



“Ecosystem for European Education Mobility as a Service: Model with Portal Demo (eMEDIATOR)”

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INTRODUCTION

In an era of rapid technological advancement and evolving educational paradigms, Mobility Education as a Service (EaaS) emerges as a pivotal concept that holds the promise of redefining the way we perceive, deliver, and consume education. The intrinsic value of mobility in education is the facilitation of learning anywhere, anytime, and on any device, ensuring that geographical constraints and traditional learning barriers are minimized, if not eradicated.

This report is a comprehensive exploration of the Mobility EaaS ecosystem, shedding light on its foundational principles, multi-dimensional components, and the tangible outcomes that can be achieved through its implementation. The structure of the report is designed to provide readers with a progressive understanding of the topic, from a holistic overview to the intricate details that shape the EaaS framework.

The first section sets the stage by elucidating the general concept of Mobility EaaS. It introduces readers to the principal goals and objectives underpinning the project, culminating in a highlight of the primary outcomes and the unveiling of a demo portal designed to showcase the practical application of the EaaS model.

The main part of the report delves deeper, dissecting the EaaS model into its core components. These components, ranging from pedagogical to technological, are the building blocks of the EaaS framework, each playing a distinct role in ensuring the efficacy and efficiency of mobile education delivery. The pedagogical component elucidates the academic principles and strategies tailored for mobile education; the organizational component underscores the logistical and structural aspects; the competence component focuses on the skills, abilities, and knowledge integral to the system; and finally, the technological component delves into the digital tools, platforms, and infrastructures that make Mobility EaaS a reality.

Lastly, the final section provides an in-depth look at the demo portal, which serves as a tangible representation of the Mobility EaaS model in action. This segment of the report not only showcases the functionality and features of the portal but also underscores the real-world applicability and potential impact of the model.

It is crucial to recognize the collective expertise and contributions that have shaped this project. Collaboration between partners, each bringing a unique perspective and specialized knowledge, has been instrumental in refining understanding and execution of the EaaS model.

In appendixes there are six interim reports, diligently prepared by partners throughout the duration of this project. These reports not only chart the progress and milestones achieved at different junctures but also highlight challenges encountered, innovations proposed, and insights garnered from each phase. They serve as both a testament to the collaborative nature of this endeavor and as valuable repositories of knowledge that informed our conclusions and recommendations.

The interim reports stand as individual pillars of knowledge, each supporting and enriching the comprehensive structure of our final report.

1. GENERAL DESCRIPTION OF THE eMEDIATOR PROJECT

In every comprehensive report, it is essential to clearly define the objectives, timeframes, and anticipated outcomes. This section serves as the compass that guides the entire report, providing readers with a roadmap to understand the purpose, scope, and expected contributions of the document. In the following section, we will delineate the formal goals, periods, and main results of this report, offering a concise overview of what to expect in the ensuing pages.

1.1 The Problem and Project's 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.

The possibilities of modern information technologies (AI, blockchain technology, etc.) yield the prerequisites for new adaptive properties of education services, verification of receiving education and training at different education establishments, such as universities and other legal training centers, new forms of educational mobility, etc. The architecture of the modern economy and technological advances allow for the creation of networked information structures facilitating a direct linkage between student clients, education providers and instructors outside rigidly limited formal educational structures. New forms of mobility encompass virtual services that form the foundation of the current EMaaS study, the practical aim of which is to demonstrate possibilities of an EaaS mobile education model with a demo portal developed on the principals of service-based, competence-based, student-centered education and business-academia partnerships for offering courses and various types of academic employment within one single European education and employment market (Fig.1).

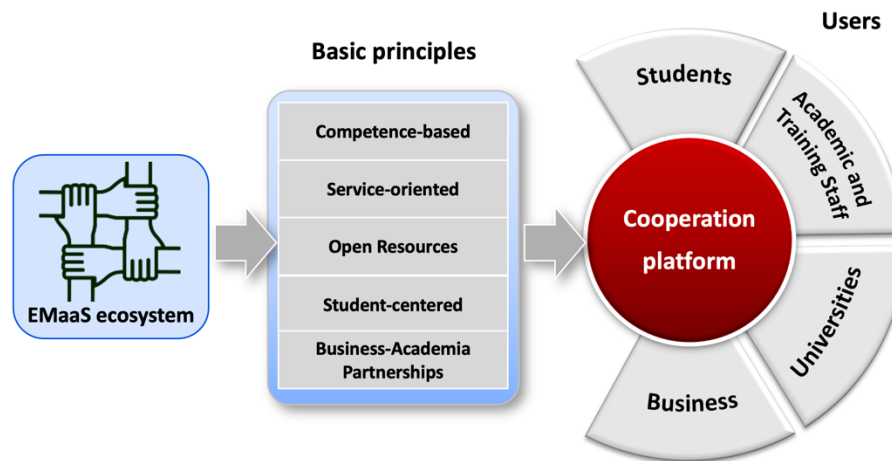


Fig. 1. Basic Principles of Ecosystem for Education Mobility as a Service

The key advantages of this model include the agility of its services created by a significant number of service providers and its focus on competences. Consistent with literature review, these two aspects form challenges for formal higher education programs and impede the transition of formal education to service-based operations.

1.2 The Project Management and Quality Assurance

Effective project management and quality assurance are the cornerstones of any successful endeavor, providing the structure and oversight necessary to achieve desired outcomes while ensuring that these outcomes meet or exceed established standards. In this dedicated section of the report, we delve into the critical aspects of project management and quality assurance that have been instrumental throughout the lifecycle of this undertaking.

Our project management approach draws from established methodologies, such as Agile, Waterfall, and a tailored hybrid model, depending on the project's unique requirements. Key aspects of our project management include:

- **Project Initiation.** A well-defined initiation phase marked the commencement of our project. During this stage, we identified stakeholders, established project goals, and developed a comprehensive project charter.
- **Resource Allocation.** Efficient allocation of resources, including human resources, financial assets, and technology, played a pivotal role in ensuring the project stayed on track.
- **Timeline and Milestones.** We established a clear project timeline with well-defined milestones. Regular reviews and progress assessments helped us gauge our adherence to schedule.

- Risk Management. Proactive risk assessment and mitigation strategies were employed to anticipate and address potential challenges. This approach allowed us to adapt to unforeseen circumstances effectively.
- Communication. Open and transparent communication channels were established to facilitate collaboration among team members, stakeholders, and partners. Regular project updates and reporting mechanisms ensured everyone remained informed.

Quality assurance is core element of our project, encompassing processes, standards, and continuous monitoring to maintain the highest quality. Key aspects of our quality assurance framework include:

- Quality Standards. We established clear quality standards and benchmarks against which project deliverables were measured. These standards were derived from industry best practices and stakeholder expectations.
- Quality Control. Rigorous quality control mechanisms were implemented at each stage of the project. These measures included peer reviews, inspections, and testing protocols to identify and rectify any deviations from quality standards.
- Continuous Improvement. Our commitment to quality extended beyond mere compliance. We actively sought opportunities for improvement, refining processes, and workflows based on feedback and lessons learned.
- Compliance and Regulations. We remained vigilant to regulatory requirements and industry-specific compliance standards. Our project adhered to all relevant regulations, ensuring legal and ethical integrity.

Throughout our project management and quality assurance journey, we encountered challenges, made discoveries, and honed our practices. Lessons learned during this process have been invaluable in shaping our approach. Looking ahead, we envision further enhancements to our project management and quality assurance methodologies, adapting to evolving needs and best practices in the field.

1.3 The Project 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 market 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.2. Use Case Diagram.

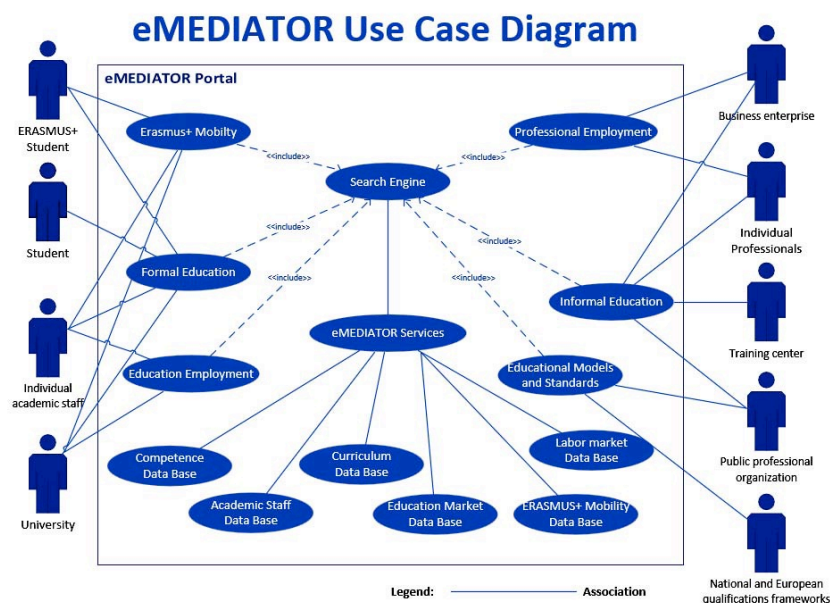


Fig. 2. eMEDIATOR Use Case Diagram

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.

1.4 Brief description of Research Activities and Project Results (PR)

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.

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.

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.

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.

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.

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.

1.5 Conclusion

At the culmination of our exploration into the overarching framework of Mobility Education as a Service (EaaS), several pivotal insights emerge. Firstly, the transformative potential of EaaS transcends conventional educational paradigms, offering a fresh, adaptable, and more inclusive approach to learning. By embracing the mobility trend that defines the modern era, EaaS embodies a progressive model where education is not constrained by physical or temporal boundaries.

The primary goals and objectives outlined in this section underscore the model's commitment to democratizing education, ensuring that learning opportunities are accessible, engaging, and tailored to the unique needs and preferences of individual learners. This is a paradigm shift from the 'one-size-fits-all' methodology, marking a significant evolution in the educational landscape.

The demonstration of the EaaS portal serves as a tangible representation of the model's capabilities. It provides a snapshot of how theoretical constructs translate into functional platforms, enriching the learning experience while maintaining the integrity and depth of educational content. The portal, in essence, stands as a testament to the harmonious integration of pedagogical principles with cutting-edge technology.

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2. Mobility Education as a Service. General concept, model and architecture of the portal

As we venture into the modern educational landscape, the necessity for agile, scalable, and universally accessible learning paradigms becomes increasingly evident. At the forefront of this evolution stands the concept of Mobility Education as a Service — a paradigm shift aiming to mold the future of learning in alignment with the digital age.

