

Mobility Education as a Service: General Concept, Model and Demo Portal

Igor Kabashkin¹ [0000-0003-4004-6620], Boriss Misnevs² [0000-0002-3311-6507], Olga Zervina³ [0000-0002-3323-9443]

Transport and Telecommunication Institute, Lomonosov str. 1, LV-19, Latvia
¹kiv@tsi.lv, ²bfm@tsi.lv, ³Zervina.O@tsi.lv

Abstract. The rapidly evolving digital economy, driven by information technology, necessitates continuous employee upskilling due to shifting work dynamics. This demands a flexible, easily accessible educational environment that enables simultaneous work and learning, paving the way for the concept of Education as a Service (EaaS). EaaS leverages modern information technologies to establish a collaborative ecosystem among entities involved in education, enabling on-demand learning without geographical constraints. This study outlines an EaaS implementation approach research within the eMEDIATOR project. It delineates the EaaS ecosystem model, encompassing architecture components and a demonstrative portal showcasing EaaS functionalities. The article highlights eMEDIATOR's research emphasis on virtual collaboration in educational mobility, offering a European-wide platform transcending national boundaries. The research embraces service-oriented, competence-based, and student-centered pedagogical principles, fostering industry-academia partnerships to address diverse employment needs in the European market. While exploring the developed EaaS model, the article assesses its strengths, limitations, and prospects for integrating emerging technologies like blockchain and artificial intelligence...

Keywords: Education Ecosystem, Digital Platform, Education as a Service, DEMO Portal, System Components Models.

1 Introduction

1.1 The Problem and Research Purposes

In modern society, the rapid development of technology creates new challenges for the education and training system. Business requires specialists with specific competencies, depending on the application area. Students, even at the stage of study at the university, would like to receive a specialization for work in specific areas, often having no idea what competencies they would have to possess in addition to fundamental education in the relevant professional field [1].

Universities are faced with the need to cooperate with each other to invite teachers to courses, the vacancies of the academic staff for which are not filled. The interaction

between universities and real business still has a gap in comparison with the requirements for the competence of graduates to the real needs of the economy. There is a large group of senior professors who can no longer work at universities on a permanent basis but could give high-quality courses for universities that do not have an academic staff in this area. At the same time there are professional training centres that ensure the acquisition of professional competencies that are outside the traditional scope of universities but are in demand in the real sector of the economy [2]. There is also no possibility of obtaining information on the principle of "one window" for both corporate and individual consumers of educational services, on the one hand, and for those who provide such services, on the other hand, for mutual satisfaction of needs in the field of academic education and professional training.

All the above is happening against the background of increasing requirements for the mobility of receiving educational services without changing the location of participants, on the one hand, and the possibility of receiving them at any time, on the other hand.

There is a need to create a new ecosystem - education mobility as a service [3]. The possibilities of modern information technologies (artificial intelligent, blockchain technology and others) create the prerequisites for the new adaptive properties of education services, verification of the fact of receiving education and training in different education establishments both universities and other legal training centers, new forms of mobility in education and others. The architecture of the modern economy allows for the creation of networked information structures facilitating a direct linkage between student clients, education providers and teachers outside rigidly limited formal educational structures. Such transformations form new mobility requirements for education - receiving educational services without changing the participants' location, possibility of receiving such services at any time and agility of education mobility.

The understanding of the need to create a single European ecosystem, providing a variety of mobile services related to education and built on a competency-based approach, among the consortium members appeared in the process of disseminating and implementing the results of the Erasmus + ISECRET project (2015-2017). Participation as invited experts in seminars related to the development of standards for e-CF and TR "ICTBoK" helped to form the idea of the project and determine the requirements for the selection of project team members.

Virtual cooperation in education mobility is the basis for the eMEDIATOR project research idea. The proposal brings added value at the EU level by introducing an ecosystem of European educational mobility services that cannot be achieved through events held in one country.

The aim of the project research is creation an ecosystem model with demo portal used principals of service-based, competence based, student-cantered education and business-academia partnerships for offering courses and various types of employment within one single European education and employment market.

