety. Interactive personalized location-based study content for pedestrians might be very useful, especially for allowing children to become familiar with crossroads they meet every day.

Today's printed study materials are complemented with digital content (PowerPoint presentations, driving simulators and various testing applications). Unfortunately, this digital content is not configurable, is limited to a certain set of predefined use cases and usually does not permit extensions, so it has nothing to do with the reality of learner driving life. Evolution in the e-Learning domain pushes us towards elaboration of the platforms for distance learning and dynamic collaborative creation of new content. Study content promises to be more interactive and attractive to a learner. The application of augmented reality and gamification to the e-Learning content creation process is becoming very important.

To achieve a vision of ubiquitous knowledge, the next generation of integration systems will need different methods and techniques such as the semantic web, web services, open linked data, mashups and various information visualization techniques. Ubiquitous learning (as a combination of e-Learning and m-Learning [10]) and playful real-life learning materials (enabling learning by exploration and educational exercise games) can activate students in new ways.

B. Co-Creative Study Content

Crossroads on Demand aims to improve the education process in driving schools and increase the training level and awareness of the drivers through personalized location-based support. It has a dual nature. On the one hand, the service can be utilized by driving schools for education purposes as a development platform for study content creation. It provides a tool for driving school experts/instructors to create tests (various crossroad situations and scenarios) in a fast visual way on top of mashups of map and traffic-related data. Such a service gives an opportunity to all the experts in the field to contribute to the study content creation process and facilitates the content growth. Meanwhile, it plays the role of a testbed for driving school students and other drivers to learn new material and test their knowledge and skills by solving various situations on selected crossroads of real cities (as well as crossroads created by themselves).

The main feature that brings added value and makes the service attractive and useful is its personalization- and location-based nature. All the crossroads of the system are real crossroads of real cities with current traffic regulation conditions. Gathered information from traffic regulation and other road related systems is integrated with the real map and

provides automated reasoning.

Being connected to traffic regulation-related data (crossroad topology, traffic regulation signs, traffic lights, road works, etc.), the service is aware of any changes in crossroads regulations, and all the corresponding modifications are handled by the service automatically and updated on the fly. Thus, the service maintains the constant awareness of drivers about the road situation and any changes in traffic regulation conditions. These features of the service entertain the students and make them more interested in the study process. Being publicly available, the service could be very useful for other drivers (especially for young and/or inexperienced drivers). The service could help them to become familiar with the crossroads of new places (new cities) which they are going to visit. Children have the possibility of studying crossroads in the neighborhood, crossroads on the way to school, etc.

C. Open Social Platform and User-Powered Data Gathering

One of the obstacles that the integration platform might face is the unavailability of required data. Finland, for example, is actively involved in the Open Data movement. The main purpose of public organizations that play the role of open data providers is to promote transparency in management and sharing of public information for use by used. The Finnish Transport Agency is one of the organizations that already support Open Data activities. It provides a Digitraffic service that is addressed to organizations developing information services or working with traffic management and planning. The service offers real-time and historical information and data about the traffic on the Finnish main roads such as: vehicle travel times, traffic volume and speed, ordinary weather conditions (temperature of air and relative moisture.