This section endeavors to introduce readers to the overarching theme of Mobility EaaS, serving as a precursor to the intricate layers that constitute this innovative educational model. We aim to unpack the foundational ethos behind EaaS, delineating its objectives and the transformative goals it seeks to achieve. The essence of Mobility EaaS lies not just in its technological prowess but in its holistic approach to reimagining the delivery and consumption of education.

2.1 Ecosystem for Education Mobility as a Service

The open-source framework of EMaaS portal identifies key domains and capabilities required for digital delivery of education mobility services across the entire study lifecycle and provides a structure to facilitate relevant cross-institution cooperation.

The EMaaS framework builds on the model of new demands to education and training already mentioned earlier. Institutional capabilities of education and business establishments are connected with individual expectations of students on obtaining professional competences across the lifecycle of professional activities initiated by the concepts of demand and the need of discovery and leading to implementation of the learning concepts, such as Learning Design, Learner Experience, Work and Lifelong Learning. The framework encompasses current capabilities, such as recruitment, curriculum design, assessment and career planning, and also looks ahead to future and emerging capacities of and for successful digital learning.

Ecosystem for Education Mobility as a Service (EMaaS) can be modeled using four components (Fig.3): organization, pedagogical, competence, and technological. Here is a brief overview of each component:

1. **Organization Component.** This component includes the various organizations involved in EMaaS, such as educational institutions, transportation companies, and government agencies. The focus of this component is on establishing partnerships and collaborations between different organizations to provide seamless and integrated EMaaS solutions. This component also includes the development of policies and regulations that govern the use of EMaaS in education.

2. **Pedagogical Component.** This component focuses on designing educational programs that integrate EMaaS as a learning tool. The focus is on creating pedagogical frameworks that incorporate EMaaS into the curriculum, as well as designing instructional materials and activities that leverage the technology. This component also includes the development of assessment and evaluation methods that measure the effectiveness of EMaaS in improving learning outcomes.
3. **Competence Component.** This component focuses on developing the competencies required to effectively use EMaaS in education. This includes the development of training programs for educators and learners on how to use EMaaS tools and technologies, as well as the development of support systems to provide ongoing assistance and guidance. The focus is on building the skills and knowledge necessary to effectively use EMaaS in different learning contexts.
4. **Technological Component.** This component focuses on the technological infrastructure required to support EMaaS in education. This includes the development of software and hardware systems that enable learners to access EMaaS tools and technologies, as well as the development of data management and analysis systems to monitor and evaluate the use of EMaaS. The focus is on ensuring that the technological infrastructure is reliable, secure, and scalable.

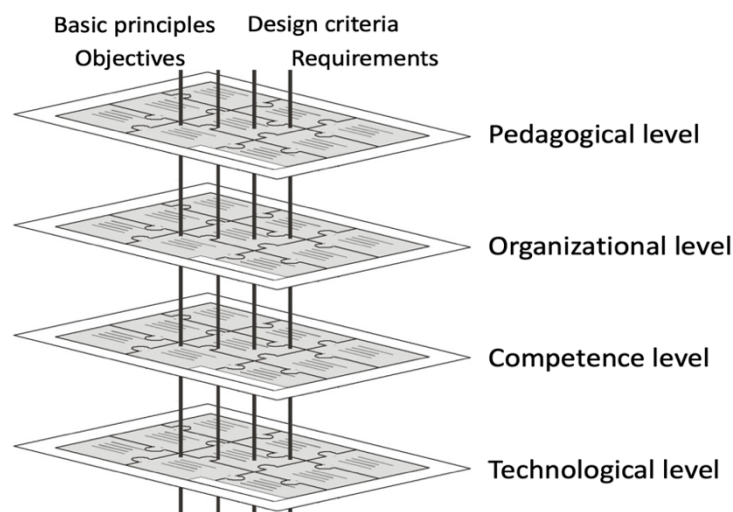


Fig. 4. Ecosystem for Education Mobility as a Service

Together, these four components provide a holistic framework for designing and implementing EMaaS in education. By addressing the organization, pedagogical, competence, and technological aspects of EMaaS, stakeholders can create a comprehensive and effective ecosystem that supports learning and mobility.

2.2 The architecture of the model for Education Mobility as a Service

The architecture of the model for Education Mobility as a Service (EMaaS) is based on the concept of a four-layer architecture that includes the following layers:

1. Service layer. This layer provides the EMaaS services to the users, including learners, educators, and administrators. The service layer includes a range of services such as transportation services, learning management services, and collaboration services that support the use of EMaaS in education.
2. Platform layer. This layer provides the technical infrastructure to support the services provided by the service layer. The platform layer includes the hardware and software components required to support EMaaS services, such as servers, databases, and communication networks.
3. Integration layer. This layer provides the integration between the different services and platforms in the EMaaS ecosystem. The integration layer includes the middleware components and APIs that enable different EMaaS services and platforms to communicate with each other and share data.
4. Application layer. This layer provides the user-facing applications that allow learners, educators, and administrators to access and use the EMaaS services. The application layer includes web and mobile applications that provide a range of functions, such as booking transportation, accessing learning materials, and collaborating with peers and educators.

The four-layer architecture provides a flexible and scalable framework for the implementation of EMaaS in education. The architecture allows for the integration of different services and platforms, and it provides a user-friendly interface for learners, educators, and administrators. By providing a comprehensive and integrated solution, the EMaaS model can support the mobility and learning needs of a diverse range of learners in different educational contexts.

2.3 Benefits and Challenges of the EMaaS Ecosystem

EMaaS offers several benefits for education, including improved access to education, increased flexibility and mobility, and enhanced collaboration and communication. However, implementing EMaaS in education also presents several challenges, including regulatory and technical challenges.

1. Benefits of Using EMaaS in Education: a. Improved Access to Education:
 - a. EMaaS can provide learners with greater access to educational opportunities by enabling them to study and learn anytime, anywhere. This can be particularly beneficial for learners who live in remote areas, have limited mobility, or have other commitments that make it difficult to attend traditional educational institutions.

- b. Increased Flexibility and Mobility: EMaaS can provide learners with greater flexibility and mobility in their learning journey by enabling them to access educational opportunities from a variety of locations and devices. This can enable learners to balance their learning with other commitments, such as work or family.
 - c. Enhanced Collaboration and Communication: EMaaS can provide learners with enhanced opportunities for collaboration and communication with peers and educators. This can enable learners to engage in more interactive and participatory learning experiences and receive more personalized support and feedback.
- 2. Challenges of Implementing EMaaS in Education:
 - a. Regulatory Challenges: Implementing EMaaS in education can be challenging due to regulatory barriers, such as data privacy and security regulations, transportation regulations, and regulations related to the delivery of educational services.
 - b. Technical Challenges: Implementing EMaaS in education can also be challenging due to technical barriers, such as the development of interoperable systems, the management of complex data flows, and the need for robust technical infrastructure.
- 3. Addressing the Challenges of Implementing EMaaS in Education: The EMaaS ecosystem can address the challenges of implementing EMaaS in education by providing a comprehensive and integrated solution that addresses the different components involved in providing EMaaS services. For example:
 - a. Regulatory Challenges: The organization component of the EMaaS ecosystem can address regulatory challenges by establishing partnerships and collaborations with different stakeholders, including educational institutions, transportation companies, and government agencies. These partnerships can enable the development of policies and regulations that govern the use of EMaaS in education.
 - b. Technical Challenges: The platform and technological components of the EMaaS ecosystem can address technical challenges by providing the technical infrastructure required to support EMaaS services. This includes the development of interoperable systems, the management of complex data flows, and the provision of robust technical infrastructure.

EMaaS offers several benefits for education, including improved access to education, increased flexibility and mobility, and enhanced collaboration and communication. However, implementing EMaaS in education also presents several challenges, including regulatory and technical challenges. The EMaaS ecosystem can address these challenges by providing a comprehensive and integrated solution that addresses the different components involved in providing EMaaS services.

2.4 Conclusion

The EMaaS ecosystem is a comprehensive and integrated solution that can provide learners with greater access, flexibility, and quality of education. The ecosystem consists of four components - organization, pedagogical, competence, and technological - and four layers - service, platform, integration, and application - that work together to provide a seamless and integrated EMaaS solution.

Implementing the EMaaS ecosystem in education requires a systematic and collaborative approach that involves different stakeholders and stages. Successful implementation can provide learners with a range of benefits, including improved access to education, increased flexibility and mobility, and enhanced collaboration and communication.

The EMaaS ecosystem also presents several challenges, including regulatory and technical challenges. However, these challenges can be addressed by leveraging the different components and layers of the ecosystem and by establishing partnerships and collaborations with different stakeholders.

The potential impact of EMaaS on education in the future is significant, providing new opportunities and challenges for educators, learners, and educational institutions. The EMaaS ecosystem can enable learners to access educational opportunities regardless of their physical location and schedule, promote lifelong learning, and optimize educational resources and infrastructure.

EMaaS ecosystem is an important and innovative solution for enhancing education in the 21st century. Its potential to provide learners with greater access, flexibility, and quality of education is significant, and its implementation requires a collaborative and systematic approach that involves different stakeholders and stages. The EMaaS ecosystem presents new opportunities and challenges for educators, learners, and educational institutions, and its development and adoption will require continued innovation, partnership, and adaptation to changing educational needs and contexts.

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3. Pedagogical/academic component of the Mobility Education as a Service model

The essence of any educational model, no matter how technologically advanced or globally integrated it might be, lies in its pedagogical core. The ways in which content is curated, structured, and delivered form the foundational pillars upon which the entire edifice of the learning experience stands. In the context of Mobility Education as a Service (EaaS), the pedagogical component takes on an even more significant role, as it has to address not just traditional learning goals, but also the unique demands of a mobile, digitally-savvy, and on-the-go audience.

This section delves into the heart of the pedagogical and academic mechanisms that underpin the Mobility EaaS model. Here, we will explore how time-tested educational philosophies merge with cutting-edge methodologies to create a learning experience that is both deeply enriching and profoundly flexible. From curriculum design to instructional strategies, from learner engagement to assessment methodologies, this section seeks to unpack the academic dimensions that make the Mobility EaaS model a perspective in contemporary education.

3.1 The definition of pedagogical model of EaaS ecosystem

The pedagogical model of the Education-as-a-Service (EaaS) ecosystem refers to the systematic design and framework that integrates educational principles, instructional strategies, and technological tools to facilitate a learner-centric, adaptive, and outcome-driven education experience in a digitized environment. This model emphasizes personalized learning pathways, multi-modal content delivery, interactive engagements, real-world applications, continuous assessments, and feedback mechanisms, all underpinned by ethical and cultural considerations to cater to a global and diverse learner base.