1.2 Research Results Overview

As a result of the project, the following contributions were achieved:

- Meeting individual educational needs of students, lecturers and employees of businesses for the development of specific competences on the base of education mobility services during study in university and long life learning;
- Promoting career development of lecturers which have their own values independently of academic institutions, mission and vision which might not be aligned with the values and career aspirations of lecturers. These lecturers might be demanded by some other institutions, and this project will help institutions and lecturers find each other. This exchange will facilitate talent development and talent exchange, which ultimately boosts European development;
- Enabling lecturers to develop their professional competences in another European context when their local context does not allow for it at the moment, the local market is not interested in this particular set of knowledge of competences or is already saturated with professionals with such competences, which results in the local inability to offer the context of the development of such competences at an academic institution or in a company. Ignoring such needs might not be advisable because universities continue to offer training that develops this particular set of competences or offered such training in the past, and therefore, should bear some degree of ethical responsibility for the implementation of such competences by graduates;
- Developing the knowledge of competences that are required on the European market, not only on their local market. This knowledge is valuable because lecturers and academic institutions are supposed to train students not only for the current local context, but for the international, European, context of today and tomorrow;
- Offering opportunities for industry to find specialists for their unique competence-based demand on the entire European common education market, without being restricted to generalized supply of knowledge constrained by their local market and local perception of development. Ultimately, this will boost macro-level economic development of the common European market;
- Offering opportunities for individuals (students and lecturers) and corporate structures (higher education institutions and enterprises) to obtain and offer services from other European countries on the continuous or sporadic full-time or part-time basis while residing in one specific location in the European Union. This is the merge of education and business, studies and work into a single agile “eduwork” space created by online activities;
- Providing academic institutions with an opportunity to recruit specialists with specific competences that they cannot find on the local market;
- Creating an economic environment for implementing academic competences;
- Implementing a competence-based model of higher education into a digital reality offering educational and employment opportunities;
- Boosting educational competitiveness of small economies, such as Latvian, via open-access to various educational and business European markets via lecturer and academic institutions employment in other European countries, perhaps, mostly in the online part-time and project-based mode often on the continuous basis.

Some details about eMEDIATOR portal functionality and expected users can be found in Fig.1. Use Case Diagram.

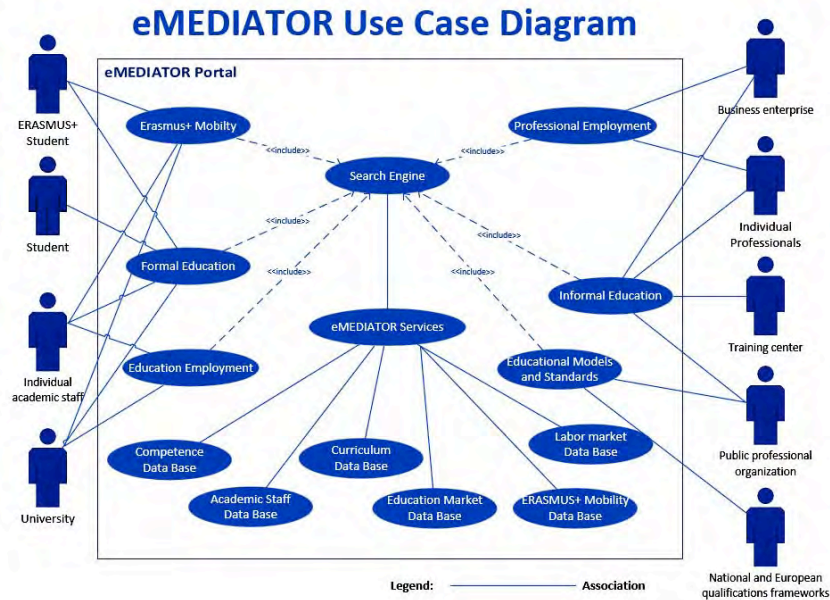


Fig. 1. Fig.1. eMEDIATOR Use Case Diagram.

Results of the project are the following:

1. Model of education ecosystem as a service for transition of academically acquired competences to the work environment of real market.
2. Demo portal of education mobility as a service with competence-based approach and with principle of "one window" administration which:
 - allows lecturers to find employment (full-time or part-time, continuous or constraint by one-time event) outside their institutions in other European countries;
 - allows students to find and enroll in courses of their interests that are not available in their home institution;
 - allows academic institutions to obtain online (often part-time) adjuncts from other European countries for specific courses and for the development of specific courses often at an affordable price and keep them for a longer period of time;
 - allows boosting competences of lecturers because lecturers will teach in another European country;
 - allows businesses to find professionals for their unique needs from other European countries, often for part-time needs.

