

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

Project No. 2021-1-LV01-KA220-HED-000027571

INTERNAL REPORT 4: Competence component of the portal

Position	
Document type	Internal Report
Responsible Partner	University of Murcia (SPAIN)
Editors	Carrillo de Gea, Juan Manuel; Nicolás Ros, Joaquín; Moros Valle, Begoña; García Berná, José Alberto
Period	4
Dissemination level	Confidential
Organizations	TTI, UL, UM, UoI, AU.
Submission date	28.02.2023
Number of pages	58



DOCUMENT HISTORY

Version #	Submission date	Responsible Person	E-mail	Reviewer	E-mail	Reviewer organization	Date of review submission
1.0	28.02.23	Juan Manuel Carrillo de Gea	jmcdg1@um.es	Joaquín Nicolás Ros / Begoña Moros Valle / José Alberto García Berná	{jnr,bmoros,josealberto.garcia1}@um.es	University of Murcia	02/28/23



The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein

Disclaimer

Responsibility for the information and views set out in this report lies entirely with the authors. Reproduction is authorized provided the source is acknowledged.

Information contained in our published works has been obtained by the authors from sources believed to be reliable. However, neither this consortium nor its authors guarantee the accuracy or completeness of any information published herein and this consortium nor its authors shall be responsible for any errors, omissions, or claims for damages with regard to the accuracy or sufficiency of the information contained in this consortium publications.

Abbreviations and Acronyms:

AI	Artificial intelligence
API	Application Programming Interface
ATS	Applicant Tracking System
AU	Aalen University
AWS	Amazon Web Services
CAS	Credential Authentication System
CDN	Content delivery network
CEN	Comité Européen de Normalisation
CI/CD	Continuous integration and deployment
CMS	Content Management System
CPU	Central Processing Unit
CRM	Customer Relationship Management
CSV	Comma-Separated Values
CV	Curriculum Vitae
CWA	CEN Workshop Agreement
EaaS	Education as a Services
EOMS	Educational Organization's Management System
EPFL	École Polytechnique Fédérale de Lausanne
ETH	Eidgenössische Technische Hochschule
GPU	Graphics Processing Unit
HTML	HyperText Markup Language
HTTP	Hypertext Transfer Protocol
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
IT	Information Technology
JAX	Java API for XML

LMS	Learning Management System
MIT	Massachusetts Institute of Technology
MOOC	Massive Open Online Course
NLP	Natural Language Processing
NUS	National University of Singapore
Pandas	Python Data Analysis Library
RAM	Random Access Memory
SFIA	Skills Framework for the Information Age
SSO	Single Sign-On
TC	Technical Committees
TPACK	Technological Pedagogical Content Knowledge
TSI	Transporta un Sakaru Institūts
UCB	University of California, Berkeley
UI/UX	User Interface/User Experience
UL	University of Łódź
UMU	University of Murcia
Uoi	University of Ioannina
URL	Uniform Resource Locator
USA	United State of America
UX	User Experience
XML	Extensible Markup Language

Content

Content.....	5
1. A2.4. Development of the curricula quality management model (UL).....	8
1.1 INTRODUCTION.....	8
1.2 QUALITY OF EDUCATION.....	8
1.3 ISO.....	10
REFERENCES.....	11
LIST OF AUTHORS.....	12
2. A3.4 Development of the organizational model of interaction between individual and corporate portal users (TSI)	13
2.1 GENERAL DESCRIPTION OF THE ORGANIZATIONAL MODEL OF THE PORTAL.....	13
2.2 FEATURES OF THE ORGANIZATIONAL MODEL OF THE EDUCATIONAL PORTAL	14
2.3 THE MAIN ARCHITECTURAL DECISIONS FOR THE ORGANIZATIONAL MODEL OF THE PORTAL	15
2.4 THE STANDARD SOLUTIONS FOR THE ORGANIZATIONAL MODEL OF THE PORTAL.....	17
2.5 THE MAIN REQUIREMENTS FOR THE ORGANISATIONAL MODEL OF PORTAL.....	18
2.6 THE PECULIARITY OF THE ORGANIZATIONAL MODEL OF EDUCATIONAL PORTAL	20
2.7 THE COORDINATION OF ORGANIZATIONAL MODEL WITH THE PEDAGOGICAL, COMPETENCY-BASED AND TECHNOLOGICAL MODELS OF THE PORTAL.....	21
2.8 THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE ORGANIZATIONAL MODEL OF THE PORTAL	21
2.9 THE FUNCTIONALITY OF THE PORTAL FOR INDIVIDUAL AND CORPORATIVE USERS	22
2.10 THE MANAGEMENT OF AN EDUCATIONAL PORTAL	23
2.11 CONCLUSIONS	26
REFERENCES.....	27
LIST OF AUTHORS.....	27
3. A4.4 Development of the model for student work, internships and placement (UMU)	29
3.1 INTRODUCTION.....	29
3.2 COMPETENCE DATABASE	30

3.2.1 COMPETENCE EXTRACTION.....	30
3.3 AUTOMATIC DETECTION OF COMPETENCES	32
3.4 CONCLUSION.....	39
REFERENCES	39
LIST OF AUTHORS.....	40
4. A5.4. Design of the user-client application (UoI).....	41
4.1 TECHNOLOGIES FOR USER CLIENT APPLICATION	41
4.1.1 TECHNOLOGIES FOR USER EXPERIENCE	41
4.1.2 TECHNOLOGIES FOR USER INTERFACE.....	41
4.2 REQUIREMENTS FOR USER INTERFACE.....	42
4.3 USER INTERACTIONS VIA USER APPLICATION.....	43
4.4 EMEDIATOR WEBSITE	49
REFERENCES.....	55
LIST OF AUTHORS.....	55
5. A6.4 Mock-up integrations in the Alpha Portal Demo (AU).....	56
5.1 MOODLE INTEGRATION	56
5.2 TECHNICAL SETUP AND CURRENT ARCHITECTURE OF EMEDIATOR PORTAL WITH ALL MOCK-UPS/APPLICATIONS.....	57
5.3 SERVER ACCESS VIA PUBLIC DOMAIN.....	58
5.4 ROADMAP FOR FURTHER IMPLEMENTATION.....	59
LIST OF AUTHORS.....	59



Funded by the
Erasmus+ Programme
of the European Union



1. A2.4. Development of the curricula quality management model (UL)

1.1 INTRODUCTION

The issue of the quality of education has been present for decades not only in pedagogy or social sciences. The problem involves eminent authorities, politicians and specialists in various fields. After all, it is about what the future of societies will be like in the foreseeable future. Experts in the problem warn that "unacceptable quality of education is a real phenomenon and, at the same time, a serious threat to both young generations and entire countries" (Galabawa and Alphonse 2005). This issue is all the more important as the 21st century is characterized by unprecedentedly dynamic socio-economic changes on a global scale, which require constant monitoring and adjustment of educational impacts.

The concept of quality comes from management theory. The creator of the concept of total quality management - (Deming 2018; Deming and Orsini 2013) - defined quality as this what satisfies (and even delights) the customers. If the concept of a "customer" appears, it means that education ceases to be a mission or a vocation, must be treated in market categories and it becomes a service. Therefore, the teacher is no longer a master leading students to knowledge, but a service provider who cares about meeting customer (learners, platform users) expectations. The customer is a platform users, and in the broadest sense, the whole society, which has an interest in the well-educated his members.

1.2 QUALITY OF EDUCATION

The quality of education is of fundamental importance, because it very often translates into the prospects of finding a good job, opportunities to participate in social life, fully exercising one's civil rights, or even health. The quality of education is one of the conditions that allows you to take advantage of opportunities and fully participate in social life.

The quality of education is a permanent process of assessment, control, improvement and streamlining of educational processes. The quality of education is most often associated with excellence, perfection, certainty of achieving the goal, financial value, transformation, the ability to adapt to changing needs, and learner satisfaction. The quality of education is the basic factor of competition, understood as rivalry between educational institutions (Clewes 2003; Harvey and Green 1993; Vlăsceanu, Grünberg, and Pârlea 2004).

Quality - both in the individual, institutional and national dimensions - is a prerequisite for the high standard of educational services offered. Continuous improvement of the quality of education ensures an appropriate level of satisfaction of stakeholders: students, parents, teachers, funding and supervisory institutions. Interest in the quality of education contributes to the development of motivation and commitment of students and teachers. Schools that care about quality assurance achieve higher test scores,

have a more favorable position on the educational services market, have a better social image, are more competitive and trusted, and make the best use of the funds entrusted to them (Mishra 2007).

Quality of education can be divided into four types:

1. **Formative quality:** provides information needed to improve educational activities and tools, modify them and control them. The purpose of determining the normative quality is to examine how much an educational project (in our case the platform) achieves the originally assigned goals.
2. **The conclusion quality (reporting):** focuses on assessing the results and effects of educational activities and refers to their overall impact.
3. **Socio-political quality:** indicates how much the goals of educational and social policy have been achieved;
4. **Administrative quality:** determines the efficiency of management in education.

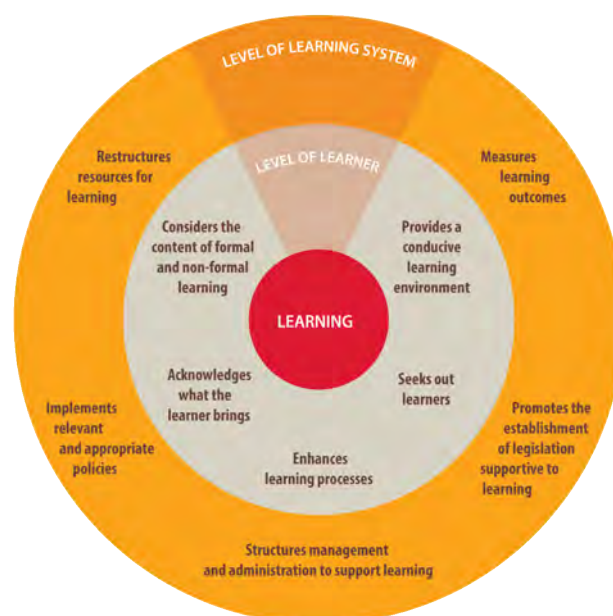


Figure 1: 10 dimensions of quality of education (source)

According to this model the quality of education can be considered in two contexts. In the context of the learner:

1. Seeking out learners
2. What the learner brings
3. Content
- 4 Processes
5. Learning environment

and in the context of the system/organization:

6. Managerial and administrative structure and processes
7. Implementation of good policies

8. Appropriate legislative framework
9. Resources
10. Measurement of learning outcomes.

Such a dynamic and multi-factor understanding of the quality of education makes it necessary to perceive it not in the dimension of the result, but in the dimension of the process. Measuring a final result of education (e.g. the level of knowledge) after completion the platform activity cannot be the base for inferring about the quality of the platform.

The curricula quality management model is the model that allows us to determine/estimate to what extent the platform allows to use the capabilities/intellectual potential of its users and to what extent the designed activities and digital tools support users in achieving educational goals. In modern pedagogy, it is learning (not teaching) decides about the final effects of education. Therefore, the quality of the platform depends on the extent to which the platform supports the effectiveness of users learning, conducive to this learning. Measuring a final result of education (e.g. the level of knowledge) after completion the platform activity cannot be the base for inferring about the quality of the platform. The following elements should be taken into account at each stage of measuring the quality of education: elements and properties of the learning environment, content, learning processes, learning outcomes and learner characteristics.



Figure 2: A new kind of study seeks to quantify educational quality [\(source\)](#) (Berrett 2014)

Such a comprehensive approach to the quality of education will allow you to reliably estimate its level and responsibly introduce improvements on the eMediator platform.

1.3 ISO

When considering quality education, we should consider the Sustainable Development Goals, specifically Goal 4: Quality Education Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all. The ISO 21001 (ISO 2018) standard can assist in achieving this goal. This is the first

management system standard designed specifically for the education sector. It aims to improve educational institutions' processes and quality to meet the needs and expectations of their users.

Moreover, ISO's technical committee ISO/TC 232 develops standards that describe the requirements for learning services provided outside of formal education, such as ISO 24913, which describes all kinds of lifelong learning, including vocational education and in-company training (either outsourced or in-house).

The ISO 21001 specifies requirements for an educational organization's management system (EOMS) when such an organization: needs to demonstrate the ability to facilitate the acquisition of competence through teaching, learning, or research; enhances learner, beneficiary, and staff satisfaction by effectively implementing EOMS, including processes for improving the system and ensuring conformity with the needs of learners and other beneficiaries.

Regardless of the type, size, or delivery method, ISO 21001:2018 applies to all organizations using a curriculum to develop competence. A professional training department within a larger organization may adopt ISO 21001:2018 as its standard for education within the organization. A company that produces or manufactures only educational products is not subject to ISO 21001:2018.

On the www.iso.org website there are numerous annexes that support the realisation of the ISO 21001 standard.

Additional requirements and guidance include:

- **Annex A** specifies additional requirements for early childhood education for organizations that provide this service.
- **Annex B** outlines the principles for an EOMS.
- **Annex C** provides a classification of interested parties.
- **Annex D** provides guidelines for communication with interested parties.
- **Annex E** provides guidance on processes, measures and tools in educational organizations.

The requirements and guidance could be fully implemented in the eMediator project, as they concern principle for an EOMS (Annex B), classification of interested parties (Annex C – that could be a good source for revision of the classification of users), communication (Annex D – eMediator assumptions may be confronted with the guidelines), and processes, measures and tools (Annex E – eMediator assumptions can be also confronted with the guidance).

It would be recommended that the platform will conform with the 21001 ISO standard from the very beginning, as in the future it could be certified and in this way used in a more standardised way.