3.2 The main components of the pedagogical model of EaaS

The pedagogical model of an Education-as-a-Service (EaaS) ecosystem integrates a blend of technological, instructional, and learner-centric components. These components are intricately interwoven to offer a seamless and efficient learning experience. Here are the main components of the pedagogical model of EaaS:



1. **Learning Objectives and Outcomes.** Every course or module within the EaaS ecosystem begins with clearly defined objectives and expected outcomes. This sets the direction and provides clarity about what learners will achieve at the end.
2. **Personalized Learning Paths.** This component ensures differentiation. Recognizing the individual needs, preferences, and pace of learners, EaaS systems utilize data analytics and adaptive algorithms to curate tailored learning journeys.
3. **Content Delivery Mechanisms.** These include multimedia lectures, readings, simulations, and virtual labs. Given the diversity of learners, a multi-modal approach ensures that different learning styles are catered to.
4. **Interactive Engagements.** This incorporates tools like discussion forums, collaborative projects, and gamified learning elements to promote active participation and peer-to-peer interactions.
5. **Real-world Application.** Project-based learning, case studies, and real-world simulations are integrated to ensure that learners can apply their knowledge in practical contexts.
6. **Formative and Summative Assessments.** These tools evaluate the learner's progress and mastery of content. While formative assessments (like quizzes and reflections) provide ongoing feedback, summative assessments (like final exams or projects) gauge the overall achievement of learning outcomes.
7. **Feedback and Reflection.** Platforms within EaaS often have tools that facilitate regular feedback from instructors and peers. They also encourage learners to engage in metacognitive practices, reflecting on their learning process and strategies.
8. **Learner Support Systems.** This includes mentorship programs, discussion forums, and AI-driven chatbots that provide instant support, ensuring that learners have the necessary help when they face challenges.
9. **Continuous Improvement.** Drawing from analytics and user feedback, courses and modules are regularly updated to ensure relevance and efficacy. This component ensures the EaaS remains agile and responsive to the changing needs of learners.
10. **Professional Development and Community Building.** Especially crucial for educators, this component provides them with the necessary training to navigate the EaaS landscape effectively. Additionally, creating a community of educators allows for the sharing of best practices and collaborative problem solving.
11. **Ethical and Cultural Considerations.** Given the global reach of EaaS platforms, it's essential to ensure that content is culturally sensitive and accessible. Additionally, issues like data privacy, equity, and inclusion also play a pivotal role in shaping the pedagogical model.



Together, these components form a holistic framework that drives the pedagogical approach of EaaS, ensuring that it's not just about delivering content but about fostering meaningful, personalized, and effective learning experiences.

3.3 The main requirements for the portal from the pedagogical perspective

Building an IT portal for the implementation of an EaaS ecosystem requires careful consideration of the pedagogical model to ensure that the platform not only delivers content but also fosters an environment conducive to effective learning. Here are some main requirements for the portal from the pedagogical perspective:

1. **Adaptive Learning Pathways.** The portal should have the capability to analyze individual learner's needs, progress, and preferences, and accordingly suggest personalized learning pathways.
2. **Multi-modal Content Delivery.** To cater to different learning styles, the portal should support various formats like video lectures, podcasts, interactive simulations, reading materials, quizzes, etc.
3. **Interactive Engagements.** Tools for real-time interactions, such as discussion forums, chatbots, collaborative whiteboards, and breakout rooms for group activities, are essential.
4. **Continuous Assessments & Feedback.** The portal should facilitate frequent knowledge checks, quizzes, assignments, and provide instantaneous feedback to learners.
5. **Real-world Application.** It should offer opportunities for learners to apply their knowledge through project-based learning, virtual labs, case studies, and simulations.
6. **Peer Learning & Collaboration:** Features that enable peer review, group discussions, collaborative projects, and community building should be embedded.
7. **Accessibility & Inclusivity.** The platform should be universally accessible, catering to learners with disabilities, and should support multiple languages for global reach.
8. **Gamification.** To enhance engagement, elements of gamification, such as badges, leaderboards, and challenges, can be incorporated.
9. **Ethical & Cultural Considerations.** The content and interactions should be designed to respect and acknowledge the diverse cultural and ethical backgrounds of global learners.
10. **Data Protection & Privacy.** Given that a lot of learner data will be processed for personalization, it's crucial that the portal complies with global data protection regulations and ensures user privacy.
11. **Professional Development & Lifelong Learning.** The portal should not just cater to traditional learners but also professionals looking for upskilling and reskilling opportunities.

12. Integration with External Tool. There should be provisions to integrate with third-party tools and platforms for a richer learning experience, such as virtual reality tools or specialized simulation software.
13. Analytics Dashboard. Educators and administrators should have access to detailed analytics on learner performance, engagement metrics, and course efficacy to refine the pedagogical approach.
14. Resource Library: A centralized repository where educators can share, update, or archive learning materials, resources, and best practices.
15. Modularity & Scalability. As education trends and technologies evolve, the portal should be designed to easily integrate new pedagogical tools and methodologies.
16. Support & Training. As it's a tech-driven platform, robust support mechanisms for educators and learners, along with training modules on how to utilize the platform to its full potential, are crucial.

The IT portal should not just be a content delivery platform but an environment that mimics the complexities and interactivity of a physical classroom, while leveraging the advantages of digital tools and methodologies to enhance the learning experience.

3.4 Conclusion

The Mobility Education as a Service model marks a significant step in the ongoing evolution of education, signaling a transformative shift from traditional pedagogical approaches to more agile, personalized, and technology-integrated methodologies. This project exploration underscores the intricate interplay between technological capabilities and pedagogical principles, demonstrating that while technology can facilitate learning, it is the underlying pedagogical model that truly defines the efficacy and impact of the educational experience.

Key reflections from this exploration include:

1. Personalization at the Forefront. The ability to tailor learning experiences to individual needs, preferences, and paces is not merely a feature of the Mobility EaaS model—it's a defining characteristic. As we've seen, this personalization is made possible through AI-driven analytics, adaptive content delivery, and continuous feedback mechanisms.
2. The Power of Modular and Contextual Learning. By breaking down education into bite-sized, mobile-friendly modules and blending digital content with real-world contexts (such as through AR), the Mobility EaaS model ensures that learning is both digestible and relevant.



3. Embracing the Social Aspect. While mobile learning is often seen as an individual endeavor, the emphasis on collaborative learning, peer review, and community engagement reveals that learning remains a social endeavor, even in a digital age.
4. Navigating Challenges with Insight. Our discussions around balancing flexibility with structure, overcoming technical limitations, and envisioning the future landscape of Mobility EaaS have underscored that while the road ahead is promising, it is also laden with challenges. Navigating these challenges will require a mix of technological innovation, pedagogical insight, and stakeholder collaboration.
5. The Future Beckons. With advancements in AI, VR, AR, and neuroadaptive systems on the horizon, the Mobility EaaS model is set to undergo further refinements and innovations. The pedagogical principles, however, will remain central—ensuring that technology serves the learner, rather than the other way around.

The Mobility EaaS model presents a compelling vision of what education can be: flexible yet structured, individualized yet collaborative, technologically advanced yet deeply rooted in timeless pedagogical principles. As educators, technologists, policymakers, and learners navigate this brave new world of mobile-first education, it's essential to remember that at the heart of it all lies the age-old quest for knowledge, understanding, and personal growth.

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4 . Organizational component of the Mobility Education as a Service model

The advent of digital technologies has revolutionized various sectors, education being a prominent one among them. As the global educational landscape grapples with the challenges and opportunities of the 21st century, it has become evident that traditional modes of education are unable to fully meet the ever-evolving demands of learners. In response to these changing dynamics, an innovative concept has emerged, namely, Education as a Service (EaaS). EaaS transforms the traditional, linear model of education into a more flexible, learner-centric, and service-oriented model that harnesses the potential of digital technologies and adaptive learning mechanisms.

While the benefits of EaaS are widely recognized, its successful implementation relies significantly on an effective and adaptable organizational model. The organizational model acts as the structural and operational backbone, determining the way educational services are managed, delivered, and evaluated in the EaaS ecosystem.

This section elucidates the main components of the model, the role and impact of these components in the overall functioning of the EaaS ecosystem.

Through its exploration of the EaaS organizational model, the project valuable insights for educators, policymakers, and technologists seeking to harness the potential of EaaS to create transformative educational experiences that cater to the needs of the digital age.

4.1 The definition of organisational model of EaaS ecosystem

The organizational model of an Education as a Service (EaaS) ecosystem is a structural and operational framework that outlines the interactions between various stakeholders, services, and supporting infrastructures within the EaaS environment. This model provides a roadmap for how educational services are managed, delivered, and evaluated, supporting competency-based and service-oriented learning in a student-centric manner.

It highlights the roles and responsibilities of all the key players including individual students, academic staff, universities, business organizations, professional training centers, and public professional organizations. Each stakeholder contributes to and benefits from the EaaS ecosystem in distinct ways, engaging with the diverse array of services that address specific needs or gaps in the educational landscape.

The model is underpinned by a cooperation platform, a digital information environment that facilitates seamless communication, collaboration, and service delivery across the ecosystem. The platform enables the collection, sharing, and analysis of data that can inform decision-making, enhance service provision, and optimize the learning experience.

In the organizational model, management and governance structures play a crucial role in ensuring the smooth functioning of the ecosystem. They establish the necessary protocols, guidelines, and rules that regulate interactions, maintain quality standards, and promote ethical practices.

Finally, the organizational model incorporates feedback and evaluation mechanisms to continually assess and improve the effectiveness of the EaaS ecosystem. This allows for regular refinement of services and systems, ensuring they remain aligned with the evolving needs of users and the broader trends in the educational landscape.

4.2 The main component of organization model of EaaS

In the context of Education as a Service (EaaS), the main components of an organizational model could be:

1. Stakeholders. This includes students, academic staff, universities, business organizations, professional training centers, and public professional organizations. Each stakeholder has different needs and plays different roles in the ecosystem.
2. Services. The services are the various offerings that address the needs of different stakeholders, such as information on potential mobility places for students, vocational training courses for universities, or the development of professional standards by public professional organizations. These services need to be effectively managed and delivered to meet user demands.
3. Cooperation platform. This is the information environment that implements the main functionality of the system. It connects all stakeholders and facilitates the sharing of information and services.
4. Management and Governance. An essential aspect of the organizational model of EaaS is the governance mechanism that oversees the interactions among all components of the ecosystem. This includes the establishment of guidelines, rules, and protocols for communication, service delivery, and decision-making processes.
5. Supporting Infrastructure. This encompasses the necessary technical, logistical, and administrative support needed to effectively deliver educational services, including IT infrastructure, administrative staff, and potentially even physical locations.
6. Feedback and Evaluation Mechanisms. These are necessary to ensure that the services provided meet the needs of the stakeholders and that improvements can be made where necessary.