3. Demo portal as applied and useable solution promoting the development of a high-performing digital education ecosystem of the Digital Education Action Plan 2021-2027 of the European Commission.
4. Methodology of game-based training for properties and possibilities of demo portal. Games for participants for the following roles: students, lecturers, universities and training centers, employers, people with disabilities, people in remote areas and with other disadvantageous circumstances.
5. Training guidelines on how to use the portal for education purposes at universities and training centers for members of academic staff and corporate structures – universities and employers.
6. Curriculum for a new multidisciplinary study pilot course on the merge of the employment market and service education in the digital environment "Digital Markets of Competences: Employment and Education".

National education and employment bodies will benefit from the portal for the following reason. Educational organizations will be able to refer educators and educational institutions to a portal providing practical, not just theoretical, information on the development of digital skills consistent with the European Commission digitalization policies, such as e-CF and DigCompEdu competences.

Using the portal and conducting online training are going to develop educators' digital skills of further and higher education on a much larger, international, scale and at much deeper level. For example, conducting classes might require using more advanced software, such as Microsoft Vision or Visual Studio, using UML or Python programming language, the rudiments of which might be learnt by anyone, especially because the portal will provide guidance on how to use such software or programming language for preparing and conducting online classes. Although information on how to use various software and learn programming languages is available online, it is not always tailored for the needs of educators.

This portal will provide informative resources with a program for the development of such skills.

The creation of such an ecosystem is an innovative approach to implementing the concept of Digital United Europe into real life. The consortium team assumes, after the successful completion of the EMEDIATOR project, to contact the European Commission with a proposal to support the next stage of development to create an industrial implementation of an ecosystem of educational mobility in Europe for global use.

2 Brief description of Research Activities and Project Results (PR1-PR6)

2.1 PR1. eMEDIATOR portal concept and architecture

The activities of the research during Period 1 were focused on analyzing state-of-the-art mobility education-as-a-service platforms, developing requirements and an architecture for the eMEDIATOR portal, and formulating initial specifications [5].

The education-as-a-service (EaaS) concept allows for the creation of networked information systems that link students, educators, and employers. EaaS platforms facilitate agile and flexible delivery of educational services on-demand without locational restrictions. The report discusses how EaaS builds on cloud computing models like IaaS, PaaS, and SaaS to enable scalable and on-demand educational services. Analysis is provided on Massive Open Online Courses (MOOC) platforms, which demonstrate the technical feasibility of building a large-scale educational ecosystem.

To guide eMEDIATOR portal development, the report extracts best practices for EaaS platforms including strong partnerships with hardware/software providers, flexible IT infrastructure, and proactive community management. Requirements are formulated around key architectural components like learning design, skill management, and underlying technology. Workflows are proposed to enable competency-based development of educational content, standardization of curricula, and job market alignment. Functional requirements focus on mobility, personalization, and integration of digital capabilities like virtual reality.

Results of the Period 1 provides critical guidance for the eMEDIATOR portal development through state-of-the-art analysis, architectural workflows, documentation standards, and an expandable requirements framework. The technical analysis demonstrates the feasibility of developing a mobility education ecosystem. The proposed architecture and requirements create a structured basis for the consortium to build an innovative student-centric and competency-based educational platform with strong labor market alignment.

2.2 PR2. Model of pedagogical academic component

The Period 2 covers the development of models for various aspects of the eMediator platform, including service delivery, portal integration, learning environment, synchronous/asynchronous learning, job skills, portal architecture, and pilot service selection.

The service delivery model categorizes services for individual students, academic staff, universities, businesses, and training centers. Services aim to facilitate competency development, document processing, job skills matching, and partnerships.

The portal integration model proposes aligning with the Higher Education Digital Capability framework. Potential integrations include CRM, marketing platforms, learning management systems, and Erasmus+ platforms [6].

For the learning environment model, analysis of interviews highlighted expectations for quizzes, games, videos, interactivity, skill-building, and accessibility. Recommendations include combining 2D and 3D elements and using AI-based systems.

The synchronous and asynchronous learning model examines the strengths of each method for lectures, labs, case studies, creation, collaboration, tutorials, discussions, presentations, assignments, and assessment. A blended approach is proposed.