REFERENCES

- Berrett, D. 2014. "A New Kind of Study Seeks to Quantify Educational Quality." *The Chronicle of Higher Education*.
- Clewes, Debbie. 2003. "A Student-Centred Conceptual Model of Service Quality in Higher Education." *Quality in higher education* 9(1): 69–85.
- Delecraz, Sebastien et al. 2022. "Responsible Artificial Intelligence in Human Resources Technology: An

- Innovative Inclusive and Fair by Design Matching Algorithm for Job Recruitment Purposes." *Journal of Responsible Technology* 11: 100041.
- Deming, W Edwards. 2018. *The New Economics for Industry, Government, Education*. MIT press.
- Deming, W Edwards, and Joyce Nilsson Orsini. 2013. "The Essential Deming: Leadership Principles from the Father of Quality." *NY, McGraw-Hill*.
- Galabawa, JJCJ, and Ndibalema N Alphonse. 2005. *Research on the Quest for Education Quality Indicators: Issues, Discourse and Methodology*. EdQual Working Paper.
- Harvey, L, and D Green. 1993. "DEFINING'QUALITY for Assessment and Evaluation in Higher Education: An International Journal."
- ISO. 2018. "ISO 21001:2018 Educational Organizations — Management Systems for Educational Organizations — Requirements with Guidance for Use." : 63.
<https://www.iso.org/standard/66266.html>.
- Mishra, Sanjaya. 2007. *Quality Assurance in Higher Education: An Introduction*. National Assessment and Accreditation Council, India;
- Vlăsceanu, Lazăr, Laura Grünberg, and Dan Pârlea. 2004. *Quality Assurance and Accreditation: A Glossary of Basic Terms and Definitions*. Unesco-Cepes Bucharest.

LIST OF AUTHORS

1. Marcin Rojek
2. Małgorzata Gawlik-Kobylińska
3. Paweł Maciejewski
4. Joanna Leek

2. A3.4 Development of the organizational model of interaction between individual and corporate portal users (TSI)

The organizational model of interaction between individual and corporate portal users is an essential tool in modern business. It provides a personalized and seamless experience to users, enhances communication and collaboration, and provides valuable insights into user behavior and preferences. Organizations that embrace this model are likely to enjoy increased customer satisfaction, employee productivity, and profitability. Therefore, it is essential for organizations to adopt this model and continuously optimize their portal to meet the changing needs of their users.

2.1 GENERAL DESCRIPTION OF THE ORGANIZATIONAL MODEL OF THE PORTAL

In today's world, technology has brought about a lot of changes, especially in the way organizations interact with their customers, employees, and other stakeholders. One of the significant changes is the development of the organizational model of interaction between individual and corporate portal users. This model is designed to facilitate seamless communication and collaboration between individual users and organizations using the portal. In this essay, we will explore the key elements of this model and its importance in modern business.

Firstly, the organizational model of interaction between individual and corporate portal users involves the creation of a user-centric portal that focuses on the needs and preferences of individual users. This means that the portal is designed to provide a personalized experience to each user based on their interests, behavior, and preferences. The portal is also designed to be intuitive, easy to use, and accessible from any device. This ensures that users can access the portal from anywhere and at any time, which improves their overall experience.

Secondly, the organizational model of interaction between individual and corporate portal users involves the creation of a collaborative platform that allows users to communicate and collaborate with each other and with the organization. This platform can include features such as instant messaging, forums, discussion boards, and social media integration. These features enable users to interact with each other and with the organization in real-time, which enhances their engagement and fosters a sense of community.

Thirdly, the organizational model of interaction between individual and corporate portal users involves the integration of analytics and reporting tools that provide insights into user behavior, preferences, and interactions with the portal. This information is used to personalize the user experience, improve the portal's functionality, and identify areas for improvement. This ensures that the organization can continuously optimize the portal to meet the changing needs of its users.

The organizational model of interaction between individual and corporate portal users is crucial in modern business for several reasons.

Firstly, it improves customer engagement and loyalty by providing a personalized and seamless experience that meets their needs and preferences. This, in turn, leads to increased customer satisfaction, retention, and advocacy.

Secondly, it enhances employee productivity and collaboration by providing a collaborative platform that facilitates communication and collaboration between team members and departments. This improves workflow and reduces errors and delays, leading to better business outcomes.

Thirdly, it provides valuable insights into user behavior, preferences, and interactions with the portal, which can be used to inform business decisions and optimize the portal's functionality. This, in turn, leads to improved efficiency, productivity, and profitability.

2.2 FEATURES OF THE ORGANIZATIONAL MODEL OF THE EDUCATIONAL PORTAL

If we are specifically talking about Education as a Services (EaaS) with educational portal (Figure 1) that provides services for individual users such as students and academic staff, as well as corporate users such as universities and employers' organizations, there are a few additional elements that can be added to the organizational model of interaction.

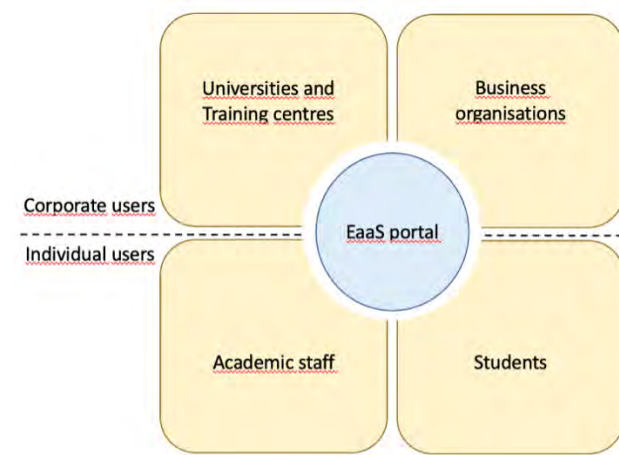


Figure 1: Main stakeholders of EaaS ecosystem

Firstly, the portal can include personalized learning paths for individual users based on their interests, academic goals, and performance. This feature can provide customized recommendations for courses, assignments, and resources to help users achieve their academic objectives. Additionally, the portal can include virtual classrooms, interactive lectures, and online discussion forums to facilitate remote learning and collaboration.

Secondly, the portal can include a job board that connects individual users with potential employers in the industry. This feature can provide job listings, career advice, and networking opportunities to help individual

users find meaningful employment opportunities. Additionally, the portal can include resources such as CV builders, interview preparation guides, and employer profiles to help users navigate the job market.

Thirdly, the portal can include analytics and reporting tools that provide insights into the performance of individual users, courses, and academic programs. This information can be used by universities and employers' organizations to identify areas for improvement, develop new academic programs, and evaluate the effectiveness of their recruitment strategies.

Fourthly, the portal can include features that enable universities and employers' organizations to promote their brand and reputation. This can include sections for university and employer profiles, success stories of alumni and employees, and virtual campus tours. This feature can enhance the visibility of universities and employers' organizations, attract more prospective students and employees, and foster a sense of community.

2.3 THE MAIN ARCHITECTURAL DECISIONS FOR THE ORGANIZATIONAL MODEL OF THE PORTAL

The architectural solutions for an educational portal that provides services for individual users (students, academic staff who want to get a job) and corporate users (universities, employers' organizations) should be designed to support the features and functionalities of the portal, as well as provide scalability, security, and performance. Some of the main architectural solutions for the specified portal are:

1. **Cloud-based infrastructure:** The portal can be hosted on cloud-based infrastructure, such as Amazon Web Services (AWS) or Microsoft Azure. This will ensure that the portal is accessible from anywhere and at any time, and can handle high traffic loads.
2. **Microservices architecture:** The portal can be built using microservices architecture, which involves breaking down the application into smaller, independent services that can be developed, deployed, and scaled independently. This approach can improve the flexibility, maintainability, and scalability of the portal.
3. **API-first design:** The portal can be designed using API-first principles, which involves designing the API before the user interface. This approach can facilitate the integration of third-party services, such as job boards and analytics tools, and ensure that the portal can be easily integrated with other systems.
4. **Single sign-on (SSO):** The portal can implement SSO, which allows users to log in once and access multiple applications without having to log in again. This can improve the user experience and reduce the risk of security breaches.
5. **Secure data storage:** The portal can store sensitive data, such as user profiles, academic records, and job applications, in secure databases. This can be achieved by implementing encryption, access controls, and regular backups.

6. Content delivery network (CDN): The portal can utilize a CDN, which caches content in multiple locations around the world to improve the speed and reliability of content delivery. This can improve the user experience for users accessing the portal from different geographic locations.
7. Continuous integration and deployment (CI/CD): The portal can implement CI/CD, which involves automating the testing, building, and deployment of code changes. This can improve the speed and quality of software releases and reduce the risk of errors and downtime.

One of the key features of the architecture of such an educational portal is the architecture of microservices. The architecture of microservices is an approach to designing complex software systems that consists of breaking down the system into small, independently deployable services that work together to deliver the desired functionality. Each service is focused on a specific task or business function, and communicates with other services through a lightweight communication protocol such as HTTP or message queues.

In the context of an educational portal that provides services for both individual and corporate users, the microservices architecture can provide several benefits:

1. Scalability: The microservices architecture allows the portal to scale horizontally, meaning that additional instances of a service can be added to handle increased load. This allows the portal to handle a large number of users and requests without sacrificing performance.
2. Modularity: The microservices architecture allows the portal to be broken down into small, independently deployable services. This makes it easier to maintain and update the portal, as changes can be made to individual services without affecting the rest of the system.
3. Flexibility: The microservices architecture allows the portal to be built using a mix of programming languages and frameworks. This provides flexibility in selecting the best technology for each service, and enables faster development and deployment of new features.
4. Resilience: The microservices architecture can make the portal more resilient to failure, as individual services can be designed to handle errors and failures gracefully without affecting the rest of the system.
5. Security: The microservices architecture can improve the security of the portal, as individual services can be designed with specific security requirements in mind. For example, sensitive data can be stored in a separate service with stronger security controls.

The microservices architecture can provide several benefits to an educational portal that provides services for both individual and corporate users. By breaking the portal down into small, independently deployable services that work together to deliver the desired functionality, the portal can be more scalable, modular, flexible, resilient, and secure.

When designing the microservices architecture for an educational portal that serves both individual and corporate users, several requirements should be formulated to ensure that the architecture is effective and meets the needs of the users. Some of these requirements include:

1. **Service independence:** Each service should be designed to function independently of other services, with well-defined inputs and outputs. This allows for easier maintenance, deployment, and scaling of individual services.
2. **Loose coupling:** The services should be loosely coupled, meaning that changes to one service should not affect the functionality of other services. This allows for faster development and deployment of new features and reduces the risk of system failures.
3. **Scalability:** The microservices architecture should be designed to be scalable, allowing for additional instances of a service to be added to handle increased load. This ensures that the portal can handle a large number of users and requests without sacrificing performance.
4. **Resilience:** The microservices architecture should be designed to be resilient to failure, with individual services handling errors and failures gracefully without affecting the rest of the system.
5. **Security:** The microservices architecture should be designed with security in mind, with sensitive data stored in separate services with stronger security controls. Additionally, each service should have its own security controls to protect against unauthorized access and data breaches.
6. **Monitoring and logging:** The microservices architecture should include monitoring and logging capabilities to help identify and troubleshoot errors and failures. This allows for quick resolution of issues and helps ensure the reliability and performance of the system.
7. **API design:** The microservices architecture should be designed with a clear and consistent API, allowing for easy integration with external systems and services. This enables seamless exchange of information between individual and corporate users and the portal.

The microservices architecture for an educational portal that serves both individual and corporate users should be designed with the above requirements in mind to ensure that the system is scalable, resilient, secure, and reliable.

2.4 THE STANDARD SOLUTIONS FOR THE ORGANIZATIONAL MODEL OF THE PORTAL

When designing an educational portal that provides services for individual users (students, academic staff who want to get a job) and corporate users (universities, employers' organizations), there are standard solutions that can be used to help address common challenges and ensure a successful outcome. Some standard solutions that can be used when designing the specified portal include:

1. **Learning Management System (LMS):** An LMS is a software application that enables the delivery, tracking, and management of online courses and training programs. Integrating an LMS into the portal can help to improve the learning experience for students and academic staff, as well as provide a platform for universities and employers' organizations to deliver training and development programs.
2. **Applicant Tracking System (ATS):** An ATS is a software application that enables organizations to manage job applications and candidate information. Integrating an ATS into the portal can help to

- streamline the recruitment process for employers, as well as provide a platform for students and academic staff to search for and apply to job openings.
3. **Customer Relationship Management (CRM) System:** A CRM system is a software application that enables organizations to manage customer interactions and relationships. Integrating a CRM system into the portal can help to improve the communication and engagement with users, as well as provide insights into user behavior and preferences.
 4. **Analytics and Reporting:** Analytics and reporting tools can help organizations to gain insights into user behavior and preferences, as well as monitor the performance of the portal. Implementing analytics and reporting tools can help organizations to identify areas for improvement and make data-driven decisions.
 5. **Social Media Integration:** Integrating social media platforms such as Facebook, Twitter, and LinkedIn into the portal can help to improve engagement with users and facilitate the sharing of information and content.
 6. **Online Payment System:** An online payment system can enable users to pay for services such as courses and training programs, as well as facilitate transactions between employers and job seekers.
 7. **Content Management System (CMS):** A CMS is a software application that enables the creation, management, and publication of digital content. Integrating a CMS into the portal can help to facilitate the creation and management of content such as course materials, job postings, and training programs.

By implementing these standard solutions, we can build a portal that delivers a seamless and engaging user experience, facilitates learning and career development, and enhances the reputation of universities and employers' organizations.

2.5 THE MAIN REQUIREMENTS FOR THE ORGANISATIONAL MODEL OF PORTAL

Developers of an educational portal that provides services for both individual and corporate users need to have a strong understanding of the specific requirements for the organizational support for the interaction between these two groups. Some of the main requirements that developers should consider include:

1. **User Experience Design:** Developers should be skilled in user experience (UX) design, which involves creating interfaces and interactions that are intuitive and easy to use for both individual and corporate clients. The UX design should take into account the different needs and expectations of each group and ensure that the portal is accessible, responsive, and visually appealing.
2. **Data Management and Security:** Developers should be experienced in data management and security, which involves ensuring that all user data is collected, stored, and managed in compliance with relevant regulations and standards. The portal should also have robust security measures in place to protect user data and prevent unauthorized access.
3. **Integration with External Systems:** Developers should be able to integrate the portal with external systems such as university databases, employer job boards, and payment gateways. This integration

should be seamless and reliable, ensuring that users have access to the most up-to-date information and services.