The organizational model for EaaS must be flexible, transparent, and user-centric, facilitating the easy flow of information between various parties. It should support competency-based, service-oriented, and open-source learning approaches, encouraging partnerships between academia and businesses and promoting student-centered learning.

4.3 The main requirements for the portal from the organisational perspective

When developing an IT portal to implement an Education as a Service (EaaS) ecosystem, several important factors need to be taken into consideration with respect to the organizational model. Here are some of the main requirements:

1. **User Accessibility and Personalization.** The portal should be designed with the user in mind. It should be accessible, intuitive, and capable of accommodating a wide variety of user needs. This may involve creating individualized user interfaces and personal dashboards that allow users to customize their experience based on their roles and needs.
2. **Role-Based Access Control.** Different users (individual students, academic staff, universities, business organizations, professional training centers, public professional organizations) will have varying levels of access and functionality depending on their role within the system. The portal should have robust and secure access controls to ensure that users can only access information and features pertinent to their role.
3. **Interoperability and Integration.** The portal should be capable of seamless integration with a variety of educational tools, platforms, and databases. This interoperability is essential for data sharing and collaborative processes within the ecosystem.
4. **Data Management and Security.** Given the volume of sensitive data likely to be processed and stored by the portal, robust data management and security protocols are crucial. This includes ensuring data privacy, data accuracy, and compliance with relevant regulations.
5. **Real-Time Collaboration and Communication.** The portal should facilitate real-time collaboration and communication between different users. This includes features such as chat forums, video conferencing, document sharing, and other collaborative tools.
6. **Feedback Mechanism.** The portal should incorporate a mechanism for collecting feedback from users and for evaluating the effectiveness of services. This will contribute to the ongoing refinement and improvement of the EaaS ecosystem.
7. **Scalability.** Given the dynamic nature of education ecosystems, the portal needs to be scalable to adapt to the growing number of users, increase in data, and the potential need for new features and services in the future.

8. **Service Management.** The portal should provide mechanisms for managing and delivering the diverse array of educational services outlined in the EaaS model. This includes course listings, competency mapping, teacher availability, student mobility options, internship opportunities, and more.
9. **Training and Support.** To ensure the successful implementation and adoption of the portal, adequate training and support should be provided to all users. This includes user guides, tutorials, and responsive customer service.
10. **Governance.** The portal needs to have a robust governance mechanism that ensures it operates within the framework set by the EaaS organizational model. This includes adherence to policies, standards, and regulatory requirements.
11. **Analytics and Reporting.** The portal should provide comprehensive analytics and reporting capabilities. This would allow the monitoring of various parameters like user engagement, course effectiveness, and performance metrics. These insights will be valuable in making data-driven decisions and enhancements to the EaaS ecosystem.
12. **Resource Management.** The portal should include functionalities for managing resources effectively. This includes the allocation and scheduling of resources such as teachers, classrooms, equipment, online resources, and more.
13. **Innovation and Flexibility.** The portal needs to support the continuous innovation that's integral to the EaaS model. This could mean integrating new educational technologies, adopting different pedagogical models, or adjusting to shifts in educational trends and demands.
14. **Community Building.** The portal should provide tools for building and nurturing an online community. Features like discussion forums, social media integration, and collaborative projects can help to foster a sense of community among users.
15. **Diversity and Inclusion.** The portal should be designed with inclusivity in mind. This involves considering the diverse needs and backgrounds of users, and ensuring that the portal is accessible and beneficial to all.
16. **Continuous Improvement.** The portal should incorporate mechanisms for continuous improvement. This might involve regular system checks, user surveys, and a commitment to updating and upgrading the portal in response to user feedback and changing requirements.
17. **Sustainability.** The portal's development and operations should consider sustainability in both an environmental and a business sense. This might include using green hosting solutions, optimizing for energy efficiency, and also ensuring that the business model supports long-term operation and maintenance of the portal.

Building an IT portal for an EaaS ecosystem involves careful planning and consideration of many diverse elements. By adhering to these principles, you can create a portal that effectively supports the organizational model of EaaS and provides a valuable resource for all users.

4.4 Conclusion

In this era of digital transformation, Education as a Service (EaaS) stands out as an innovative approach capable of reshaping the educational landscape. The EaaS model aims to offer flexible, personalized, and efficient educational services by leveraging the power of technology and adaptive learning mechanisms. However, the successful realization of this model heavily relies on its underlying organizational structure. The project endeavored to elucidate the intricate nature of this organizational model and its crucial role in orchestrating the functioning of the EaaS ecosystem.

Through a comprehensive exploration of the main components of the EaaS organizational model, we highlighted the pivotal roles that governance, educational service delivery, competency-based learning, IT infrastructure, student-centricity, and feedback loops play in the successful implementation of EaaS. The project also addressed the importance of understanding and managing both static and dynamic parameters within this model to ensure its adaptability to evolving educational needs and technological advancements.

However, it is crucial to acknowledge that the EaaS organizational model is not a one-size-fits-all solution. Its implementation needs to be carefully tailored to the specific context of each educational institution, considering its unique educational objectives, available resources, and the specific needs and preferences of its learners.

As the field of EaaS continues to evolve, further research should be directed towards understanding its implementation challenges and possible solutions, especially in diverse and resource-constrained settings. By doing so, we can contribute towards harnessing the full potential of EaaS, making quality education more accessible, personalized, and impactful for learners worldwide.

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5. Competence component of the Mobility Education as a Service model

The ever-evolving landscape of education, intensified by technological disruptions and an increased appetite for on-the-move learning experiences, necessitates a revised comprehension of competence. While traditionally, competence was often viewed through the lens of knowledge retention and skill demonstration, the advent of Mobility Education as a Service demands a more holistic and integrated perspective.

Mobility EaaS represents not just a shift in how education is delivered but also in how learning outcomes are defined and measured. In this dynamic ecosystem, learners engage with content across varied contexts, devices, and time frames within flexible learning paradigms.

In this part of the project the concept of competence within the Mobility EaaS framework is study with its multi-faceted nature, exploring its cognitive, behavioral, and socio-emotional dimensions. Furthermore, by drawing distinctions between traditional educational competence approaches and those relevant for a mobile-centric learning environment, the project has aim to chart a clear path for educators, developers, and stakeholders to understand and optimize competence-driven outcomes in the Mobility EaaS landscape.

5.1 The definition of competence model of EaaS ecosystem

The competence model of the Mobility EaaS ecosystem is a comprehensive framework that identifies and categorizes the pivotal skills, knowledge, behaviors, and attitudes essential for learners navigating the mobile-centric educational environment. In this model, competencies are tailored to align with the unique affordances and challenges of mobile learning, emphasizing immediacy, accessibility, and real-world integration. The model accommodates diverse learning paths, prioritizes just-in-time knowledge acquisition, and champions microlearning, while ensuring that learners are both digitally fluent and equipped with the adaptive skills necessary for an ever-changing, mobile-first world.

5.2 The main components of the competence model of EaaS ecosystem

The competence model within the Mobility Education as a Service ecosystem focuses on ensuring that learners are equipped with the necessary skills, knowledge, attitudes, and behaviors to effectively navigate and thrive in today's dynamic and often decentralized learning environments. Here are the main components of the competence model in such an ecosystem:



1. Skillsets:

- Definition: Tangible abilities that learners can demonstrate.
- Examples: Coding, problem-solving, data analysis, communication skills, etc.
- EaaS Application: Modular courses tailored to specific skills, with clear learning outcomes.

2. Mindsets:

- Definition: Attitudes and dispositions that influence behaviors and learning.
- Examples: Growth mindset, resilience, adaptability, collaboration.
- EaaS Application: Interactive courses that foster these attitudes, peer interactions, mentorship, etc.

3. Knowledge Base:

- Definition: The foundational information and understanding necessary to apply skills and mindsets.
- Examples: Core principles of a subject, interdisciplinary insights, foundational theories.
- EaaS Application: Curated content libraries, foundational courses, multimedia resources.

4. Performance Indicators:

- Definition: Observable and measurable behaviors or outputs that demonstrate competence.
- Examples: Successful project completion, innovation in task execution, effective team leadership.
- EaaS Application: Assessment tools, project-based evaluations, feedback mechanisms.

5. Personalized Learning Paths:

- Definition: Tailored educational trajectories that respond to individual learner needs, goals, and progress.
- EaaS Application: Adaptive learning algorithms, course recommendations, competency-based progressions.

6. Experiential and Applied Learning:

- Definition: Opportunities for learners to apply their knowledge in real-world or simulated scenarios.
- Examples: Internships, project-based learning, simulations.
- EaaS Application: VR/AR experiences, collaboration with industry partners, real-world projects.

7. Continuous Feedback and Assessment:

- Definition: Ongoing mechanisms to gauge learner progress and provide constructive feedback.
- EaaS Application: Automated quizzes, peer review systems, AI-driven feedback tools, analytics dashboards.

8. Lifelong Learning and Up-skilling:

- Definition: Encouraging continuous learning and development beyond formal education.



- EaaS Application: Updateable course content, new skill modules as per industry trends, alumni networks.

9. Interdisciplinary Integration:

- Definition: Combining knowledge and skills from multiple disciplines to address complex problems.
- EaaS Application: Courses that integrate content from different fields, team projects across disciplines.

10. Collaborative and Social Learning:

- Definition: Learning through interaction with peers, mentors, or a community.
- EaaS Application: Discussion forums, group projects, mentorship programs.

Understanding and effectively integrating these components in the Mobility EaaS ecosystem can help in achieving a comprehensive and future-ready competence model.

5.3 The main requirements for the portal from the competence perspective

Implementing an EaaS ecosystem through an IT portal with a focus on the competence model requires a blend of technological, instructional, and user-centric considerations. Here are the main requirements:

1. Competence Framework Integration:

- Dynamic Competence Matrix. The portal should have an integrated dynamic matrix that lists all competencies, levels of mastery, and the associated resources or learning modules for each.
- Customization and Adaptability. The ability to customize or update the competence framework based on evolving educational or industry standards.

2. User Profiling and Progress Tracking:

- Individual Competence Profiles. Each learner should have a profile showcasing their current competencies, levels of mastery, and areas needing improvement.
- Real-time Progress Monitoring. Track the learner's progress in real-time as they master various competencies.

3. Resource Mapping:

- Relevant Content Linkage. Each competence should link to relevant learning modules, resources, or activities.
- Multiple Learning Pathways. For each competence, offer multiple pathways or resources to cater to diverse learning styles and preferences.