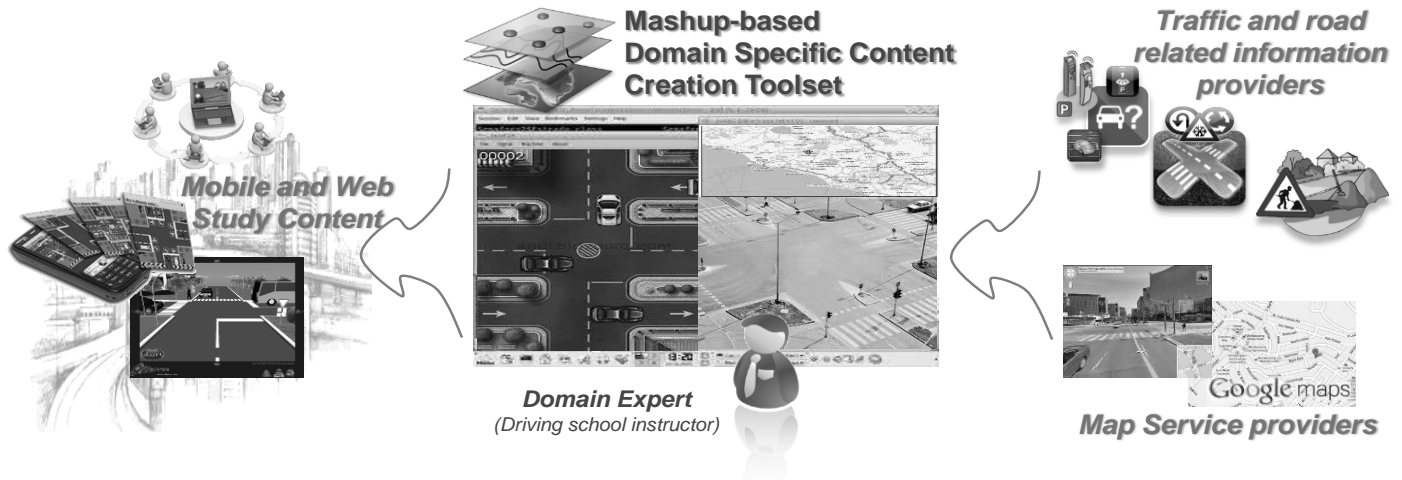


Fig. 1. Mashup-based study content co-creation platform.

are private companies and it makes data retrieval even more complicated. Steering a course between society-oriented and user-powered services, Crossroad on Demand applies a user-sourcing business model and provides a toolset for users to generate necessary data for the service. Users are able to describe crossroad regulation data (topography of a crossroad, crossroad regulation signs and traffic lights, etc.) and build a corresponding data set of crossroads using distributed collaborative intelligence.

Being a platform for education services, Crossroad on Demand may also act as an open social platform where people can model/render real-life situations experienced on a road and get comments and explanations from domain experts (instructors) as well as from other active users of the platform. Additionally, such a platform allows participants to point out various defects and violations regarding traffic regulation, road infrastructure and other aspects that might influence safety on a road. Consequently, we obtain an additional source of public open data that can be used by individuals and a number of authorities (municipality, traffic regulation and management agencies, road reconstruction units, etc.) to improve the situation on roads and increase traffic safety. Thus, we have one more public communication channel with a government that allows the community to take active position in public work.

V. CONCLUSION

Integration of achievements in education science with innovative web technologies (semantic web, augment reality, gamification, social media, etc.) could bring very promising and unexpected results. To achieve a vision of innovative ubiquitous education environment, we need to develop a digital learning ecosystem with integrated innovative tools, solutions and services for learning and teaching. We need to increase the learner's motivation and concentrate on developing her/his abilities and skills through innovative and interactive study content. One way to enhance the content creation process is to elaborate a mashup-based platform for new content co-creation based on (semi)automated composition of content retrieved from external services and collaboration of content providers and learners. The next generation of innovative education environments should also utilize achievements of the Open Data initiative and human power to move towards learner-driven and society-oriented systems. Open data will significantly enhance e-Learning products and services. Allowing anyone to use and redistribute data freely, we may build a basis from which to create enriched content mashed up with augmented reality and the social life of a learner.

A learner-oriented education environment is the best way to recruit active and goal-driven students with innovative mindsets. Earlier involvement of learners in education content creation, improvement and personalization will provide a deeper understanding of their needs and increase the likelihood that the new education content will meet those needs. At the same time, we need to know more about the downside of learner involvement and when not to involve

learners at all. A risk might be that focusing on learners will result in "learner nearsightedness." Finding a fruitful balance between technology push and market pull when it comes to learner involvement needs to be researched more in the future.

The collaborative, interactive and co-creative nature of future education system requires ICT support in the form of intelligent collaborative e-Learning environments. The shift from professional to unprofessional use of ICT technologies requires new infrastructure and tools to make the process human-oriented, trustworthy and competent. In this paper, Crossroad on Demand service is presented as an example of a learner-powered co-creative platform for e-Learning services. Like any other products or services, such environments and services need marketing to attract customers and appropriate business models to be integrated in the current economy.

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