4. **Scalability and Performance:** Developers should design the portal with scalability and performance in mind, ensuring that it can handle a large volume of users and data without sacrificing speed or reliability. This may involve implementing cloud-based solutions or other technologies that can support high levels of traffic and usage.
5. **Collaboration and Communication:** Developers should be skilled in collaboration and communication, working closely with stakeholders from both individual and corporate clients to ensure that the portal meets their needs and expectations. This may involve conducting user research, soliciting feedback, and incorporating changes based on user input.

In terms of organizational support for the interaction of individual and corporate clients, there are several key requirements that the educational portal should meet to ensure a seamless and effective user experience for both groups:

1. **Accessibility:** The portal should be accessible to users of all abilities, including those with disabilities. This may involve incorporating features such as alternative text for images, captions for videos, and keyboard navigation.
2. **Personalization:** The portal should allow users to customize their experience based on their preferences and needs. For example, individual users may want to save their search criteria or set up notifications for job openings, while corporate clients may want to customize their job listings or receive analytics reports.
3. **Integration with External Systems:** The portal should be integrated with external systems such as university databases, employer job boards, and payment gateways. This integration should be seamless and reliable, ensuring that users have access to the most up-to-date information and services.
4. **Security and Data Privacy:** The portal should have robust security measures in place to protect user data and prevent unauthorized access. This includes using encryption for sensitive data, implementing user authentication and authorization protocols, and complying with relevant regulations and standards.
5. **Collaboration and Communication:** The portal should facilitate collaboration and communication between individual and corporate users, enabling them to interact and exchange information in a smooth and efficient manner. This may involve features such as messaging, chat, forums, and social media integration.
6. **Analytics and Reporting:** The portal should provide analytics and reporting features that allow both individual and corporate users to track their progress and performance. For example, individual users may want to track their learning progress, while corporate clients may want to track their recruitment metrics.

7. **Mobile Compatibility:** The portal should be compatible with mobile devices such as smartphones and tablets, allowing users to access the portal on the go. This may involve using responsive design, mobile-friendly layouts, and mobile app development.

By meeting these requirements, the educational portal can provide a seamless and effective user experience for both individual and corporate clients, supporting their interaction and collaboration and helping them achieve their goals.

2.6 THE PECULIARITY OF THE ORGANIZATIONAL MODEL OF EDUCATIONAL PORTAL

The organizational model of an educational portal that provides services for both individual and corporate users is unique in that it must balance the needs and expectations of these two distinct groups while also facilitating their interaction and collaboration. This requires a number of specific features and functionalities that are tailored to the needs of both individual and corporate clients.

One of the key features of this organizational model is the integration of external systems, such as university databases and employer job boards. This integration allows for a seamless exchange of information between individual and corporate users, enabling employers to find qualified candidates and students to find relevant job opportunities. Additionally, the portal may include features such as personalized job recommendations based on a user's skills and preferences, which can help individual users find the right job opportunities and employers find the right candidates.

Another unique aspect of the organizational model of such an educational portal is the emphasis on collaboration and communication. The portal must facilitate communication and collaboration between individual and corporate users, enabling them to interact and exchange information in a smooth and efficient manner. For example, the portal may include messaging, chat, forums, and social media integration to encourage communication and networking among users.

Additionally, the organizational model of such an educational portal may include features such as analytics and reporting, which enable both individual and corporate users to track their progress and performance. For example, students may be able to track their learning progress and career goals, while employers may be able to track their recruitment metrics and the performance of their job listings.

The organizational model of an educational portal that provides services for both individual and corporate users is unique in that it must balance the needs and expectations of these two distinct groups while also facilitating their interaction and collaboration. By including features such as integration with external systems, collaboration and communication tools, and analytics and reporting, the portal can provide a seamless and effective user experience for both groups, supporting their interaction and helping them achieve their goals.

2.7 THE COORDINATION OF ORGANIZATIONAL MODEL WITH THE PEDAGOGICAL, COMPETENCY-BASED AND TECHNOLOGICAL MODELS OF THE PORTAL

The organizational model of an educational portal that serves both individual and corporate users should be coordinated with the pedagogical, competency-based, and technological models to ensure that the portal meets the needs of its users and achieves its educational goals.

- **Pedagogical model:** The pedagogical model should be designed to align with the organizational model, taking into consideration the needs of both individual and corporate users. The pedagogical model should focus on providing high-quality educational content and services that meet the needs of both types of users, while also taking into account their different learning styles and goals. For example, individual users may require more personalized learning experiences, while corporate users may require more standardized training programs.
- **Competency-based model:** The competency-based model should be integrated into the organizational model to ensure that the portal is designed to help users develop the skills and competencies they need to succeed in their chosen field. The portal should be designed to provide users with clear learning outcomes and competencies, and should use assessment and feedback mechanisms to measure and track progress towards these outcomes.
- **Technological model:** The technological model should be aligned with the organizational model to ensure that the portal is built using the most appropriate and effective technologies. The technological model should focus on providing a reliable, scalable, and secure platform for delivering educational content and services to users. It should also include features such as analytics, data visualization, and machine learning to help personalize and optimize the user experience.

The coordination of the organizational, pedagogical, competency-based, and technological models is critical to the success of an educational portal that serves both individual and corporate users. By ensuring that these models are aligned and integrated, the portal can provide high-quality educational content and services that meet the needs of its users and help them achieve their learning goals.

2.8 THE ROLE OF ARTIFICIAL INTELLIGENCE IN THE ORGANIZATIONAL MODEL OF THE PORTAL

Artificial intelligence (AI) can play a significant role in the organizational model of an educational portal that serves both individual and corporate users. Some of the ways that AI can be used in the organizational model of such a portal include:

- **Personalized learning:** AI can be used to analyze user data and provide personalized recommendations for learning content and activities. This can help individual users to learn at their own pace and in a way that meets their individual needs and preferences.
- **Adaptive assessments:** AI can be used to create adaptive assessments that adjust to the user's level of knowledge and provide feedback that is tailored to their learning needs. This can help to improve the accuracy of assessments and help users to better understand their strengths and weaknesses.

- Intelligent tutoring systems: AI can be used to create intelligent tutoring systems that provide users with personalized feedback and guidance. These systems can help users to identify areas where they need to improve and provide suggestions for how to do so.
- Natural language processing: AI can be used to improve communication between users and the portal, for example, by providing chatbots or virtual assistants that can answer questions and provide guidance in a natural language format.
- Predictive analytics: AI can be used to analyze user data and make predictions about future behavior, such as whether a user is likely to drop out of a course. This can help to identify users who may need additional support and intervention.

The use of AI in the organizational model of an educational portal can help to improve the user experience, increase engagement and motivation, and provide personalized support for learners. It can also help to optimize the performance of the portal and improve the efficiency of the learning process. However, it is important to ensure that the use of AI is transparent and ethical, and that users' privacy and data protection rights are respected.

2.9 THE FUNCTIONALITY OF THE PORTAL FOR INDIVIDUAL AND CORPORATIVE USERS

The functionality of an educational portal for individual users should be designed to meet their needs and preferences and provide them with a personalized learning experience.

There is the main functionality that an educational portal can provide for individual users:

1. Course catalog: A course catalog is a directory of courses that the portal offers. Individual users can browse the catalog and choose the courses that they want to take. They can filter courses based on their interests, subject, level, and duration.
2. Learning management system (LMS): An LMS is a platform that allows individual users to access course materials, complete assignments, take quizzes and tests, and communicate with their instructors and peers. The LMS can provide personalized learning experiences based on individual users' learning styles and progress.
3. Career services: An educational portal can provide career services to help individual users find jobs and advance their careers. This can include job boards, resume builders, career counseling, and networking opportunities.
4. Learning resources: An educational portal can provide learning resources such as textbooks, articles, videos, and podcasts. These resources can be curated based on individual users' interests and needs.
5. Certification and credentialing: An educational portal can offer certifications and credentials to individual users who complete courses and demonstrate mastery of skills. These certifications and credentials can be valuable for career advancement and recognition.
6. Community engagement: An educational portal can provide social features to help individual users connect with other learners and form communities. This can include forums, chat rooms, and social media integration.

The functionality of an educational portal for individual users should be designed to help them achieve their personal and professional goals. The portal should provide a variety of courses and programs, personalized learning experiences, and career services to support lifelong learning and career development.

For corporate users An educational portal can provide a wide range of functionality to meet the needs of businesses and organizations. There is the main functionality that an educational portal can provide for corporate users:

1. **Talent acquisition:** An educational portal can serve as a platform for corporate users to recruit talented individuals for their organization. This can include job posting, applicant tracking, and candidate screening features.
2. **Professional development:** An educational portal can provide professional development courses and training programs for corporate users to help them develop new skills and advance their careers. These programs can be tailored to the specific needs of the organization.
3. **Learning management system (LMS):** An LMS can be used by corporate users to deliver training and development programs to their employees. The LMS can be customized to match the organization's branding and can provide reporting and analytics features to track employee progress.
4. **Certification and credentialing:** An educational portal can offer certifications and credentials to corporate users who complete courses and demonstrate mastery of skills. These certifications and credentials can be used by the organization to demonstrate expertise in a particular area or to meet regulatory requirements.
5. **Corporate training:** An educational portal can provide custom training solutions for corporations, including e-learning modules, webinars, and virtual instructor-led training. These training solutions can be customized to match the specific needs of the organization.
6. **Data analytics:** An educational portal can provide data analytics tools for corporate users to track the effectiveness of their training and development programs. These tools can provide insights into employee performance, learning outcomes, and return on investment.

The functionality of an educational portal for corporate users should be designed to help organizations improve their talent acquisition, employee development, and overall performance. The portal should provide custom solutions that meet the specific needs of the organization.

2.10 THE MANAGEMENT OF AN EDUCATIONAL PORTAL

The management of an educational portal with individual and corporate users can be a complex task that requires a range of skills and expertise. Here are some key considerations for managing such a portal:

- **Governance:** Establishing a clear governance structure is essential for managing the portal effectively. This includes defining roles and responsibilities, establishing policies and procedures, and ensuring compliance with relevant regulations.

- Content management: The portal will require ongoing maintenance and updates to ensure that the content is up-to-date and relevant. This may involve creating new content, curating existing content, and reviewing user-generated content.
- User support: Providing support to users is critical for ensuring that they can use the portal effectively. This may include providing technical support, answering user questions, and providing training and resources.
- Data management: The portal will generate a significant amount of data that can be used to improve the user experience and track performance. This may involve collecting and analyzing user data, managing databases, and developing reports and analytics.
- Marketing and promotion: The success of the portal will depend on its ability to attract and retain users. This may involve developing marketing and promotional campaigns, engaging with users through social media, and building partnerships with other organizations.
- Continuous improvement: The portal should be regularly evaluated and improved based on user feedback and performance metrics. This may involve conducting user surveys, analyzing data, and implementing changes based on user needs.

The management of an educational portal with individual and corporate users requires a range of skills and expertise, including project management, content development, user support, data management, marketing and promotion, and continuous improvement. Effective management can help ensure that the portal provides a valuable and engaging experience for all users.

There are two main management models for an educational portal with individual and corporate users depends on various factors such as the size of the portal, the number of users, the scope of services, and the objectives of the portal.

A collective management model involving several key organizations may be preferred if the portal aims to provide a wide range of services and resources from different organizations or if there are multiple stakeholders involved. In such a model, each organization may be responsible for managing a specific area or functionality of the portal, such as content creation or technical support. This can allow for more diverse perspectives, expertise, and resources, and can help ensure that the portal meets the needs of all stakeholders.

On the other hand, an individual management model may be preferred if the portal is smaller in scale or if it is focused on providing a specific service or resource. In this model, one organization may have full responsibility for managing all aspects of the portal, from content creation to technical support. This can provide a more streamlined and centralized approach to management and may be more efficient in terms of decision-making and resource allocation.

Ultimately, the choice of management model should be based on careful analysis of the goals and objectives of the portal, the needs and preferences of the users, and the available resources and capabilities of the organizations involved.

When creating a collective portal management model for an educational portal with individual and corporate users, the following organizational points should be taken into account:

1. **Governance structure:** A governance structure should be established to define the roles and responsibilities of each organization involved in managing the portal. This can include the establishment of a steering committee or board that oversees the overall direction and strategy of the portal, as well as working groups or subcommittees that are responsible for specific areas of the portal.
2. **Decision-making processes:** Clear decision-making processes should be established to ensure that decisions are made in a timely and effective manner. This can include the establishment of decision-making criteria, as well as clear communication channels for decision-making.
3. **Communication and collaboration:** Effective communication and collaboration are essential for successful collective portal management. Regular meetings, working groups, and other communication channels should be established to facilitate communication and collaboration among the organizations involved in managing the portal.
4. **Resource allocation:** Clear mechanisms should be established for allocating resources among the organizations involved in managing the portal. This can include the establishment of budgets, staffing plans, and other resource allocation mechanisms.
5. **Performance metrics:** Clear performance metrics should be established to measure the success of the portal and the effectiveness of the collective management model. This can include measures of user satisfaction, usage statistics, and other key performance indicators. The following are some parameters that can be used as performance metrics for an educational portal with individual and corporate users:
 - **User satisfaction:** This can be measured through surveys or feedback mechanisms that allow users to rate their overall satisfaction with the portal.
 - **Usage statistics:** This can include metrics such as the number of users, the frequency of usage, and the length of time users spend on the portal.
 - **Learning outcomes:** This can include measures of student performance, such as grades, test scores, or other indicators of learning outcomes.
 - **Engagement:** This can include metrics such as the number of forum posts, the number of interactions with other users, and the level of participation in online activities.
 - **Business outcomes:** This can include measures of the portal's impact on the organizations that use it, such as increased recruitment or retention rates, improved employee performance, or increased revenue.

By taking these organizational points into account when creating a collective portal management model, it is possible to establish a clear and effective framework for managing the portal that meets the needs of all stakeholders involved.