4. Assessment Tools:



- Competence-Based Assessments. Implement assessments specifically tailored to measure mastery over competencies.
 - Instant Feedback Mechanism. Offer instant, actionable feedback after assessments to guide the learner on areas of improvement.
5. Collaboration and Peer Interaction:
- Competence-Based Discussion Forums. Spaces where learners can discuss and collaborate based on specific competencies.
 - Peer Assessment Tools. Allow learners to assess and provide feedback on peers' competence demonstrations, fostering a culture of collaborative learning.
6. Mobility Features:
- Responsive Design. The portal should be accessible and user-friendly on a range of devices, from smartphones to tablets and desktops.
 - Offline Access. Given it's a mobility-focused model, essential resources or modules should be available offline.
7. Gamification and Motivation Tools:
- Badges and Certifications. Award digital badges or certificates as learners achieve competencies.
 - Leaderboards. Highlight learners who have achieved the most competencies or highest mastery levels to foster healthy competition.
8. Integration with External Platforms:
- APIs and Interoperability. To ensure that the competence model can be updated or integrated with external tools, platforms, or industry databases.
9. AI and Data Analytics:
- Predictive Analysis. Use AI to predict which competencies a learner is most likely to struggle with and offer preemptive resources.
 - Personalized Recommendations. Suggest resources or pathways based on a learner's past behavior, preferences, and performance.
10. Privacy and Security:
- Data Protection. Ensure user data, especially competence profiles, are protected and compliant with relevant data protection regulations.
 - Transparent Data Usage. Clearly communicate how learner data, especially performance and competence mastery data, will be used.
11. Continuous Improvement Mechanisms:
- Feedback Loops. Regularly gather feedback from learners on the utility and effectiveness of the competence-focused features.

- Updates and Evolution. Regularly update the portal's competence framework based on industry changes, technological advancements, and pedagogical research.

Integrating the competence model seamlessly into the Mobility EaaS ecosystem demands a combination of robust technology, pedagogical foresight, and user-focused design. The goal should be to provide an environment where competencies are not just listed but actively cultivated, assessed, and celebrated.

5.4 Conclusion

The paradigm shift towards a competence-based framework in the Mobility Education as a Service (EaaS) ecosystem underscores a larger evolution in education, one that prioritizes demonstrable skills, adaptable learning paths, and real-world applicability. This project has delved deep into the intricacies of the competence model, elucidating its components, its integration with adaptive learning, and the methods for effective assessment and validation.

As we distill our discussions, a few salient points emerge:

1. **Holistic Development.** A well-structured competence model does more than just prepare learners for job-specific tasks; it aims for a holistic development, encompassing foundational, specialized, and soft skills, all of which are critical for success in the 21st-century workspace.
2. **Dynamic Evolution.** The ever-evolving nature of industries, job roles, and societal needs necessitates a competence model that is flexible and continuously updated. The ability to quickly pivot and introduce new competencies is no longer a luxury but a mandate.
3. **Technological Integration.** The synergistic union of technology with the competence model can catalyze transformative learning experiences. From AI-driven personalized learning paths to VR simulations for skill practice, the technological horizon for competence-based EaaS is vast and promising.
4. **Assessment as a Continuous Journey.** The emphasis shifts from terminal evaluations to continuous assessments, providing learners with real-time feedback and ensuring they are always on the right trajectory towards competence mastery.
5. **Future Forward.** As we gaze into the future, it's clear that the boundaries between learning and working will blur further. The competence model will likely integrate even more seamlessly with workplaces, addressing real-time competence needs of professionals.
6. **Challenges Ahead.** While the benefits are manifold, challenges in implementation, ensuring depth and rigor, and navigating the evolving competence needs cannot be overlooked. It's imperative to address these with a balanced approach, ensuring quality isn't compromised in the pursuit of flexibility.

The competence model of Mobility EaaS is not just a theoretical construct but a tangible blueprint for the future of education. It champions the ethos that learning is most impactful when it is relevant, timely, and



directly aligned with real-world challenges and opportunities. As educators, technologists, and policymakers, our task is to collaboratively steward this model, refining and adapting it, as we usher in a new era of learning.

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6. Technological component of the Mobility Education as a Service model

The transformative potential of Mobility Education as a Service is anchored in its adept fusion of pedagogical methodologies with state-of-the-art technological paradigms. As we venture into the digital age, technology isn't merely an enabler or a supportive tool but the very fabric that weaves the Mobility EaaS ecosystem together. It determines how content is accessed, the manner in which learners interact, and the efficiency of assessments, feedback, and continuous improvement cycles.

In this part of the project a comprehensive exploration of the technological component that underpins the Mobility EaaS model is carried out. From the omnipresent cloud infrastructures that guarantee anytime-anywhere accessibility to the intricate algorithms powering personalized learning experiences, we aim to demystify the technology stack that makes mobile education both robust and scalable.

By understanding the intricate interplay between technology and education in this model the tremendous opportunities that arise when technological advancements are harmoniously integrated into educational delivery, setting the stage for an educational experience that is both contemporary and future-forward can be understood.

6.1 The definition of technological model of EaaS ecosystem

The technological model of the Education as a Service ecosystem refers to the integrated framework of digital tools, platforms, and protocols specifically designed to facilitate the seamless delivery, management, and consumption of educational content and services over the internet. This model encompasses elements such as cloud-based infrastructure, responsive design for device-agnostic access, data analytics for personalized learning experiences, and stringent security protocols, all harmonized to offer scalable, accessible, and efficient educational services to diverse learners across geographies.

6.2 The main components of the technological model of EaaS ecosystem

The technological model of the Education as a Service ecosystem is intricate and is structured to ensure that educational services are delivered seamlessly, accessibly, and efficiently. Here are the main components:

1. Cloud-based Infrastructure. This is fundamental for EaaS. Cloud platforms provide scalable storage and computing resources to host courses, applications, and data. They enable real-time access to educational



content from any location, accommodating the demands of a growing learner base without degradation in performance.

2. **Mobile Platforms and Responsive Design.** Given the mobility inherent in EaaS, platforms are developed to be device-agnostic. Responsive design ensures that content and interfaces adjust optimally for smartphones, tablets, or desktops, ensuring a consistent learning experience.
3. **API Integrations.** To ensure compatibility and expand functionality, the EaaS platforms can be integrated with other systems using Application Programming Interfaces (APIs). These integrations can include Learning Management Systems (LMS), content providers, payment gateways, and other third-party applications.
4. **Data Analytics and Machine Learning.** A pivotal component, analytics provides insights into user behavior, course engagement, and areas of improvement. Machine learning, on the other hand, personalizes the learning experience based on individual behaviors, tailoring content to suit each learner's needs.
5. **AR and VR Integration.** Augmented Reality (AR) and Virtual Reality (VR) offer immersive learning experiences, turning theoretical knowledge into interactive simulations. This is especially valuable for courses that require hands-on training or visualization of complex concepts.
6. **Security Protocols.** Given the personal and sensitive nature of educational data, strong security measures are essential. This encompasses data encryption, two-factor authentication, regular security audits, and adherence to global data protection regulations.
7. **Interactivity Tools.** These tools enhance the learning experience and can include chatbots for instant support, forums for peer discussions, and gamification elements to boost engagement.
8. **Content Management Systems (CMS).** A CMS facilitates the addition, modification, and management of digital content, allowing educators and administrators to keep the course materials updated and relevant.
9. **Continuous Update Mechanisms.** With the rapid evolution of technology and educational needs, the platform must support seamless updates, both in terms of technological advancements and content enhancements.
10. **Scalability and Modular Architectur.** As EaaS platforms grow and more users join, the technology should easily scale to meet the increased demands. A modular design ensures that new features or technologies can be integrated with minimal disruption.

These components, when effectively integrated, result in a robust and dynamic EaaS ecosystem, capable of delivering education that is not just informative but also engaging, personalized, and globally accessible.

6.3 The main requirements for the portal from the technological perspective

Building an IT portal for the implementation of the Education as a Service ecosystem requires careful consideration of various technological facets. From the perspective of the technological model, here are the main requirements:

1. Scalable Infrastructure. Utilize cloud-based solutions to ensure scalability. As the number of learners grows, the system should adapt without degradation in performance.
2. Device-agnostic Design. A responsive design that ensures the portal is accessible from various devices (smartphones, tablets, laptops, desktops) without compromising the user experience.
3. Robust Security Protocols:
 - Data encryption during transit and at rest.
 - Multi-factor authentication for users.
 - Regular vulnerability assessments and penetration testing.
 - GDPR and other data protection regulation compliances for user data.
4. Integrated Learning Management System (LMS). A system that can host, track, and distribute course materials, manage student enrollments, and report student progress.
5. Personalization Engines. Employ data analytics and AI to tailor the learning experience based on a learner's preferences, strengths, and areas of improvement.
6. Collaboration Tools. Integration of tools that facilitate synchronous (live video sessions, chats) and asynchronous (forums, comments) communication among learners and instructors.
7. Content Delivery Network (CDN). To ensure fast and uninterrupted delivery of learning materials globally.
8. API Integration Capabilities. For third-party tools or services such as payment gateways, external course content, or tools like plagiarism checkers.
9. Assessment and Testing Modules. Tools for creating quizzes, exams, and assignments with automated grading capabilities, if applicable.
10. Feedback and Survey Tools. Mechanisms to gather feedback from users to improve and refine the platform.
11. Gamification Features: Elements like badges, leaderboards, and points to engage and motivate learners.
12. Augmented Reality (AR) and Virtual Reality (VR) Support. As AR and VR become more mainstream in education, ensuring your platform can support such content is crucial.
13. Continuous Integration/Continuous Deployment (CI/CD) Capabilities. For regular and seamless software updates without disrupting the user experience.
14. Offline Capabilities. Allows users to download materials and access them without an internet connection.



15. Multilingual Support. Providing content in multiple languages to cater to a global audience.
16. Adaptive Streaming. Adjust video quality based on the user's internet connection speed.
17. Analytics and Reporting Tools. Monitor user engagement, track course completions, and gain insights into user behavior.
18. Backup and Recovery Systems. Regular data backups and a robust disaster recovery plan.

The technological model for the EaaS portal should center around user experience, scalability, and security, providing a seamless educational journey tailored to individual needs.

6.4 Conclusion

The Mobility Education as a Service ecosystem, with its melding of education and technology, stands at the crossroads of a transformative journey. The technological model underpinning this ecosystem is intricate, multifaceted, and ever-evolving. From cloud-based architectures that ensure ubiquitous access to AI-driven personalized learning pathways, the gamut of technological interventions in EaaS is expansive.

Challenges, undoubtedly, loom large. Integration concerns, data privacy, and the need to constantly adapt to rapidly emerging technologies are but a few of the hurdles this domain faces. However, with these challenges come unparalleled opportunities. Augmented and virtual reality has the potential to redefine immersive learning experiences, while real-time analytics can offer insights previously deemed unattainable.