The job skills model maps academic competencies to career skills using knowledge/skills taxonomies. It extends prior competence models to cover both spheres.

Lastly, the pilot service selection model establishes criteria and processes for identifying relevant, high-impact services for the demonstration platform. Services from learning mobility to entrepreneurship are chosen.

The Period 2 results demonstrate comprehensive models and recommendations to guide the development of the innovative eMediator platform and ensure it meets user needs. Key goals are enhancing competencies, employability, and digital experiences.

2.3 PR3. Organizational component of the portal

The results of the Period 3 cover the design of the search engine for the eMediator platform. It will allow learners to search for courses and competencies [7].

The search engine will be a hybrid type, combining crawler results and human-curated listings. It will search both the platform's database and external online databases. Machine learning and data mining techniques will be utilized to improve relevance.

Proposed features include keyword extraction, spelling correction, course/competence clustering, classification algorithms, and a reputation system. Keyword extraction will help match user queries to course content. Clustering will group similar courses.

Classification algorithms will analyze user behavior to recommend relevant competencies. The reputation system will weight user ratings to provide better recommendations.

Machine learning techniques like supervised learning, reinforcement learning, and neural networks are explained. Different types of data mining like classification, clustering, and association rules are also covered.

Specific algorithms like linear regression, k-means clustering, decision trees, and TF-IDF are analyzed. Their applications to improve search engine performance are discussed.

We may conclude that developed during the Period 3 advanced techniques will allow the search engine to provide an enhanced personalized experience by understanding user intent and matching relevant learning content.

2.4 PR4. Competence component of portal

The results of the Period 4 cover the development of models for the competence component of the eMediator portal. It utilizes natural language processing and machine learning techniques to extract and classify competencies.

Over 5,600 competencies were extracted from computer science curricula at top global universities. These covered areas like math, algorithms, software engineering, robotics, and modern technologies.

The dataset was used to train a linguistic model for automatic competency recognition. Testing on job posting competencies showed a high success rate in identifying competencies.

Further exploration of NLP methods is recommended to improve convenience and enable self-completion of competency information. Clustering competencies by theme would also improve search and discovery.

Another potential application is comparing student competencies from their degree programs to required job competencies. This could quantify the degree of job readiness.

Overall, the use of AI and NLP looks promising for managing the extensive competency data needed for the portal. Matching academic and professional competencies is a key goal.

In summary, we may state that advanced techniques will allow the competence component to effectively bridge learning and employment goals by understanding and aligning competency information.

2.5 PR5. Technological component of portal

The development of robust technological components is essential for building an effective education mobility portal. Recent work by [authors] has made significant strides in this endeavor through the design and implementation of key elements including formal/informal education services, application and enrollment systems, job search functions, search algorithms, and portal testing.

The authors adopt a multi-faceted approach for developing education services, considering organizational, competency, pedagogical and technological dimensions. Comprehensive models for application, admission and enrollment are proposed, emphasizing requirements like user-friendly interfaces, course catalog management, and competency mapping.

Advanced techniques are leveraged for job search and graduate placement, integrating career counseling, networking, and artificial intelligence-driven algorithms. The search engine design incorporates decision tree algorithms and integration with major learning platforms.

Rigorous testing on a portal prototype has enabled faster iteration through migration from Liferay platform to WordPress. Core features like AI-powered competence matching have been implemented. Server configuration and theme customization optimize performance and user experience.

This research reflects remarkable progress in constructing a robust technological framework tailored to education mobility. The integration of artificial intelligence and learning platforms is especially notable. Further details of the Technological component implementation will be delivered in a separate publication.

2.6 PR6. Demo implementation of developed eMEDIATOR components of portal

The demo implementation of the developed eMEDIATOR portal components involved designing the website navigation and structure. The implemented website navigation was structured as follows:

- The homepage provided an overview of the portal's purpose and key features. It included brief descriptions of each major section.
- A user registration section enabled new users to create accounts. It included fields for entering username, email, password, and other details.