If we use the portal management model for an individual organization, some of the same organizational features may still apply, but other important features for individual portal management may include:

1. **Leadership:** There should be a clear leader or team responsible for the management of the portal, who can make strategic decisions and manage resources effectively.
2. **Communication:** Effective communication between the portal management team and other stakeholders, including users and other internal departments, is critical for ensuring that the portal meets the needs of all parties.
3. **Resource allocation:** Adequate resources, including staffing, budget, and technology infrastructure, must be allocated to support the ongoing development and maintenance of the portal.
4. **User engagement:** User engagement strategies must be in place to ensure that users are motivated to use the portal and that their needs and feedback are taken into account during the development and maintenance processes.

While the organizational features may differ somewhat between individual and collective management models, the importance of effective leadership, communication, resource allocation, and user engagement remains critical to the success of the portal.

2.11 CONCLUSIONS

The organizational model of interaction between individual and corporate users of an educational portal refers to the underlying framework of processes, policies, and practices that enable effective collaboration between these two groups of users. It encompasses the key elements of the portal's design and architecture, as well as the strategies and mechanisms in place to ensure that individual and corporate users can access the portal's resources and services in a seamless and integrated manner.

At its core, the organizational model of such an educational portal aims to provide a user-centric approach that puts the needs of both individual and corporate users at the forefront. It involves the development of functional subsystems that support various aspects of user interaction, including content management, user authentication and access control, user engagement and feedback, and analytics and reporting.

Effective management of the portal requires a clear understanding of the goals and objectives of the organization, as well as the needs and expectations of individual and corporate users. This understanding informs the development of performance metrics and quality standards that can be used to measure and evaluate the effectiveness of the organizational model, and to identify opportunities for continuous improvement.

Overall, the organizational model of interaction between individual and corporate users of an educational portal is a complex and multifaceted framework that requires careful planning, design, and implementation to ensure that the portal meets the needs of all users and stakeholders in an efficient and effective manner.

REFERENCES

- Ng, I. C. L., Forbes, J.: Education as Service: The Understanding of University Experience through the Service Logic. *Journal of Marketing of Higher Education*. Available at: <https://ore.exeter.ac.uk/repository/handle/10036/33054>. Last accessed 2021/07/22 (2008)
- Digital Learning Framework.: From Department of Education, published on 18 November 2020, last updated on 30 June 2021. Available at: <https://www.gov.ie/en/service/8ae17-digital-learning-framework/#>. Last accessed 2022/08/27 (2021)
- Misnevs, B., Kabashkin, I., Uzule, K.: Education Mobility as a Service: Model of the Ecosystem. In: Kabashkin I., Yatskiv I., Prentkovskis O. (eds) *Reliability and Statistics in Transportation and Communication*. RelStat 2021. *Lecture Notes in Networks and Systems*, vol 410. Springer, Cham, pp. 598-607. Available at: https://doi.org/10.1007/978-3-030-96196-1_54. (2022)
- BS EN 16234-1:2019. e-Competence Framework (e-CF). A Common European Framework for ICT Professionals in all Sectors. Available at: <https://www.en-standard.eu/bs-en-16234-1-2019-e-competence-framework-e-cf.-a-common-european-framework-for-ict-professionals-in-all-sectors-framework/>. Last accessed 2021/04/25 (2019)
- Craig, R.: Education-as-a-Service: 5 ways Higher Ed. Must Adapt to a Changing Market. Available at: <https://venturebeat.com/2014/05/11/education-as-a-service-5-ways-higher-ed-must-adapt-to-a-changing-market/>. Last accessed 2021/07/22 (2014)
- Adachi, C.: Education as a Service. Available at: <https://www.futurelearn.com/info/courses/digital-learning/0/steps/49002>. Last accessed 2021/07/22.
- Gokhale, S. D., Vidyavihar, S.: Cloud Computing Platform for Education System: A Review. *International Journal of Computer Applications* 177 (9), 41-45 (2019)
- Meyer, R., etc.: Offering Big Data Services in an Educational Context Using Cloud Infrastructure. In: *Proceedings of the 3rd International IBM Cloud Academy Conference (ICA CON) 2015*, Budapest, Hungary. Available at: https://www.researchgate.net/publication/281967450_Offering_Big_Data_Services_in_an_Educational_Context_Using_Cloud_Infrastructure. Last accessed 2021/07/22 (2015)
- Yang, P., Cheng, Y.: Educational Mobility and Transnationalization, in N.W. Gleason (ed.), *Higher Education in the Era of the Fourth Industrial Revolution*, Singapore: Palgrave Macmillan, pp. 39-64 (2018)
- Ben Stopford. *Designing Event-Driven Systems Concepts and Patterns for Streaming Services with Apache Kafka*. O'Reilly Media. 166 p. (2018)
- Svetoslav Zhelev, Anna Rozeva. Using microservices and event driven architecture for big data stream processing. *Proceedings of the 45th International Conference on Application of Mathematics in Engineering and Economics (Ame'e'19)*. DOI: [10.1063/1.5133587](https://doi.org/10.1063/1.5133587) (2019)

LIST OF AUTHORS

1. Boris Misnevs



2. Igor Kabashkin
3. Olga Zervina



3. A4.4 Development of the model for student work, internships and placement (UMU)

This section describes the steps taken to improve the applicability of the competence model to student work, internships and placement. Artificial Intelligence (AI) has been explored as a way to deal with competences efficiently. Thanks to AI, it has been possible to automatically determine whether a sentence was a competence in the field of technology. First, around 5,600 competences were extracted from the study programmes of computer science degrees from the 10 most prestigious universities in the world, covering topics such as mathematics, algorithms, electronics, digital systems, software development, databases, robotics and modern technologies. The dataset was used to train a linguistic model using Natural Language Processing (NLP). Then, the model was tested on competences extracted from job offers. A high success rate for automatic recognition of competences was achieved. The results are promising for further exploration of the NLP approach to make the model more convenient to use, facilitating the management of student profiles in job search according to the competences that come into play.

3.1 INTRODUCTION

Finding a job after graduation can be overwhelming as students have not always been exposed to the business world. Recent graduates spend an inordinate amount of time looking for a job. Therefore, institutional and legislative interventions are required (Choi et al. 2020) in order to promote the factors that determine that students remain in a certain job (Evans et al. 2020). In the literature, the factors that attract students to stay in a country such as Japan have been analyzed. They were (1) the initial motivation of a student before moving to the country, (2) the impressions that students have of native people after moving and finally, (3) the time they have been living in the country (Cao 2022). Thus, motivation is a key factor in order to achieve the sustainability of the job position.

Generation Z, which is currently entering the labor market, shows some particular characteristics that companies have to consider. This cohort was born in a globally connected world and as such has expectations, perceptions and preferences about the work that are different from the traditional ones (Kirchmayer and Fratričová 2020). There is no doubt that technology is present among the individuals of this generation, since it is a means to be informed at all times, moreover helping future job candidates to make decisions (Ledbetter 2021).

In this line, AI in recruitment processes is gaining momentum. A previous study showed that the use of AI does not affect the likelihood of candidates applying for a job, even if they have little knowledge of AI. In fact, companies should not hide the use of AI in recruitment, as candidates have a positive opinion of both the company and the AI (Van Esch, Black, and Ferolie 2019). Several technologies have been studied in the literature to improve e-recruitment, such as the use of social networks with LinkedIn, a MOOC with Audacity,

a serious game from the L'Oréal company called Reveal, the Ari chatbot from the TextRecruit application, and massive comparative data analysis systems with Randstad.tech (Allal-Chérif, Aránega, and Sánchez 2021).

Artificial intelligence applied to job search is an emerging field of study to better match candidates to a given job (Delecraz et al. 2022). Motivated by the potential of AI, together with the significant workload that may be involved in dealing with a large number of competences, the use of NLP techniques was explored to provide greater applicability to the previously developed competence model.

3.2 COMPETENCE DATABASE

To date, work has been carried out on a competence model based on the harmonisation of the IEEE 1484.20.1 (IEEE 2008) and CWA 16655-1 (CEN 2013) standards, together with the SFIA skills (sfia-online.org) and TPACK knowledge (tpack.org) models. The result was a competence model that allows the representation of competences extracted from job offers and study programmes. A reduced set of competences was used to both validate the model and refine it. Nevertheless, the set of competences was so small that it could lead to biased results when used in NLP. Therefore, a larger database was necessary as input dataset for AI algorithms (Shah, Schwartz, and Hovy 2019).

3.2.1 COMPETENCE EXTRACTION

The database was populated with competences in the curricula of computer science degrees from the top 10 universities according to the Shanghai ranking (see universities in Table 1). The competences covered different areas of the computer science curriculum, including mathematics, algorithms, electronics, digital systems, computer science, software development, databases, robotics and modern technologies. These competences were automatically extracted by using a text processor coded in Python 3.5. In addition, the Beautiful Soup API was used when dealing with HTML code, along with well-known Python commands for string handling. The tool was developed in the Google Colab environment.

The steps taken to extract the academic information are shown in Figure 1. As the university portals presented the competences of the curricula in different ways, each step had to be adapted in some cases. The steps were as follows:

1. **Degree curricula:** The first step was to search in each university portal for the curricula of the subjects required to obtain the degree of Computer Science.
2. **Label:** Each subject of the degree curricula was identified by a label, which was usually part of the web link where the subject competences were hosted.
3. **URL:** from the labels extracted in the previous step, it was possible to build the URLs of the web pages where the information for each subject was stored. This made it possible to have all the URLs in advance to check them in the next step, before automatically accessing the information with the Python code.
4. **Web Page Checking:** before extracting the information, the web pages of the subjects were inspected to check whether they contained competences. In addition, attention was paid to the

sections of the website where the competences were to be found, in order to locate them later in the html code.

5. **Get HTML:** the HTML code was downloaded in order to programme the automatic extraction of the competences after the previous checks.
6. **Extraction:** using the Beautiful Soup API, it was possible to locate the HTML tags in which the competences were located and to automate the extraction of the information.
7. **Separation:** in some cases, several competences were downloaded for the same HTML tag. It was necessary to separate them automatically with the Python code.
8. **Revision:** finally, the downloaded competences were checked one by one to ensure that the code had worked well.

In most cases, these steps enabled the competence dataset to be extended. However, the Stanford University portal was the most heterogeneous in its presentation of academic information. Some syllabi were pdf files, while in others the information was in html format. Due to this variability, only general competences of the degree could be achieved. On the other hand, at the University of Singapore, a very limited number of competences were found, as this information was not accessible to the public. The competences of the universities École Polytechnique Fédérale de Lausanne (EPFL) and ETH Zurich - Swiss Federal Institute of Technology had to be discarded because they were written in a language other than English.

Table 1: Top 10 universities in Computer Science Degree in 2021 (sources: [2021](#) & [2022](#))

Top 10			
Rank	Name of Institution	Location	Score
1	Massachusetts Institute of Technology (MIT)	Cambridge, United States	93.7
2	Stanford University	Stanford, United States	93.1
3	Carnegie Mellon University	Pittsburgh, United States	93
4	National University of Singapore (NUS)	Singapore	90.3
5	University of California, Berkeley (UCB)	Oxford, United Kingdom	89.5
6	University of Oxford	Cambridge, United States	89.1
7	Harvard University	Cambridge, United Kingdom	88.2
8	University of Cambridge	Lausanne, Switzerland	88
9	École Polytechnique Fédérale de Lausanne (EPFL)	Zürich, Switzerland	86.2
10	ETH Zurich - Swiss Federal Institute of Technology	Oxford, United Kingdom	85.6



Figure 1: Steps to extract competences

The number of competences extracted from each university varied considerably (see Table 2). A threshold of 3,000 competences was sought to prevent NLP from working incorrectly (Li, Zhang, and Zhao 2020; Suzuki, Zen, and Kazawa 2023). A total of 4,559 competences were initially downloaded. This number was above the target threshold.

Each line of the competence dataset was visually checked to avoid incomplete sentences, conflicting spellings and overlaps. After revision, the number of competences rose to 5,643. The increase in the number of competences was due to the fact that there were sometimes lines in the dataset where the Python code had not correctly separated the competences in step number 7. On the other hand, knowledge concepts that appeared in the same sentence as a list of nouns were split into different lines. This revision of the dataset was done by one of the authors, who checked and separated the competences manually. All the competences are available [online](#).

3.3 AUTOMATIC DETECTION OF COMPETENCES

Once step 7 has finished (Figure 1) a wide amount of sentences have been automatically extracted. Then, the manual verification of whether all these sentences are competences or no could be cumbersome. In order to facilitate this task, a NLP-based system has been developed. The main objective was to detect whether a sentence is a competence in the technological domain or not. The sections that make up the code are described below.

First of all, Transformers library from Hugging Face Inc. was installed (see Figure 2). This company is based in the USA and produces tools for building machine learning systems. Transformers is a collection of APIs that makes it easy to download and develop pre-trained machine learning models. The use of this library avoids the need to build new models from scratch for common tasks like NLP, computer vision, audio, and

others, such as automatic question answering, optical character recognition, information extraction from scanned documents, video classification, and visual question answering. The library provides communication between multiple different machine learning libraries, including PyTorch, TensorFlow and JAX, which allows free will of choice to train a model in one framework and load it into another. In addition, trained models in Transformers library can also be exported for use in production contexts.