Looking ahead, the landscape is rife with possibilities. Emerging technologies promise to further democratize education, make learning more engaging, and ensure that educational content is tailored to individual needs like never before. As stakeholders in this ecosystem, it is incumbent upon us to not only keep pace with these technological advancements but also to shape them in a way that they align with pedagogical goals and uphold the sanctity of the educational process.

The technological model of Mobility EaaS is not just a backdrop; it is an active participant in the education of tomorrow. Embracing it, refining it, and steering it in the right direction is our collective responsibility, one that holds the promise of an enlightened, informed, and tech-savvy future professionals.

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7 . Demo portal implementation of the developed Mobility Education as a Service model

In this of this report, we delve into the intricate development and implementation of the demo portal for the eMEDIATOR project. This initiative represents a significant stride in digital education, blending innovative technologies with educational methodologies to create a comprehensive digital platform. The focus of this section is to shed light on the various facets of the eMEDIATOR demo portal, from its conceptualization to its practical execution.

The core objective of this section is to provide an in-depth analysis of the processes involved in bringing the eMEDIATOR platform to life. It outlines the meticulous selection of pilot services, the development of user-centric applications, and the seamless integration of advanced technological solutions. This section also explores the pivotal role of user experience enhancements and feedback mechanisms in refining and optimizing the platform.

This section is essential for understanding the comprehensive nature of the eMEDIATOR project. It not only demonstrates the technological advancements and educational innovations integrated into the platform but also underscores the commitment to fostering a user-focused, efficient, and all-encompassing digital educational environment. Through this exploration, we aim to highlight the journey of the eMEDIATOR platform from its inception to its current state, underscoring the challenges faced, milestones achieved, and the vision for its future.

7.1 Overview

The selection process for pilot services in the eMEDIATOR project was a crucial phase, primarily conducted by Aalen University. This process involved an in-depth secondary research methodology to identify and choose the most appropriate services for the eMEDIATOR platform.

In the realm of digital experience platforms, two main categories of platforms are generally recognized: aggregation/integration platforms and development platforms. Aggregation/integration platforms are designed to combine multiple sources into a single cohesive platform, whereas development platforms focus on product and technological development, offering frameworks, services, and methods for the advancement of digital products.

For eMEDIATOR, based on the requirements outlined in the initial report, the project was classified as an aggregation/integration platform. This categorization was due to the nature of the functionalities required, which were already available in the market, especially in the digital learning and education sectors. The eMEDIATOR project aimed to aggregate these functionalities into a single, unified platform.

A thorough analysis of existing digital portals and platforms was conducted to understand the landscape of digital learning and education services. This analysis helped in identifying the functionalities that are essential for a platform like eMEDIATOR, which aspires to be a comprehensive digital experience platform in the educational sector.

Several well-known software solutions were evaluated during this process. These solutions provided a benchmark for the kind of services and functionalities eMEDIATOR aimed to integrate and offer. This comparative analysis was vital in ensuring that eMEDIATOR could incorporate the most effective and user-friendly features available in the market.

7.2 Selected Services for the eMEDIATOR Platform Development

The selection of services for the eMEDIATOR platform was a critical step in its development, conducted with thorough analysis and strategic planning. This process involved evaluating existing digital portals and platforms, leading to a curated list of services essential for the eMEDIATOR platform. The services were categorized into three distinct groups to cater to the diverse needs of academic institutions, students, and combined users.

1. Services for Academic or Other Institutions:

- **Recruiting Service.** This service is designed to recruit new employees, academic staff, and graduated students for various economic or research challenges. It facilitates the connection between the academic world and industry, aiding in talent acquisition and research collaborations.
- **Curriculum Creation Service.** This service allows for the creation and management of curricula directly within the portal, streamlining the process of curriculum development and updating for academic institutions.
- **Research Project Management Service.** Aimed at managing research projects, this service tracks invested time and documents all work for funding organizations, ensuring efficient management of research initiatives.

2. Services for Students:

- **Profile Management Service.** This service enables students to manage and update their profiles, an essential feature for maintaining up-to-date personal and academic information.



- Document Management Service. Students can create and collaborate on documents, such as research papers, facilitating academic collaboration and project management.
- Communication Service. This service fosters communication between students, academic institutions, and economic institutions, enhancing the network and interaction among these entities.

3. Combined Services:

- Learning Service. It provides learning capabilities similar to existing e-learning platforms, catering to the educational needs of students.
- Forum Service. This service offers a platform for opening new discussion threads about education or new information, functioning like a blackboard in academic or economic institutions.
- Rating Service. Enables users to rate courses and course materials directly via the platform, providing valuable feedback for continuous improvement.

From the list of services, certain services were specifically chosen for technical implementation in the eMEDIATOR demo. These services were selected based on their immediate applicability and relevance to the prototype's objectives. The chosen services include:

1. Recruiting Service. Integrated with BookAScience Platform component for a seamless recruiting experience.
2. Learning Service. Integration with Moodle functionalities to provide a comprehensive learning platform.
3. Curriculum Creation Service. Features integration with process and workflow management tools for efficient curriculum development.
4. Wiki-Service. Implemented for its adaptable and straightforward functionality, essential for information management.
5. Document Management Service. Utilizes adaptable functionalities and can be realized via Google Docs integration for collaborative document creation.
6. Forum Service. Offers a platform for discussions, integrating standard forum functionalities.
7. Research Project Management Service. Similar to the Recruiting Service, it integrates with the BookAScience Platform for efficient project management.

These services, selected for the eMEDIATOR demo, represent the core functionalities that the platform aims to offer. They were chosen for their ability to showcase the potential and utility of the eMEDIATOR platform effectively. Each service addresses a specific need within the educational ecosystem, ranging from administrative tasks like curriculum creation to student-centric services like learning and document management. The integration of these services into the eMEDIATOR platform demonstrates the project's commitment to creating a versatile and comprehensive digital educational experience.

7.3 Development of the Mock-up Testing Procedure and Test Case Requirements

The development of the eMEDIATOR Mock-Up, spearheaded by Aalen University during the third period of the eMEDIATOR project, was a significant step towards realizing the project's objectives. This phase involved creating a prototype that combines various functionalities essential for the eMEDIATOR portal:

1. Login and User Management Functionality:
 - Vital for portal access and managing user-specific data.
 - Allows management of personal information, upload of profile images, and other user data.
 - Enables personalized experience and security in user interactions within the portal.
2. Blog Functionality:
 - Serves as a platform for news and important information dissemination.
 - Users can access and interact with blog posts, making the portal a dynamic and informative space.
3. Message Board:
 - Acts as a communication tool within the portal.
 - Supports forum-like interactions where users can initiate threads and engage in discussions. Plans for an internal chat tool to further ease communication were also noted.
4. Wiki-System:
 - To support information management and user onboarding.
 - Enables documentation of processes and workflows, enhancing the knowledge base and collaborative learning.
5. Workflow Management System:
 - Utilizes Liferay technology for integration and workflow management.
 - Tested with processes like paper approval for conferences, demonstrating its potential in academic and administrative tasks.

The development of test case requirements was a collaborative effort involving eMEDIATOR partners, moderated by Aalen University. This phase aimed to create a common understanding of the crucial test requirements, following a structured approach similar to commercial system development workshops. Key aspects considered included:

1. Defining the goals of the new system/solution.
2. Establishing the framework within which the system operates.
3. Identifying responsible parties, involved individuals, and user categories.
4. Outlining essential functions the system should offer.
5. Identifying additional requirements beyond basic functionalities.

The eMEDIATOR portal underwent continuous testing by partners and the technical team, categorized as Alpha-Tests. This iterative testing process aimed to refine the portal before moving to broader pilot testing. Key steps in the testing roadmap included:

1. Internal Alpha-Tests. Conducted within the eMEDIATOR team to ensure the portal's readiness for pilot testers.
2. Inclusion of Pilot Testers. Integrating students, companies, and academic staff as the first users to provide feedback and suggestions for improvements.
3. Future Developments. Laying out a plan for subsequent phases, focusing on enhancing functionalities and user experience.

The development and testing of the eMEDIATOR Mock-Up represented a critical phase in the project. It not only demonstrated the portal's potential functionalities but also set the stage for further development and refinement based on structured testing and feedback mechanisms. This phase ensured that the eMEDIATOR portal was on track to becoming an effective and user-friendly digital educational platform.

7.4 Design of the User-Client Application for eMEDIATOR

The design of the user-client application for the eMEDIATOR platform played a crucial role in enhancing the platform's functionality and user experience. This phase of the project focused on integrating advanced IT technologies such as blockchain, cloud computing, big data, and artificial intelligence to streamline pedagogical and organizational tasks within the portal.

The main Technologies for User Experience (UX) are:

1. UX Design
 - Emphasis on creating a positive and satisfying user experience.
 - Goal to enhance accessibility and usability, making users' interaction seamless and engaging.
 - UX design as one of the most dynamic fields, continually adapting to new technological environments and user needs.
2. Machine Learning and AI
 - Integration of Machine Learning to reduce user effort in navigation and enhance the overall experience.
 - Use of smart automation for customizing user experience by observing user preferences and behaviors.
 - Implementation in search engines to personalize user experience based on user data and profile information.

*Technologies for User Interface (UI):*

1. User Interface Design

- Focus on the interaction points between the user and the digital platform.
- Involves designing screens, pages, and visual elements to facilitate user engagement with the portal.
- UI as a subset of UX, concentrating on the aesthetics and visual aspects of the platform.

2. UX before UI

- Prioritization of UX to establish a solid foundation for the user experience before delving into UI design.
- Importance of research and testing in developing an effective UX, followed by the implementation of UI design for the creative aspect.

Requirements for User Interface:

- Key elements for the portal's UI include friendly user interface, robust security, dynamic user profile management, efficient taxonomy, application integration, and a comprehensive database repository.
- Emphasis on cross-platform support to ensure accessibility across various devices.
- Development of an advanced search engine considering different user information and requirements.

The user-client application accommodated various roles, including students, teachers, and employers, each with distinct functionalities:

1. Students and Learners

- Access to learning materials and job opportunities.
- Services like profile management, document management, and communication tools.

2. Academic and Other Institutions

- Services like recruiting, curriculum creation, and research project management.

3. Combined Services

- Encompassing learning, forum, rating, and exam services for a holistic educational experience.

eMEDIATOR Website Features:

- The eMEDIATOR website allowed account creation and featured a search bar for material exploration.
- Additional features like a blog screen for news updates and a message board for discussions enhanced the user engagement and information dissemination on the platform.

The design of the user-client application for eMEDIATOR was a comprehensive effort that amalgamated various modern technologies to ensure an interactive, user-friendly, and efficient digital education platform. This phase was pivotal in ensuring that the eMEDIATOR platform not only met the technical and functional requirements of an educational portal but also provided an engaging and intuitive user experience, crucial for its success and user adoption.