- A news section displayed the latest updates related to the portal. It contained articles, announcements, blog posts, and other news content organized by date or category.
- A reporting section gave users access to statistical data, activity reports, performance metrics, and other analytics providing insights into portal usage.
- Moodle access linked to the Moodle LMS, allowing users to access online courses, materials, assignments, and other learning resources.
- A "Book-a-science" section was dedicated to the save-a-science initiative. It provided information on scientific projects, funding, and participation opportunities.
- Competence search sections enabled searching for competencies based on specific needs, with sub-sections for employment, learning, and teaching. Search filters, criteria and options helped refine searches.

The footer on all pages contained essential links like contact info, terms of use, and privacy policy for easy access to key information.

The demo implementation deliverable involved designing and structuring the portal navigation to provide key functions supporting education mobility goals. Details of the DEMO Portal implementation will be described in a separate publication.

3 Discussion of Results

The research presented in this paper outlines the development of an innovative education mobility portal through the eMediator project. Significant progress was made across architectural design, pedagogical models, organizational components, competency management, technology implementation, and demo deployment.

A key accomplishment was the creation of a comprehensive architectural model and requirements framework that provides critical guidance for ongoing portal engineering. Adopting service-oriented and student-centric design principles enables on-demand and personalized education experiences.

The pedagogical models reflect careful consideration of learning modalities, environments, job skills alignment, and pilot service selection. The proposed blended learning approach is well-suited for competence development.

For organizational aspects, the hybrid search engine with AI and data mining matches user intent with relevant competencies, enhancing discovery. The competence component leverages NLP to extract, classify and align academic and professional competencies.

Robust technological components support core portal capabilities from admissions to job placement, integrating AI algorithms and learning platforms. Portal testing and demo implementation validated the navigation design and key functions.

Overall, significant progress was made in conceptual modeling, technical development and validation testing to construct a next-generation mobility education ecosystem. The results establish a strong foundation for further enhancement and real-world deployment [8].

4 Conclusion

This paper summarizes R&D activities undertaken during the eMediator project focused on engineering an innovative mobility education portal.

Testing and demo implementation validated the navigation design and key functions. The iterative, modular approach enables ongoing refinements and emerging technology integration.

The research makes advances in conceptual modeling, technical development and validation testing to construct a next-generation mobility education ecosystem. The rigorous foundations established here provide a solid basis for future enhancement and real-world deployment.

Acknowledgments

This paper has been financially and conceptually supported by the EU grant of ERASMUS+ project Ecosystem for European Education Mobility as a Service: Model with Portal Demo (eMEDIATOR), Agreement No 2021-1-LV01-KA220-HED-000027571.

References

1. Zaitseva L., and Misnevs B.: Competency-Based Approach Teaching Software Engineering In book: "Smart Education and e-Learning 2019". Uskov, V. L., Howlett, Robert, Jain and L. C. eds. Springer. 2019. pp. 231-241.
2. Misnevs B., Kabashkin I., and Užule K.: A Model Describing the Required Digital and Green Competences of VET Educators for Practical Use. 2021 6th South-East Europe Design Automation, Computer Engineering, Computer Networks and Social Media Conference (SEEDA-CECNSM), Preveza, Greece. 2021.
3. Antonio Sánchez J., et al. Cloud service as the driver for university's software engineering programs digital transformation, *Procedia Computer Science*, Vol. 149. 2019, pp. 215-222
4. B. Misnevs. "Software Engineering Competence Evaluation Portal", *Procedia Computer Science*, March, pp. 11 – 17 (2015).
5. Misnevs B., and Kabashkin I.: Services Delivery Model for Education-as-a-Service Based Framework. In book: "Reliability and Statistics in Transportation and Communication. Rel-Stat 2022. Lecture Notes in Networks and Systems". Kabashkin, I., Yatskiv, I., Prentkovskis and O. eds. Springer. pp. 523–538 (2023).
6. Gawlik-Kobylińska M., Kabashkin I., Misnevs B., and Maciejewski P.: Education Mobility as a Service: A Study of the Features of a Novel Mobility Platform, *Applied Science*, MDPI, Vol. 13(9). pp. 1-17 (2023).
7. Misnevs B., and Kabashkin I.: Competence-Based Digital Framework for Education as a Service In book: "Advances in Information and Communication. FICC 2023". Springer Nature. pp. 775–784 (2023).
8. Kabashkin I., Misnevs B., and Puptsau A.: Transformation of the University in the Age of Artificial Intelligence: Models and Competences, *Transport and Telecommunication*, Vol. 24, June, pp. 209 – 216 (2023).