Table 2: Number of competences extracted from each portal

Top 10 universities	
Name of Institution	Competences
Massachusetts Institute of Technology (MIT)	55
Stanford University	34
Carnegie Mellon University	793
National University of Singapore (NUS)	11
University of California, Berkeley (UCB)	699
University of Oxford	1,117
Harvard University	382
University of Cambridge	1,468
École Polytechnique Fédérale de Lausanne (EPFL)	-
ETH Zurich – Swiss Federal Institute of Technology	-
TOTAL:	4,559

Transformers is one of the flagship products of Hugging Face Inc and supports a wide range of automatic language processing models that can be checked online at the company's [webpage](#). In this demo, a smaller, faster and lighter multilingual model was chosen.

```
# Install transformers
!pip3 install -U transformers datasets
# Choose pretrained language model
path_bert_model = 'bert-base-multilingual-cased'
```

Figure 2: Installing Transformers library

A basic test was carried out to know the performance of the model by classifying the sentences with and without competences into two groups. The idea was to work with the model later to automatically separate sentences depending on the presence of a competence. The model was then loaded together with the lexical analyser (tokeniser). The lines of code required to configure this test are shown in Figure 3. As expected, the results were random and the model put the sentences into the same group whether they had competences or not (LABEL_1/LABEL_0, see the output section in Figure 4).

```

NUM_LABELS = 2
from transformers import AutoModelForSequenceClassification, AutoTokenizer
bert_class_model =
AutoModelForSequenceClassification.from_pretrained(path_bert_model, num_labels =
NUM_LABELS)
tokenizer = AutoTokenizer.from_pretrained(path_bert_model)

```

Figure 3: Initial test configuration

The test was then performed. PyTorch machine learning library was used to run the test. This resource is open source and has been developed by Meta AI. It is flexible and modular, providing the stability and support required for production use. The results of the test were imprecise because they did not separate the sentences according to whether they were competences or not (see output section in Figure 4). This result was expected since no previous training on competences was carried out.

```

textos=['Nancy was proud that she ran a tight shipwreck',
        'She used her own hair in the soup to give it more flavor',
        'Boulders lined the side of the road foretelling what could come next',
        'Develop and help maintain the firm's intranet webpage and custom web applica
tions utilizing HTML, PHP and other programming languages',
        'Participate in the planning, implementation and testing phases of applica
tionn and database installations and upgrades',
        'Bachelor's Degree in computer science, information systems or other related
field preferred',
        'The doll spun around in circles in hopes of coming alive']

# Perform test
from torch import no_grad
for text in textos:
    inputs = tokenizer(text, return_tensors = "pt")
    with no_grad():
        logits = bert_class_model(**inputs).logits
        predicted_class_id = logits.argmax().item()
        prediction = bert_class_model.config.id2label[predicted_class_id]
    print(text, '=>', prediction)

```

Output:

```

Nancy was proud that she ran a tight shipwreck => LABEL_1
She used her own hair in the soup to give it more flavor => LABEL_1
Boulders lined the side of the road foretelling what could come next => LABEL_1
Develop and help maintain the firm's intranet webpage and custom web applications
utilizing HTML, PHP and other programming languages => LABEL_1
Participate in the planning, implementation and testing phases of application and
database installations and upgrades => LABEL_1
Bachelor's Degree in computer science, information systems or other related field
preferred => LABEL_1
The doll spun around in circles in hopes of coming alive => LABEL_1

```

Figure 4: Basic test and output

At this point, the competence dataset previously extracted from the syllabi was needed to train the model. In NLP, this action is called fine-tuning, which refers to the process of training a language model with custom data. This training results in a new model in which the previous model is updated with respect to the characteristics of the domain data, in this case the detection of competence sentences in the technology domain.

First, PyDrive, a Google API client, was installed to access the CSV files stored in Google Drive containing the competences along with random sentences. The random sentences were extracted from online sentence generators. Another CSV file, also, indicated whether the statement was a competence or not. The Pandas library was used to open both CSV files, one with the statements and the other with the labels, and horizontally concatenate them. Figure 5 shows the lines of code required to prepare the dataset.

```
# Load competence sentences from Google Drive
!pip install -U -q PyDrive
from google.colab import auth
from pydrive.auth import GoogleAuth
from oauth2client.client import GoogleCredentials
from pydrive.drive import GoogleDrive

auth.authenticate_user()
gauth = GoogleAuth()
gauth.credentials = GoogleCredentials.get_application_default()
drive = GoogleDrive(gauth)

import pandas as pd
link='https://drive.google.com/file/d/18WjnGJ0Tvxq6595zuc23l51FQX8-7euG/view'
id = link.split("/")[-2]
downloaded = drive.CreateFile({'id':id})
downloaded.GetContentFile('competencias-frases-random.csv')
daa = pd.read_csv('competencias-frases-random.csv')

link='https://drive.google.com/file/d/1UG30KZYZrSMsdwaP2Uzzw97eZw7g6Z3e/view'
id = link.split("/")[-2]
downloaded = drive.CreateFile({'id':id})
downloaded.GetContentFile('competencias-frases-random-indices.csv')
dbb=pd.read_csv('competencias-frases-random-indices.csv')

df=pd.concat([daa, dbb.reindex(daa.index)], axis=1)
print(df)
```

Figure 5: Importing datasets

The next step was to set up the training. This process consisted of 3 steps: 1) defining sub-dataframes, 2) configuring the training, and 3) running the training. First, the dataframe was shuffled and all sentences were made lower case. The SciKit library was used to select sub-dataframes. These dataframes were required for training, evaluating and testing the updated model. The percentage of sentences extracted from

the initial dataframe was as follows: 80% sentences for training, 20% for evaluation and another 20% for testing. The code in Figure 6 shows these steps.

```
p_train = 0.80 # Train percentage
p_eval = 0.20 # Evaluation percentage
p_test = 0.20 # Test percentage

df = df.sample(frac=1) # Mix dataset
df.tweet = df.tweet.apply(lambda x: x.lower()) # Lower case sentences

from sklearn.model_selection import train_test_split # Split dataframes
df_train, df_test = train_test_split(df, test_size = p_test)
df_train, df_eval = train_test_split(df_train, test_size = p_eval)
print("Examples used to train: ", len(df_train))
print("Examples used for evaluation: ", len(df_eval))
print("Examples used for test: ", len(df_test))
```

Figure 6: Defining sub-dataframes

The next step was to configure the training. This involved reloading the initial pre-trained model, defining the basic training arguments, creating the sub-dataframes according to the previous step, and defining a function to compute the training metrics. To create this function, the Datasets library was installed. This resource, also from Hugging Face Inc, serves a dual purpose. It allows data to be loaded and pre-processed with a single command line. Furthermore, this pre-processing is efficient, simple, fast and reproducible for all public datasets and machine learning models available in the [HuggingFace Datasets Hub](https://huggingface.co/datasets) . Once these steps were completed, the data was loaded into the training configuration, as shown in Figure 7.

```
# Loading the pretrained model
bert_class_model_pytorch = AutoModelForSequenceClassification.from_pretrained(path_bert_model, num_labels = NUM_LABELS)
# Basic training arguments definition
from transformers import TrainingArguments
batch_train_size = 8
batch_val_size = 64
training_args = TrainingArguments(
    output_dir = './results',
    logging_dir = './logs',
    #The batch size per GPU/TPU core/CPU for training
    per_device_train_batch_size = batch_train_size,
    #The batch size per GPU/TPU core/CPU for evaluation
    per_device_eval_batch_size = batch_val_size
)
```

```

# Dataset generation
tokenized_train_dataset=tokenizer(df_train.tweet.tolist(),truncation=True,padding=True)
tokenized_eval_dataset=tokenizer(df_eval.tweet.tolist(),truncation=True,padding=True)
tokenized_test_dataset=tokenizer(df_test.tweet.tolist(),truncation=True,padding=True)

# Defining Torch Dataset functions
import torch
class TGINEDataset(torch.utils.data.Dataset):
    def __init__(self, encodings, labels):
        self.encodings = encodings
        self.labels = labels
    def __getitem__(self, idx):
        item = {key: torch.tensor(val[idx]) for key, val in self.encodings.items()}
        item['labels'] = torch.tensor(self.labels[idx])
        return item
    def __len__(self):
        return len(self.labels)

# Label indicating whether each sentence in the sub-dataframes is a competence or not
train_dataset = TGINEDataset(tokenized_train_dataset, df_train._label.tolist())
eval_dataset = TGINEDataset(tokenized_eval_dataset, df_eval._label.tolist())
test_dataset = TGINEDataset(tokenized_test_dataset, df_test._label.tolist())

# Generating compute_metrics function
!pip3 install -U datasets
from datasets import load_metric
metric = load_metric("accuracy")
import numpy as np

def compute_metrics(eval_pred):
    logits, labels = eval_pred
    predictions = np.argmax(logits, axis=-1)
    return metric.compute(predictions=predictions, references=labels)

# Training configuration
from transformers import Trainer
trainer = Trainer (
    model = bert_class_model_pytorch,
    args = training_args,
    train_dataset = train_dataset,
    eval_dataset = eval_dataset,
    compute_metrics = compute_metrics,
)

```

Figure 7: Training configuration

Finally, the training was carried out. The GPU resource was additionally activated, together with CPU and RAM resources, in the Google Colab notebook while running the code to speed up the fine-tuning. In total, it took 30 minutes to complete the entire task. The code is depicted in Figure 8.

```

# Running training for fine-tuning
trainer.train()

# Running evaluation on the re-trained model
from json import dumps
print("Predictions on evaluation")
bert_class_model_pytorch.eval()
print(dumps(trainer.evaluate(), indent = 2))

# Saving retrained model
modelo = 'modeloReentrenadoPytorch'
bert_class_model_pytorch.save_pretrained(modelo)
tokenizer.save_pretrained(modelo)

# Testing the re-trained model
print ("Predictions on test")
predictions = trainer.predict(test_dataset)
print(dumps(predictions.metrics, indent = 2))

```

Figure 8: Training performance

Fine-tuning consisted of adjusting the weights of the model during training and performing an additional evaluation to verify the aforementioned adjustment. The evaluation yielded an accuracy of 99.44%. After both retraining steps, the resulting model was saved for future use. In the fine tuning, a new test was carried out with the remaining sentences of the initial dataframe in order to evaluate the improvement generated by the aforementioned evaluation, and the accuracy increased to 99.60%.

With the sentences of the variable *textos* in Figure 4, a new classification test was carried out between sentences that are technological competences and those that are not. In this test, the same lines of code from Figure 4 were used, but first the model to be loaded was modified in the lines of code from Figure 3 and the newly generated model was loaded. As a result, the categorisation shown in Figure 9 is correct and no errors were generated. This test was repeated with competences taken from a job advert consisting of around 50 technology competences. Again, the results were as expected, successfully flagging the sentences that were competences and separating them from the new sentences randomly generated online.

Output:

```

Nancy was proud that she ran a tight shipwreck => LABEL_0
She used her own hair in the soup to give it more flavor => LABEL_0
Boulders lined the side of the road foretelling what could come next => LABEL_0
Develop and help maintain the firm's intranet webpage and custom web applications
utilizing HTML, PHP and other programming languages => LABEL_1
Participate in the planning, implementation and testing phases of application and
database installations and upgrades => LABEL_1
Bachelor's Degree in computer science, information systems or other related field
preferred => LABEL_1
The doll spun around in circles in hopes of coming alive => LABEL_0

```

Figure 9: Output with the re-trained model

3.4 CONCLUSION

Some comments can be made about the work. The simplicity of Python, which has libraries for implementing NLP, made it easy to produce the code quickly. In addition, the existence of extensive documentation on the Internet made it possible to quickly obtain a proof of concept demonstrating the usefulness of the code. It is considered that the work carried out could be extended for its use in the eMediator demo portal, with the aim of facilitating the handling of the competence catalogue for its reuse. A possible extension of the work would be to train the system not only to identify what is a competence and what is not, but also to classify the type of competence according to its skills, knowledge and other attributes in the competence model. In this way, the model could be self-completing if textual descriptions of competences are already available in a given information system. However, the computational cost of using NLP could be a limitation. This was demonstrated by the need to activate the GPU to speed up the processing. Without this resource, training and testing would have taken much longer and could have become impractical.

It is worth noting that the very high percentages of accuracy obtained in the detection of competences lead us to consider that the effectiveness of the NLP is undeniable, extending the applicability of the model, which was the main objective of this work. It will be necessary to analyse the trade-off between the hardware requirements and the efficiency of the NLP system for its use in the eMediator demo portal.

Moreover, the use of text string management commands used to download the competences from web portals could have been replaced by the use of NLP. The possibility of developing an algorithm to detect competences directly from the HTML code of web portals is being considered. This would make it possible to collect huge amounts of competences for subsequent analysis using big data techniques. This is another avenue for future work that will be explored to make the competence model more interesting.

Another application of NLP could be to search for competences within an existing model. Using these techniques would allow us to study the similarities and group them. Having categories of competences organised by themes would make it easier to find them between sets/catalogues of competences.

Finally, and the most ambitious of all future work, is the possibility of using NLP to study the similarities between the competences in a particular degree and a job offer, in order to know how well a student will be able to cover a job on the basis of the competences acquired. As described in the text, the use of NLP in recruitment processes is already a reality, but it is still in its infancy. The idea of carrying out studies that would make it possible to know the percentage of coverage has already been proposed in a previous deliverable, and this is an idea that gains in importance after the results obtained in the present work. It is therefore not excluded that this work will be resumed in the future.

REFERENCES

- Allal-Chérif, Oihab, Alba Yela Aránega, and Rafael Castaño Sánchez. 2021. "Intelligent Recruitment: How to Identify, Select, and Retain Talents from around the World Using Artificial Intelligence." *Technological Forecasting and Social Change* 169: 120822.
- Cao, Nguyet Thi Khanh. 2022. "Determinants of International Students' Decision to Remain in Japan to Work after Graduation." *Journal of Asian Economics* 82: 101529.

- CEN. 2013. "InLOC - Part 1: Information Model for Learning Outcomes and Competences (CWA 16655-1)." : 1-48. <https://www.cetis.org.uk/inloc/Home> (Accessed on April 9, 2022).
- Choi, Daeheon, Chune Young Chung, Mira Yoon, and Jason Young. 2020. "Factors in a Sustainable Labor Market: Evidence from New College Graduates' Initial Job Placement in Korea." *Sustainability* 12(6): 2386.
- Delecraz, Sebastien et al. 2022. "Responsible Artificial Intelligence in Human Resources Technology: An Innovative Inclusive and Fair by Design Matching Algorithm for Job Recruitment Purposes." *Journal of Responsible Technology* 11: 100041.
- Van Esch, Patrick, J Stewart Black, and Joseph Ferolie. 2019. "Marketing AI Recruitment: The next Phase in Job Application and Selection." *Computers in Human Behavior* 90: 215-22.
- Evans, Jo et al. 2020. "The Future in Their Hands: Graduating Student Midwives' Plans, Job Satisfaction and the Desire to Work in Midwifery Continuity of Care." *Women and Birth* 33(1): e59-66.
- IEEE. 2008. "IEEE 1484.20.1-2007, IEEE Standard for Learning Technology—Data Model for Reusable Competency Definitions." : 1-36.
- Kirchmayer, Zuzana, and Jana Fratričová. 2020. "What Motivates Generation Z at Work? Insights into Motivation Drivers of Business Students in Slovakia." *Proceedings of the Innovation management and education excellence through vision* 6019: 6030.
- Ledbetter, Donte. 2021. *Just Make It Work: An Honest Guide to Navigating the First Decade of Your Career*. Donte Ledbetter.
- Li, Junlong, Zhuosheng Zhang, and Hai Zhao. 2020. "Dialogue-Adaptive Language Model Pre-Training From Quality Estimation." *arXiv preprint arXiv:2009.04984*.
- Shah, Deven, H Andrew Schwartz, and Dirk Hovy. 2019. "Predictive Biases in Natural Language Processing Models: A Conceptual Framework and Overview." *arXiv preprint arXiv:1912.11078*.
- Suzuki, Jun, Heiga Zen, and Hideto Kazawa. 2023. "Extracting Representative Subset from Extensive Text Data for Training Pre-Trained Language Models." *Information Processing & Management* 60(3): 103249.