7.5 User Interactions and Website Features of eMEDIATOR

The eMEDIATOR digital portal, designed to cater to a diverse range of users, incorporates several distinct features aimed at enhancing user interaction and engagement. This section delves into the various functionalities provided by the platform, emphasizing how these features cater to the needs of different user groups such as students, educators, and employers.

User Interaction Roles:

1. Simple User (Student)

- Students can access educational content, interact with course materials, and engage in learning activities.
- Features include course searching, enrollment, and participation in educational forums and discussions.

2. Teacher/Educator

- Educators have access to tools for course creation, curriculum development, and educational resource management.
- The platform enables them to disseminate course content, engage with students, and monitor educational progress.

3. Employer

- Employers can utilize the portal for recruitment purposes, post job positions, and scout for potential talent among students and graduates.
- They have access to services that facilitate connections with the academic community and enable them to contribute to educational content.

Website Functionalities:

1. Account Creation

- The website allows all visitors to create a user account, essential for accessing personalized services and content.
- Account creation is a straightforward process, requiring basic user information.

2. Search Bar

- A prominent feature of the website, allowing users to search for specific materials, courses, or information across the portal.
- Enhances the discoverability of content and makes navigation user-friendly.

3. Blog Screen

- A platform for sharing news and essential updates related to education, research, and other relevant fields.

- Users can read posts from others and engage through comments, fostering a sense of community and interaction.
4. Message Board
 - Serves as a hub for communication and discussion among users.
 - Features categories, recent posts, statistics about discussions, and functionalities to start new threads on various topics.
 5. Wiki-System
 - A collaborative feature allowing users to create, edit, and manage content.
 - Facilitates knowledge sharing and collaborative learning, tailored to different user roles within the portal.
 6. Access to External Platforms
 - Integration with platforms like Bookscience and Moodle.
 - Provides users with additional resources for job searching, research activities, and educational content.

The eMEDIATOR website and its various features are meticulously designed to foster a dynamic and interactive environment for students, educators, and employers. Each feature, from the account creation process to the integration with external platforms, is tailored to enhance the user experience and meet the diverse needs of its audience. By offering a range of functionalities such as a searchable content database, a platform for news and updates, and interactive forums, the eMEDIATOR portal stands as a comprehensive digital solution in the educational and professional landscape.

7.6 Development of the Search Engine for eMEDIATOR

The development of a specialized search engine for the eMEDIATOR platform was a pivotal component of the project, aiming to revolutionize how users discover and engage with educational content. This sophisticated tool leverages cutting-edge algorithms and data-driven techniques to provide an intuitive and effective search experience.

The search engine was designed to address the challenge of navigating through a vast array of courses and competencies available on platforms like Moodle and Coursera. The goal was to create a user-friendly tool that could simplify the process of finding relevant courses and skills, aligning with individual interests and learning objectives.

Key Technologies and Algorithms:

1. Decision Tree Algorithm
 - The backbone of the search engine, used for classifying courses and competencies.



- It processes vast amounts of course data, facilitating efficient retrieval of relevant courses based on attributes like subject matter, difficulty level, and required skills.
- The algorithm learns from labeled datasets to predict categories for new courses, enhancing the search engine's recommendation capabilities.

2. Robust Database Structure

- A comprehensive database stores and organizes course and competence data, ensuring efficient retrieval during searches.
- The database is structured to capture essential information about courses, such as titles, descriptions, and learning outcomes.

3. Integration of Competence Database

- Combines competences with job skills, creating a powerful tool for users to connect their educational pursuits with professional development.
- Stores details about competences, related courses, and proficiency levels, aiding users in understanding the scope of each competence.

4. Linking Courses and Competences

- Establishes a relationship between courses and competences in the database.
- This feature allows users to search for courses based on specific competences they aim to acquire, offering a targeted approach to learning.

5. Bridging Academic and Professional Needs

- The integration of competences into the search engine narrows the gap between academic learning and practical skills required in the job market.
- Helps users understand how learning outcomes translate into desirable skills and abilities.

Integration with Moodle and Coursera:

1. Seamless Platform Connectivity

- Direct integration with Moodle and Coursera ensures access to up-to-date course information and a wide range of educational content.
- Utilizes APIs for efficient communication and data exchange between the search engine and these educational platforms.

2. Data Synchronization

- Regularly updates the course database with the latest offerings, modifications, and deletions from Moodle and Coursera.
- Ensures users have access to the most current and relevant course information.

User Experience and Interface:

1. Intuitive User Interface

- Designed to be user-friendly, enabling easy navigation and efficient course discovery.
- Incorporates clear search functionalities, responsive design, and well-organized course information.

2. Personalization and Customization

- Offers personalized search results based on user preferences and prior interactions.
- Allows users to bookmark courses, receive recommendations, and track their learning progress.

The development of the eMEDIATOR search engine represents a significant technological advancement in the realm of digital education. By combining sophisticated algorithms, a robust database, and seamless integration with prominent educational platforms, the search engine stands as a key feature of the eMEDIATOR platform. It not only enhances the user experience through efficient and personalized course discovery but also bridges the gap between academic learning and professional skill development. This innovative tool is a testament to the project's commitment to delivering a comprehensive and user-centric educational experience.

7.7 Integration with Moodle and Coursera in eMEDIATOR

A crucial aspect of the eMEDIATOR platform's functionality was its integration with prominent online educational platforms, Moodle and Coursera. This integration aimed to expand the range and accessibility of educational resources available to eMEDIATOR users, enhancing the platform's overall effectiveness and utility.

The primary goal of integrating Moodle and Coursera with the eMEDIATOR platform was to provide users with seamless access to a vast repository of educational content. This integration was intended to:

1. Enhance Educational Resource Accessibility

- Offer users a wide range of courses and learning materials from both Moodle and Coursera.
- Provide up-to-date and comprehensive course information directly within the eMEDIATOR platform.

2. Facilitate Personalized Learning Experiences

- Allow users to find courses that align with their individual learning objectives and interests.
- Enable users to easily navigate and enroll in courses offered by these external platforms.

Technical Implementation:

1. API Integration

- Utilization of Application Programming Interfaces (APIs) provided by Moodle and Coursera.
- These APIs enabled efficient data exchange and communication between the eMEDIATOR platform and the educational platforms.
- Allowed for the retrieval of necessary course data including titles, descriptions, and other relevant details.

2. Database Synchronization

- Periodic retrieval of course data from Moodle and Coursera to ensure the eMEDIATOR database was current with the latest offerings and updates.
- Maintained data integrity and relevance by reflecting recent modifications and course additions.

Enhancing User Experience:

1. Seamless Course Discovery and Enrollment

- By integrating these platforms, eMEDIATOR enabled users to discover and enroll in courses without needing to navigate away from the eMEDIATOR platform.
- This integration provided a more streamlined and cohesive educational experience.

2. Data Transformation and Parsing

- Once course data was retrieved via the APIs, it was parsed and transformed to be compatible with the eMEDIATOR platform's format and structure.
- Ensured a smooth and coherent presentation of course information within the platform.

The integration of Moodle and Coursera into the eMEDIATOR platform was a significant development, markedly enhancing the platform's educational scope and usability. This integration not only provided users with a more extensive and diverse range of educational resources but also simplified the process of finding and enrolling in courses. By seamlessly linking these external educational platforms, eMEDIATOR established itself as a comprehensive and user-friendly digital learning environment, effectively catering to a wide range of educational needs and preferences.

7.8 Search Engine Architecture and User Profiles in eMEDIATOR

The eMEDIATOR platform's search engine represents a complex and sophisticated system designed to meet the diverse needs of various user profiles. This section delves into the detailed architecture of the search engine and the specific functionalities tailored to each user group, ensuring a seamless and personalized experience for all.

Search Engine Architecture:

1. User Interface (UI)

- The UI is the front-facing component that users interact with. It is designed to be intuitive, visually appealing, and easy to navigate.
- It includes search input forms, result visualization, and design elements that facilitate a smooth user experience.
- The UI plays a crucial role in making the search engine accessible and user-friendly.

2. Database Management System (DBMS)

- The DBMS is responsible for handling the data related to courses and competencies.



- It ensures the integrity, storage, and retrieval of data, providing the backbone for the search engine's functionality.
- Seamless interaction with the DBMS is vital for accurate and efficient access to course and competence information.

3. Algorithmic Processing

- This component incorporates algorithms, like the decision tree, to classify courses and associate them with relevant competencies.
- It analyzes course attributes and uses decision models to predict the appropriate category for each course, enhancing the accuracy of search results.

4. Search Engine Core

- Acting as the central processing unit, the core integrates the UI, DBMS, and algorithmic processing.
- It processes user queries, interacts with the database, applies classification algorithms, and returns accurate search results.
- The core is optimized for performance, ensuring quick responses to user searches.

5. Integration with Moodle and Coursera

- The search engine integrates with Moodle and Coursera through APIs, allowing access to a vast array of courses.
- This integration is critical for ensuring that the eMEDIATOR platform provides up-to-date and comprehensive educational content.

User Profiles and Their Interactions:

1. General Public

- Anonymous users can access basic functionalities and explore a subset of the course and competence information.
- They can view course overviews and get a general understanding of the platform without creating an account.

2. Students and Learners

- These users have expanded access and rights within the search engine, including the ability to search for courses, enroll, and track their progress.
- Features like saving courses, leaving reviews, and participating in forums are available.

3. Educators and Instructors

- They have access to additional features tailored to their professional needs, such as creating and managing course content and accessing teaching resources.
- Their rights include participating in online teaching communities and providing course feedback.

4. Employers and Recruiters

- This group can search for courses that align with their organization's skill requirements and use the platform for talent acquisition and professional development.
- They have access to employer-specific tools and resources and can recommend courses to employees.

The architecture of the eMEDIATOR search engine is a finely tuned system that caters to a wide range of user profiles, each with unique needs and preferences. From general visitors to specialized users like educators and employers, the platform offers tailored functionalities and access rights, ensuring that each user group finds the search engine a valuable and effective tool for their specific purposes. This thoughtful design underpins the eMEDIATOR platform's commitment to providing a comprehensive, user-centric educational experience.

7.9 User Experience and Feedback Mechanisms in eMEDIATOR

In the development of the eMEDIATOR platform, a significant emphasis was placed on crafting a user experience (UX) that is intuitive, efficient, and tailored to the diverse needs of its users. Integral to this process was the establishment of feedback mechanisms to continually refine and enhance the platform's usability and effectiveness.

User Experience (UX) Design:

1. Search Functionality

- The search engine was designed with clear and intuitive search functionalities, enabling users to effortlessly find courses and competences.
- It included advanced filtering options and search criteria to help users quickly locate the most relevant content based on their specific needs.