LIST OF AUTHORS

1. José Alberto García Berná
2. Begoña Moros Valle
3. Joaquín Nicolás Ros
4. Juan Manuel Carrillo de Gea

4. A5.4. Design of the user-client application (UoI)

This section presents the innovative IT technologies (e.g., blockchain, cloud, big data, artificial intelligence) that support User Client application. These technologies will be developed for the portal in order to implement pedagogical and organizational tasks. Furthermore, the UX/UI is described, including each aspect of the portal and its function, along with the relevant mock-ups.

4.1 TECHNOLOGIES FOR USER CLIENT APPLICATION

4.1.1 TECHNOLOGIES FOR USER EXPERIENCE

The interaction between a user and a product is widely referred to as user experience (UX) design. It emphasizes enhancing accessibility and usability while making sure users have a positive and satisfying experience. A pleased user is the ultimate objective, since they naturally support the goals and objectives of the site owner. As a result of the completely new interactive environment, UX design is one of the most dynamic design fields. UX and UI designers must address issues and opportunities that did not previously exist, such as the creation of innovative interactions and relationships. In addition, technology advances are driven by user experience (UX), whereas any change in technology has an effect on UX (Centric Digital 2021). In order to achieve a satisfying user experience in eMEDIATOR portal, a series of technologies can be used, emphasizing in Machine Learning and Artificial Intelligence. Machine Learning aims to reduce the amount of work users must make in order to navigate through the portal, and to provide a smoother user experience. Smart automation works to automate a high level of customization by observing users' preferences and behaviors. This can be achieved through the search engine, as described in Internal Report 3, Section 5.5. According to a search, users' data can be used, after their permission, in order to design a better user experience. In addition, data can be gathered from users' profiles in order to improve their experience and provide them targeted information that matches their profile.

4.1.2 TECHNOLOGIES FOR USER INTERFACE

The point of human-computer contacts and communication in a device is the user interface, or UI. These can include desktop displays, keyboards, a mouse, and other pointing devices. It also refers to the manner in which a user engages with a website or application. For example, a set of screens, pages and visual elements (buttons, icons, etc.) that one uses to interact with a device are what is called user interface. UI is a building block of UX and is housed under the large umbrella of User Experience along with Visual Design, Information Architecture, Interaction Design, Usability, User Research and Content Strategy (Zegkinoglou 2023).

UX design focuses on the user experience with a product, while UI design is more concerned with the look and feel of the product. In eMEDIATOR portal, the best approach would be to focus on UX before continuing with UI design. Research and testing are important procedures that need to be completed in order to provide the best user experience, and then proceed with the appearance and the creative aspect of the portal.

In order to provide a better understanding of eMEDIATOR's UI, mock-ups were created depicting the different user interactions. According to the user's role, the functionalities of the portal are different, as well as the UI. The tool that was used is "Moqups", which is a visual collaboration program with many tools like whiteboards, design features, and diagrams. It offers a lot of capabilities for planning, collaborating, communicating and enhancing work management. "Moqups" is a platform with a variety of wireframing tools.

4.2 REQUIREMENTS FOR USER INTERFACE

According to Internal Report 2, Section 6.2.3, the key elements of the portal are:

- Friendly User Interface
- Security
- User profile
- Taxonomy and dynamic navigation
- Application integration
- Database repository
- Cross platform Support
- Search engine

The user interface of the portal should be friendly and enhanced in order to make the portal and the user experience as successful as possible, using the right algorithms and technologies.

As far as security is concerned, there are two levels of security on the eMEDIATOR site, along with the use of cookies, secure sockets layer encryption, and authentication processes. First of all, there is support for anonymous users from the general public. Furthermore, authenticating portal users constitutes the second level of security, where users can see a portion of the data and get a basic understanding of the platform without creating an account. The site's material is entirely accessible to registered users. Moreover, in order to accomplish all the security matters, the portal should support the Credential Authentication System (CAS) for the defined roles of users. The credentials are different depending on the user (simple user, teacher, employer).

The user profile is essential for the portal and for the development of a successful user experience, since it will be one of the main sources of data, along with the search engine, for the application of machine learning algorithms. According to Internal Report 3, Section 6.1., the user profile, and the user account generally, will include information based on the different users working with the portal (simple user, teacher, employer). This information includes personal information of the user (name, email, job title, birthday, etc.), as well as information about the organization that a user might belong to, memberships, roles, and apps. Users will have a username and a password for authentication, which they can change anytime, along with other profile information. These aspects will be supported by the CAS mentioned above in order to enhance the security of the portal.

Taxonomy and dynamic navigation will make the search and navigation of the user easier. These are attributes of the search engine, as they contribute to the classification system of the portal, which will work based on technologies like Machine Learning and Artificial Intelligence.

The portal should also be able to integrate with other applications, especially with the larger portal framework. This integration needs to be invisible to end users, as far as user experience is concerned. Application integration is essential, especially when data from various sources must frequently be combined by users.

Another key element of the portal is the database repository, which should be able to contain structured data if required, such as inventory management systems. In addition, they should contain the content management system's updated information, the content management system's control over certain documents, individuals' profiles and metadata, such as the connections between the tables and their structure.

The portal should have a cross platform support, meaning that the users should be able to access it through tablets, smartphones or computers. Thus, the portal needs to be responsive.

The last key element is the search engine. Taking into consideration the different information and elements of the portal, as well as the various roles that it supports, a search engine is crucial. Furthermore, in order to make the search engine successful and provide the most accurate results according to the user, machine learning techniques will be used, so that each result and each proposal is targeted to the user.

4.3 USER INTERACTIONS VIA USER APPLICATION

The roles that are available to registered users of the portal are simple user (student), teacher and employer. Through eMEDIATOR digital portal, the individual can access two platforms: the BookAScience platform and the LMS platform. The user will be able to access the courses that the teachers developed for this project in the LMS platform. Users will be able to locate jobs on the BookAScience platform based on job positions established by employers.

According to Internal Report 2, Section 6.2.4, the activities that users can carry out in the portal are registration, creation of user profile, job position creation, job position find, course creation, and course searching. In addition, according to Internal Report 2, Section 7.2, the services that the platform provides, depending on the user's role are:

- **Services for academic or other institutions:** Recruiting Service, Curriculum Creation Service and Research Project Management Service
- **Services for students:** Profile Management Service, Document Management Service, Communication Service, Wiki-Service
- **Combined Services:** Learning Service, Forum Service, Rating Service, Exam Service.

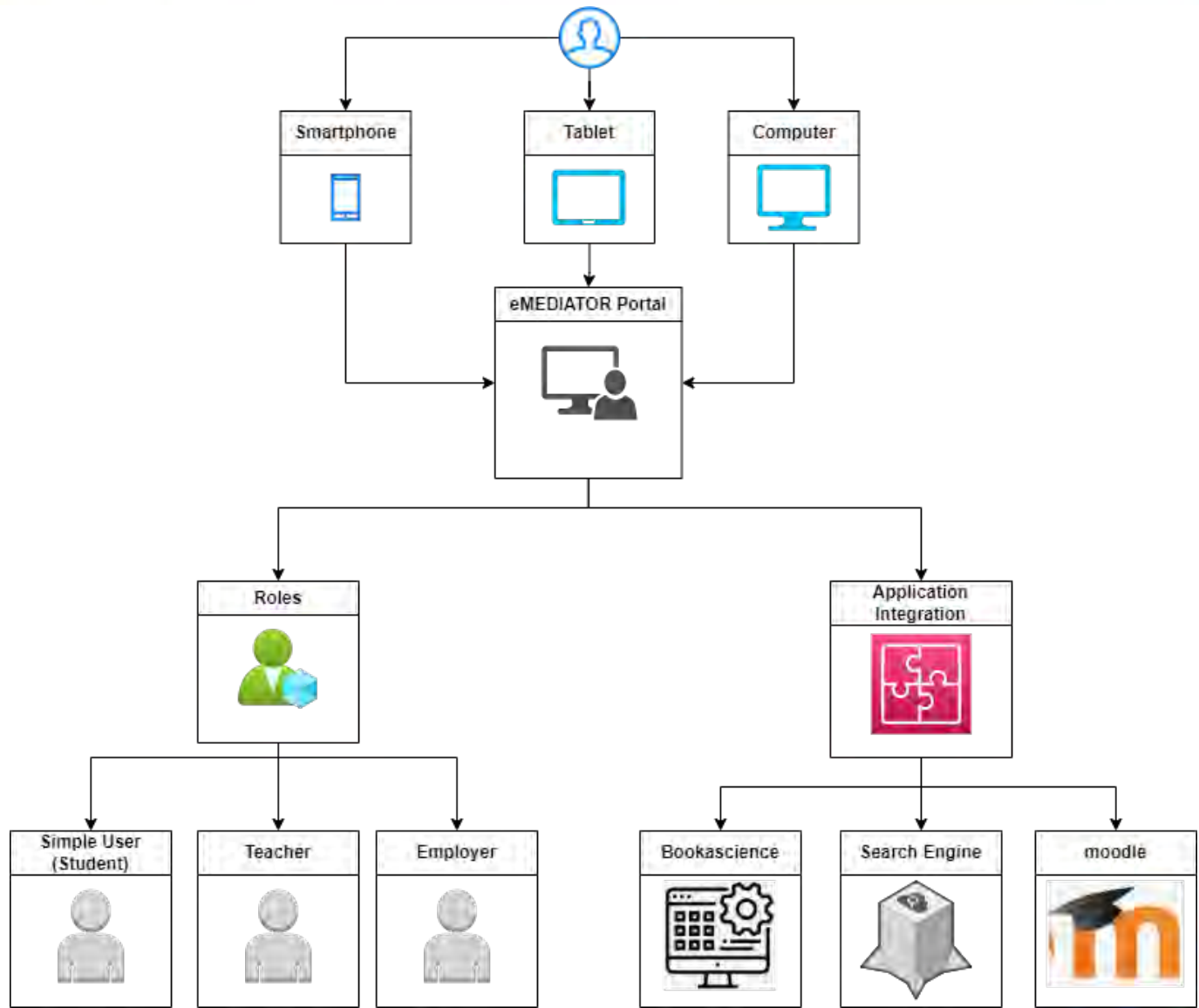


Figure 1: Portal architecture

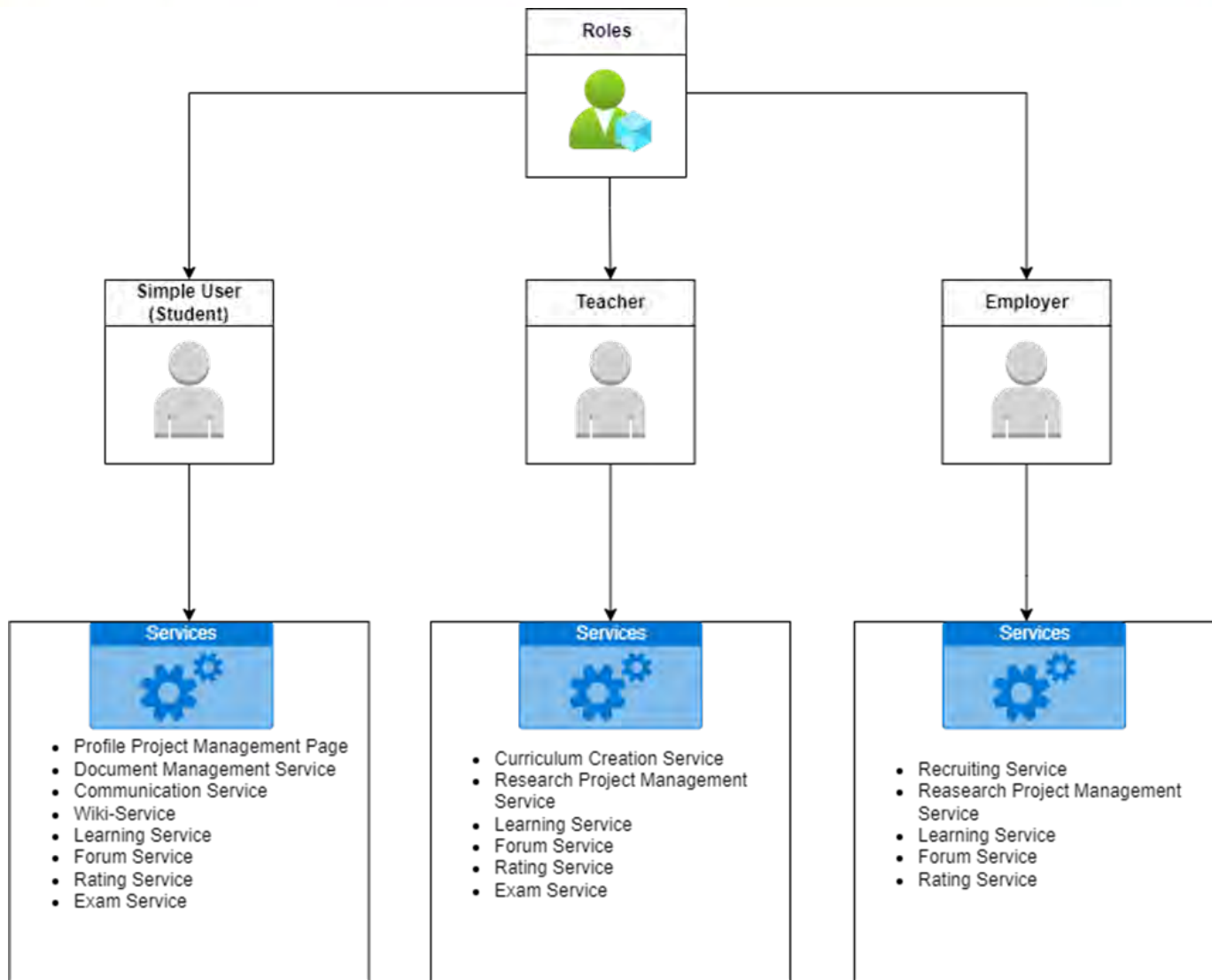



Figure 2: Portal roles

Everyone who visits the portal will be able to register. Simple users, who can look for jobs on the platform, include professional and research organizations. Employers who submit jobs are the clients. Before moving on, newly registered users need to finish their profile page. This will enable prospective employers to learn about their qualifications and history before employing them.



User Profile

Personal Information	Additional Information
<p>Username</p> <input type="text"/>	<p>Job Title</p> <input type="text"/>
<p>Email Address</p> <input type="text"/>	<p>Company Name</p> <input type="text"/>
<p>First Name</p> <input type="text"/>	<p>Organization Name</p> <input type="text"/>
<p>Last Name</p> <input type="text"/>	
<p>Birthday</p> <input type="text"/>	
<p>Add Image</p> 	

[SIGN UP](#)

Figure 3: User profile mock-up

Depending on their needs, employers will have the ability to establish a variety of job positions. There are particular fields that must be filled out for each job role. The information needed to create a task is displayed in the following mock-up.



Create Job Position**General Information**

Title

Job Privacy

Public Description

Description

Location

Languages

Project Type

Budget

Specialization

Additional Information

Science Categories

Experiences

Skills

Period

Intellectual Property

Delivery Acceptance Criteria

Select NDA Penalty Options

PUBLISH**Figure 4: Create job position mock-up**

The registered user will be able to examine open positions according to their area of specialization. Furthermore, they will be able to submit an application for the job if they discover something that appeals to them.

Job Description

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nulla quam velit, vulputate eu pharetra nec, mattis ac neque. Duis vulputate commodo lectus, ac blandit elit tincidunt id.

[APPLY](#)

Application Form

Message

Budget

Duration

Location

Intellectual Property

Delivery Acceptance Criteria

[APPLY](#)

Figure 5: Job position find mock-up

New courses can be made by users who have the teacher position. The accompanying mock-up shows the procedures needed to create the course.

Course creation

Create Curriculum

Enter Key Competency

Curriculum Description

ILOs Description

UPLOAD DIGITAL MATERIALS

Figure 6: Course creation mock-up

The ability to search for and enroll in courses will be available to registered users who want to learn new skills. The steps that users can take to look for and sign up for a course are shown in the accompanying mock-up.

Course Description

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Nulla quam velit, vulputate eu pharetra nec, mattis ac neque. Duis vulputate commodo lectus, ac blandit elit tincidunt id.

ENROLL

Figure 7: Search for a course mock-up

4.4 EMEDIATOR WEBSITE

eMEDIATOR Website, apart from supporting the roles and functionalities described above, has additional features that all users have access to. First of all, everyone who visits the portal will be able to create an account. The steps necessary to complete the process include entering the user's required information, like username, email, first and last name, password, etc. Some of this information is necessary for the completion of the search engine and the development of machine learning algorithms.

Another attribute of the website is the ability to search material through the search bar, which is available in all screens of the website.

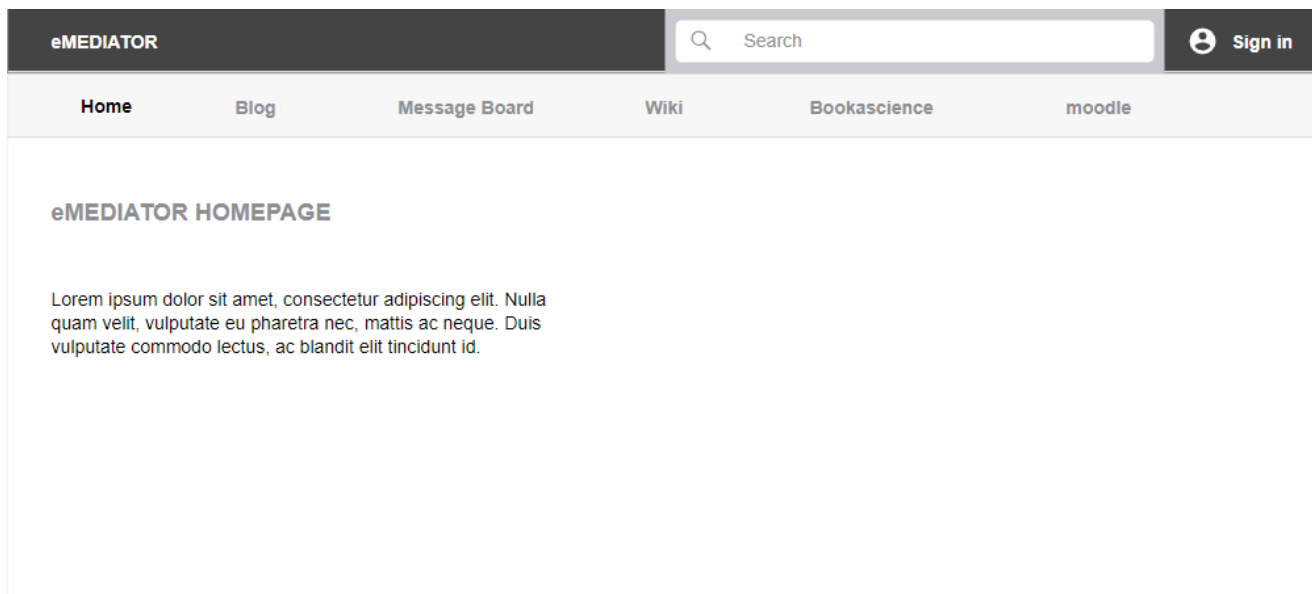


Figure 8: Website mock-up

One of the available screens of the website is the Blog screen which contains news and essential information. Users can read posts of other users, as well as leave comments on a post.

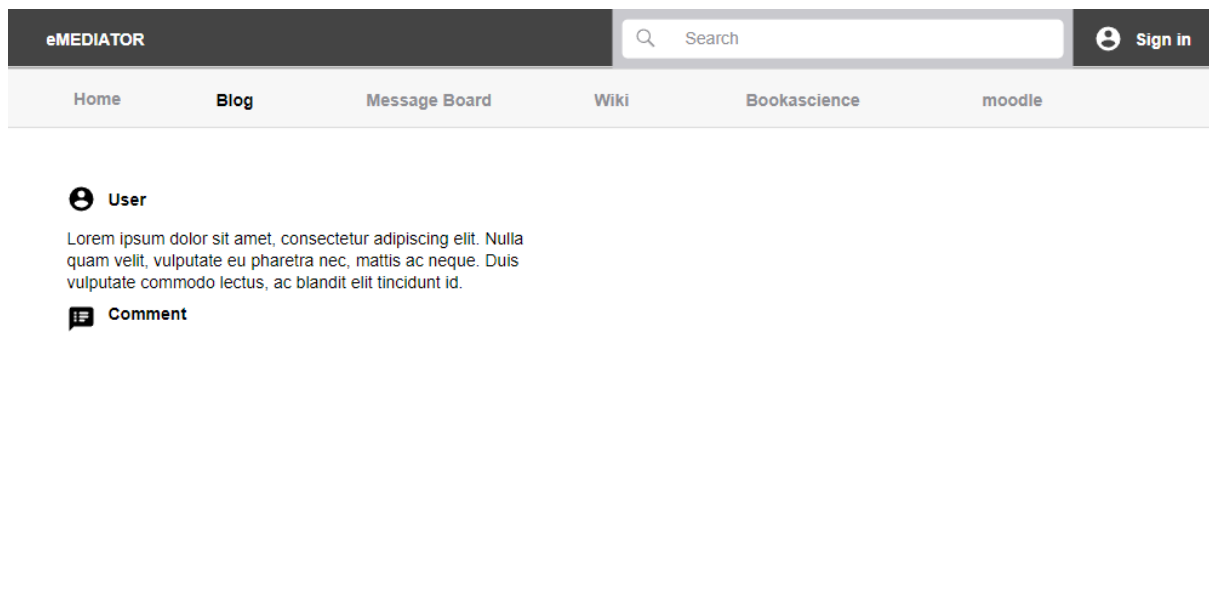


Figure 9: Blog mock-up

Another screen is the Message Board where users can communicate and create threads in order to discuss various topics. In addition, this screen contains three tabs concerning the categories of the threads, the recent posts and some statistics concerning the number of categories, posts and participants, as well as the top posters.