2. Organized Course Information

- The platform provided well-structured course and competence information, including details like titles, descriptions, instructors, ratings, and prerequisites.
- This organization aimed to aid users in making informed decisions about their educational paths.

3. Personalization Features

- Personalization was a key aspect, with features allowing users to save their preferences, bookmark courses, receive recommendations, and track their learning progress.
- These features aimed to create a more engaging and relevant user experience, catering to individual learning goals and interests.

4. Responsive Design

- The platform was developed with a responsive design, ensuring a seamless experience across different devices and screen sizes.



- This responsiveness allowed users to access the search engine anytime, anywhere, whether on a desktop, tablet, or smartphone.

Feedback and Continuous Improvement:

1. Feedback Mechanisms

- The eMEDIATOR platform incorporated various mechanisms to gather user feedback, such as surveys, user testing sessions, and analytics tools.
- This feedback was essential in identifying areas for improvement and understanding user satisfaction and engagement levels.

2. Iterative Enhancements

- The collected feedback was meticulously analyzed and used to iteratively enhance the platform's features and functionalities.
- Regular updates and refinements were made based on this feedback, ensuring that the platform remained aligned with user needs and expectations.

3. User-Centric Development

- The continuous improvement process was user-centric, focusing on addressing user concerns, enhancing usability, and adding new features that provided additional value to users.
- This approach ensured that the eMEDIATOR platform evolved in a manner that consistently met and exceeded user expectations.

Privacy and Data Protection:

1. Secure Data Handling

- Respecting user privacy and ensuring data security were paramount considerations in the development of the eMEDIATOR platform.
- Measures such as secure data storage, encrypted communication, and adherence to privacy policies were implemented to safeguard user information.

2. Regulatory Compliance

- The platform was developed with a keen awareness of data protection regulations, ensuring compliance with legal standards and best practices in data security and privacy.

The user experience and feedback mechanisms in the eMEDIATOR platform played a critical role in shaping a search engine that was not only functional and efficient but also user-friendly and responsive to user needs. Through ongoing feedback collection and analysis, the platform continued to evolve, reflecting the changing preferences and requirements of its users. This commitment to a user-centric approach and continuous improvement was key to maintaining the platform's relevance and effectiveness as a leading educational resource.

7.10 Development and Features of the Search Engine Mockup in eMEDIATOR

The development of the search engine mockup for the eMEDIATOR platform was a cornerstone in demonstrating the platform's capabilities in enhancing the educational experience. This mockup showcased a user-friendly interface with advanced search functionalities, emphasizing a competence-based approach to learning and resource discovery.

Design and Functionalities:

1. User-Friendly Interface

- The mockup featured a clean and intuitive interface with a prominent search bar, allowing users to easily enter queries related to courses, competences, or specific skills.
- The design focused on simplicity and efficiency, ensuring that users could navigate the platform without any unnecessary complexity.

2. Advanced Search Capabilities

- The search engine was equipped with the ability to perform detailed searches based on specific competences, offering users a targeted approach to find relevant courses and materials.
- It utilized sophisticated algorithms to match user queries with the most appropriate courses and competences, enhancing the relevance of search results.

Integration with Moodle and Coursera:

1. Efficient Data Retrieval

- The mockup integrated seamlessly with Moodle and Coursera platforms, leveraging Application Programming Interfaces (APIs) for efficient data retrieval.
- This integration provided access to a diverse range of courses, ensuring that users had a comprehensive selection of educational resources.

2. Competence Database

- A key feature of the mockup was the competence database, which captured essential skills, knowledge, and abilities associated with each course.
- Users could explore competences, view detailed information, and understand how their educational choices aligned with professional scenarios.

User-Centric Content Display:

1. Modified Content for Different User Profiles

- The search engine was designed to provide different or modified content based on each user's role, ensuring a personalized experience for students, educators, and employers.
- This approach recognized the unique needs and objectives of various user groups, tailoring the platform's offerings accordingly.

2. Mockups for Various User Profiles

- Specific mockups were created to depict the potential outcomes of the search engine for different users, illustrating how the platform would cater to their unique requirements.
- These mockups provided a visual representation of the platform's versatility and user-centric design.

The search engine mockup for the eMEDIATOR platform was a critical demonstration of the platform's potential in transforming the educational experience. By focusing on user-friendly design, advanced search functionalities, and seamless integration with external educational resources, the mockup successfully showcased how the eMEDIATOR platform could effectively meet the diverse needs of its users. This development represented a significant step forward in creating a comprehensive, intuitive, and resource-rich educational platform.

7.11 Future Development and Migration of eMEDIATOR

The ongoing development and migration phase of the eMEDIATOR project played a pivotal role in enhancing the platform's effectiveness and user experience. This phase focused on transitioning the platform to more agile and user-friendly technologies while integrating essential educational tools and resources.

Migration to WordPress and Linux Server Setup:

1. WordPress Migration

- The decision to migrate the eMEDIATOR system to WordPress was driven by the need for faster demo application development and ease of use.
- WordPress offered a user-friendly interface and a range of pre-designed templates, expediting the development process.
- This migration was essential in showcasing the core functionalities of eMEDIATOR efficiently during demos and presentations.

2. Linux Server Deployment

- The platform was deployed on a Linux-based server, chosen for its stability and security.
- The Linux environment provided robust tools and resources for server management, optimizing system performance and resource utilization.

Moodle Integration:

- A significant achievement was the integration of Moodle, a widely-used Learning Management System (LMS).
- This integration allowed students to access course materials and participate in interactive learning experiences directly through eMEDIATOR.

- The successful Moodle integration illustrated the team's capacity to work with various technologies and enhance the platform's overall educational value.

Competence Module Development:

- The development of the Competence Module was a crucial part of the project, enabling students to select competences from available courses.
- This module aimed to provide an intuitive and user-centered design for efficient competence selection and learning path customization.

Integration of AI-Based Search Engine Functionality:

- An innovative feature of eMEDIATOR was the integration of AI-based search functionality for competences, using similarity search techniques.
- This functionality aimed to offer personalized course recommendations based on individual competences, enhancing the user experience with tailored content.

Challenges and Recommendations:

1. Liferay Versus WordPress

- While Liferay was deemed suitable for the productive version of eMEDIATOR due to its comprehensive feature set, its complexity posed challenges for rapid prototyping.
- WordPress, with its simpler interface and quicker setup, was recommended for faster demo application development and initial user testing phases.

2. Platform Design Considerations

- The design aspect required attention to ensure alignment with the project's branding and user experience goals.
- Whether through customizing Liferay's interface or using WordPress templates, the design needed to be user-friendly and visually appealing.

The ongoing development and migration phase of the eMEDIATOR project marked a significant transition towards creating a more agile, user-friendly, and educationally rich platform. The move to WordPress, the integration with Moodle, and the incorporation of AI-based search functionalities exemplified the project's commitment to enhancing the digital educational experience. These developments laid a solid foundation for the platform's future growth, ensuring it would continue to serve as a valuable resource in bridging the gap between academic learning and practical skill development.

7.12 User Client Mockup Implementation in eMEDIATOR

The User Client Mockup in eMEDIATOR was a significant step in the project, focusing on enhancing user experience and accessibility. This phase was dedicated to the technical development of the search engine, incorporating a range of technologies and frameworks to ensure seamless functionality and user interaction.

Importance of the User Client Mockup:

1. Enhancing User Interface
 - The mockup served as a user-facing gateway to the search engine, emphasizing the importance of an intuitive and efficient platform for course discovery and skill development.
 - It was designed to cater to the various needs of users, providing a personalized and streamlined experience.
2. Role in Project Development
 - The development of the User Client Mockup was pivotal in demonstrating the technical capabilities of the eMEDIATOR project.
 - It involved the integration of various technologies to ensure that the search engine operated efficiently and met user expectations.

Technologies and Frameworks Used:

1. Flask for Web Application Structure
 - Flask, a lightweight Python web framework, was used to define routes, handle HTTP requests, and structure the web application.
 - Its simplicity and ease of use made it ideal for building the search engine's web interface.
2. Sentence Transformer for NLP
 - The Sentence Transformer model, an advanced NLP tool, was employed for transforming text into meaningful vector representations.
 - It played a crucial role in calculating semantic similarity scores between user queries and course descriptions.
3. Numpy and Pandas for Data Handling
 - Numpy, a numerical computing library, and Pandas, a data manipulation tool, were used for efficient data management and vector calculations.
 - These libraries facilitated the handling of large datasets and ensured quick, accurate search results.
4. Flask-CORS for Cross-Origin Resource Sharing
 - Flask-CORS was implemented to enable the web application to interact with external resources, such as APIs hosted on different domains.

- This was essential for the search engine to communicate with external educational platforms.

5. Python as the Foundation

- Python's readability and versatility made it the primary programming language for the project.
- The extensive ecosystem of Python libraries and frameworks provided a solid foundation for the search engine.

Backend Integration:

1. Harmonious Data Interface

- The Python script was integral in retrieving and processing data from the provided dataset, which included universities, courses, competences, skills, and other relevant information.
- It ensured that this data was readily available for search queries, contributing to the search engine's comprehensive functionality.

2. Preprocessing and Integration

- Before integration into the search engine, the data underwent a preprocessing phase using Python libraries for cleaning, formatting, and transformation.
- This step was crucial in maintaining data accuracy and consistency for seamless integration.

The User Client Mockup phase in eMEDIATOR was a testament to the project's commitment to delivering an intuitive and effective search platform. By integrating a range of modern technologies and ensuring seamless backend integration, the team was able to provide a user-centric search experience. This phase not only showcased the technical prowess of the eMEDIATOR project but also set the stage for its success as a comprehensive educational resource platform.

7.13 Conclusion

In concluding of this section we have comprehensively explored the multifaceted development and implementation of the eMEDIATOR demo portal. This journey, from conceptualization to realization, showcases a significant leap in the field of digital education, blending innovative technology with effective educational practices. The eMEDIATOR project stands as a testament to the power of digital transformation in the educational sector, offering a new paradigm for learning and teaching.

Throughout this section, we have detailed the rigorous process of selecting pilot services, each chosen for their relevance and potential impact on the educational landscape. The development of the eMEDIATOR Mock-Up, with its varied functionalities and user-centric design, highlights the project's commitment to delivering a practical and engaging digital experience. The integration of advanced technologies, notably in the user-client application and the sophisticated search engine, demonstrates a forward-thinking approach to educational resource accessibility and user interaction.



It is clear that the eMEDIATOR project represents a significant advancement in digital education platforms. The project's dedication to creating a user-friendly, efficient, and comprehensive educational environment has the potential to revolutionize how learners and educators interact with digital resources. The journey of the eMEDIATOR platform, marked by innovation, user-centric design, and continuous development, sets a benchmark in the field of digital education, promising a future where technology and education converge to create enriched learning experiences.

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