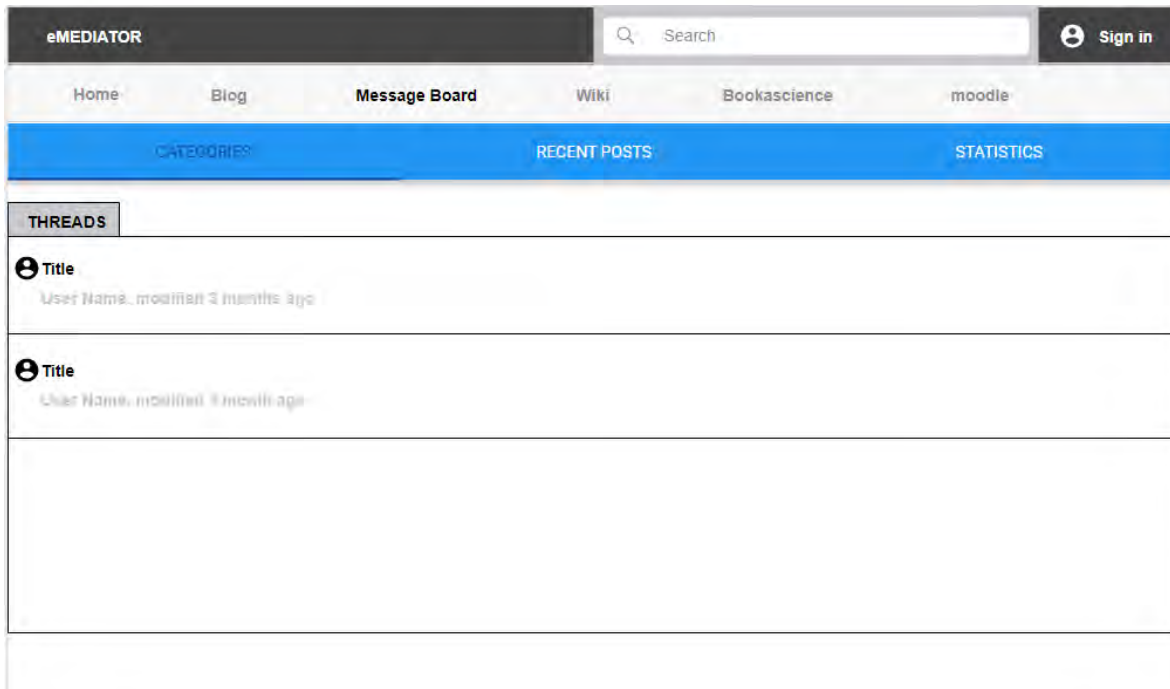


Figure 10: Message Board mock-up – Categories

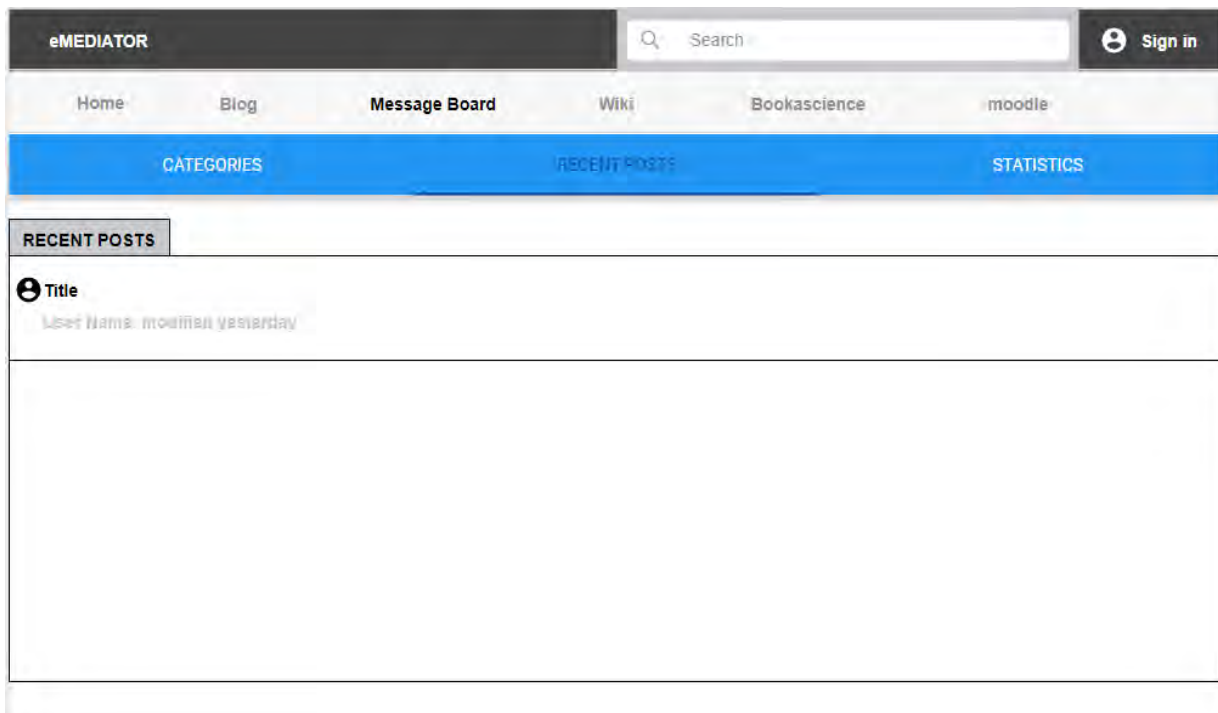


Figure 11: Message Board mock-up – Recent Posts

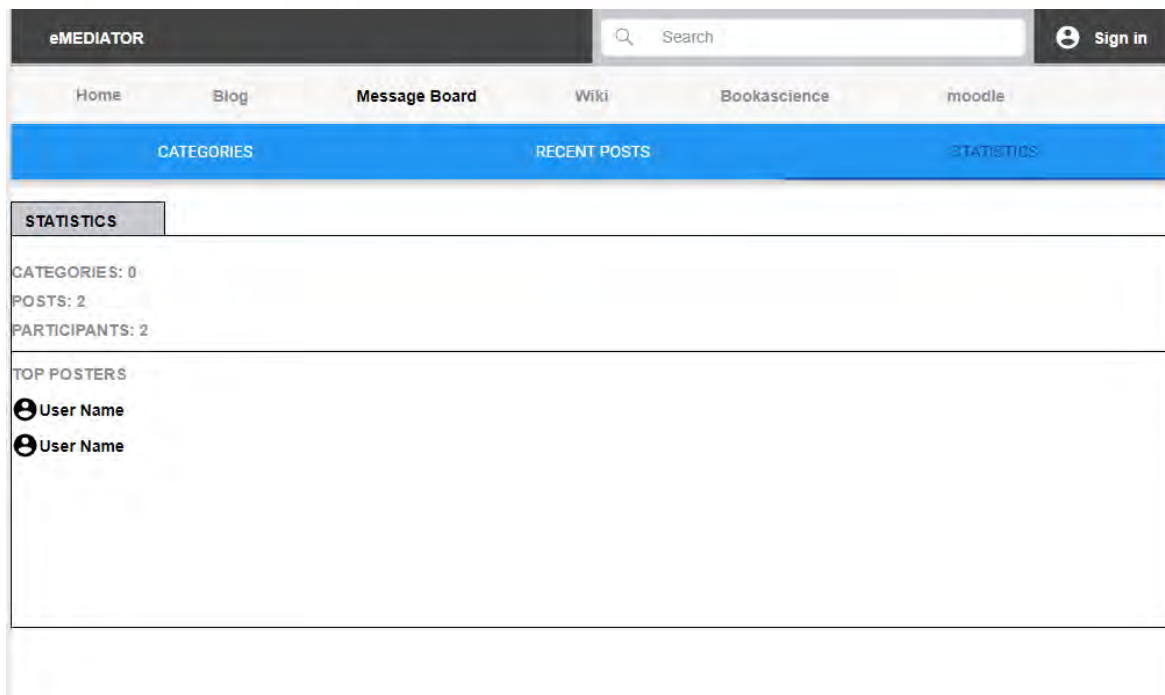


Figure 12: Message Board mock-up – Statistics

The eMEDIATOR website has been designed in order to support a Wiki-System. Users are able to create and collaboratively manage and edit pages or entries. Depending on their different role on the portal, users will be able to work with the system and manage its content.

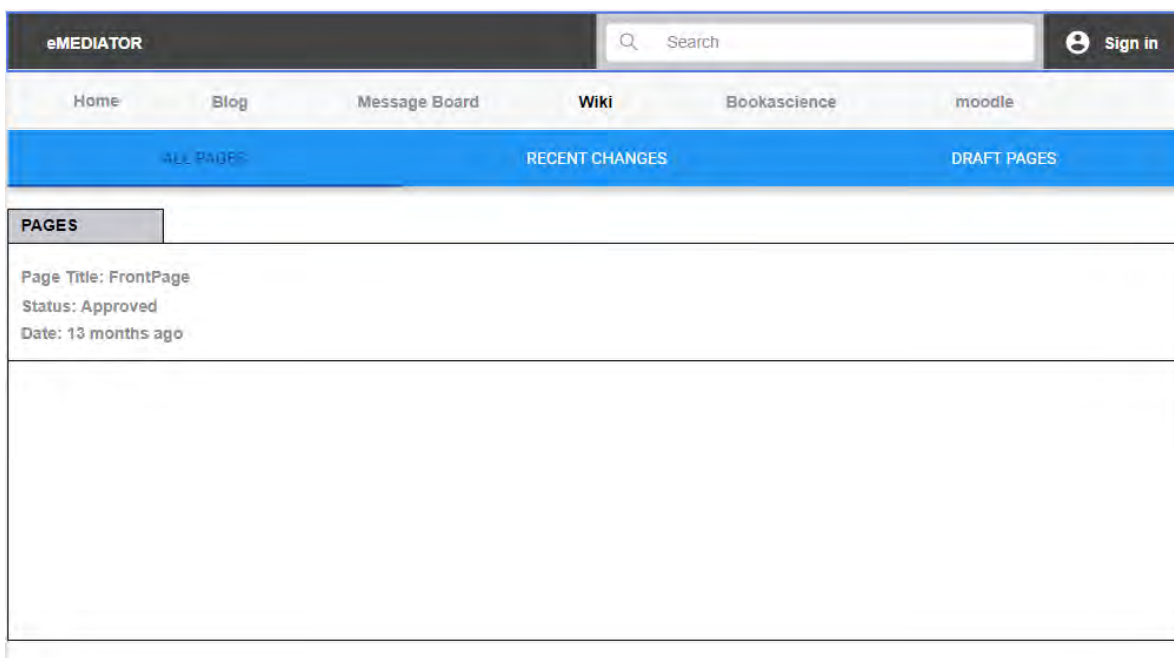


Figure 13: Wiki mock-up – All pages

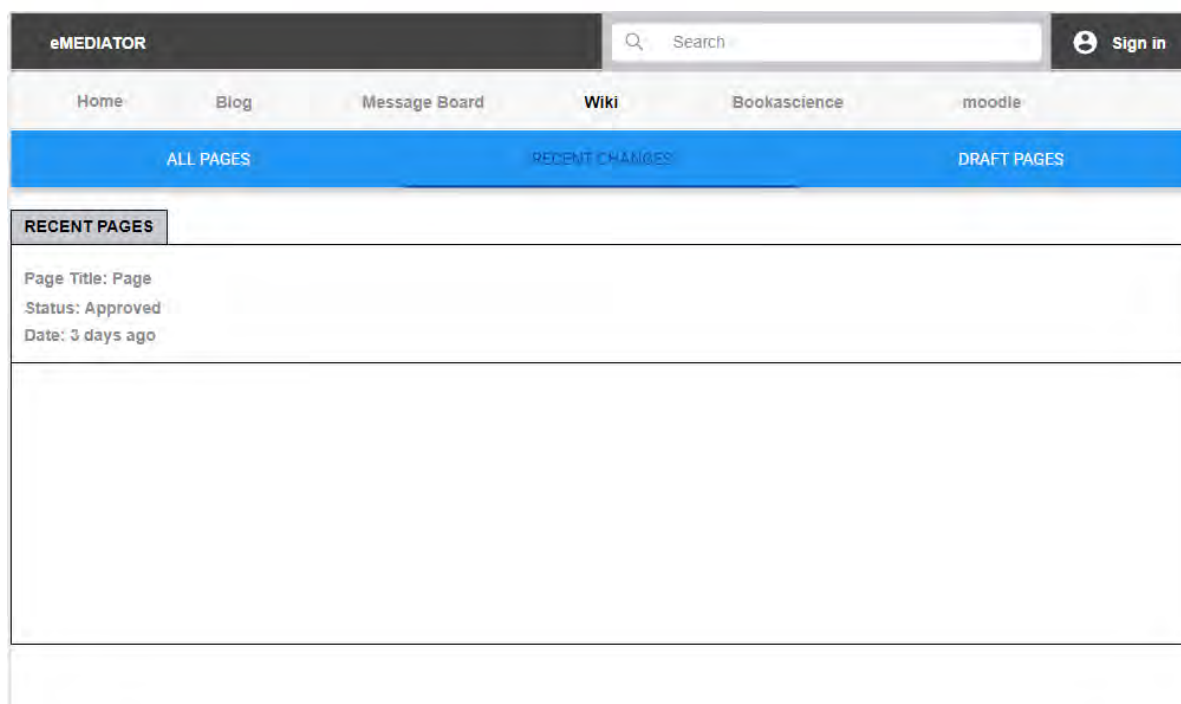


Figure 14: Wiki mock-up – Recent Pages

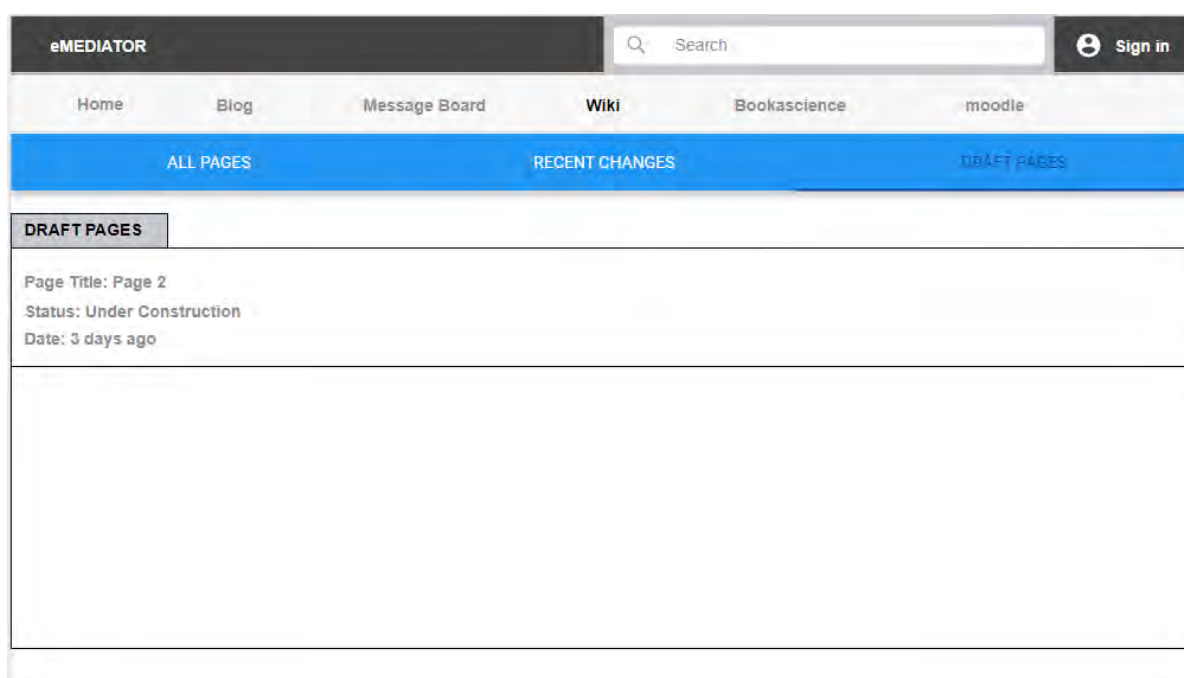


Figure 15: Wiki mock-up – Draft Pages

Furthermore, the portal offers access to Bookascience site where users, depending on their role, can either look for a job in the field that they are interested in, or look for a research activity. In addition, users can create a professional profile so that they can be reached by employers.

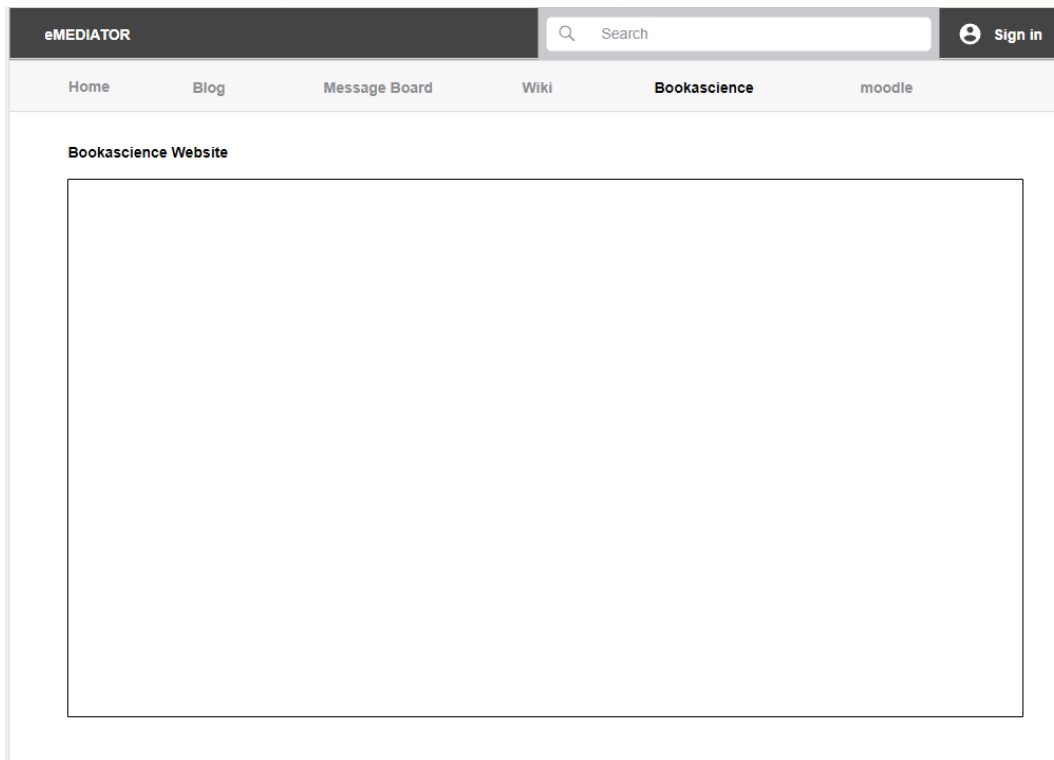


Figure 16: Bookascience mock-up

Finally, through the eMEDIATOR website, users also have access to the Moodle, where they can search for courses, or create them and manage them, according to their role.

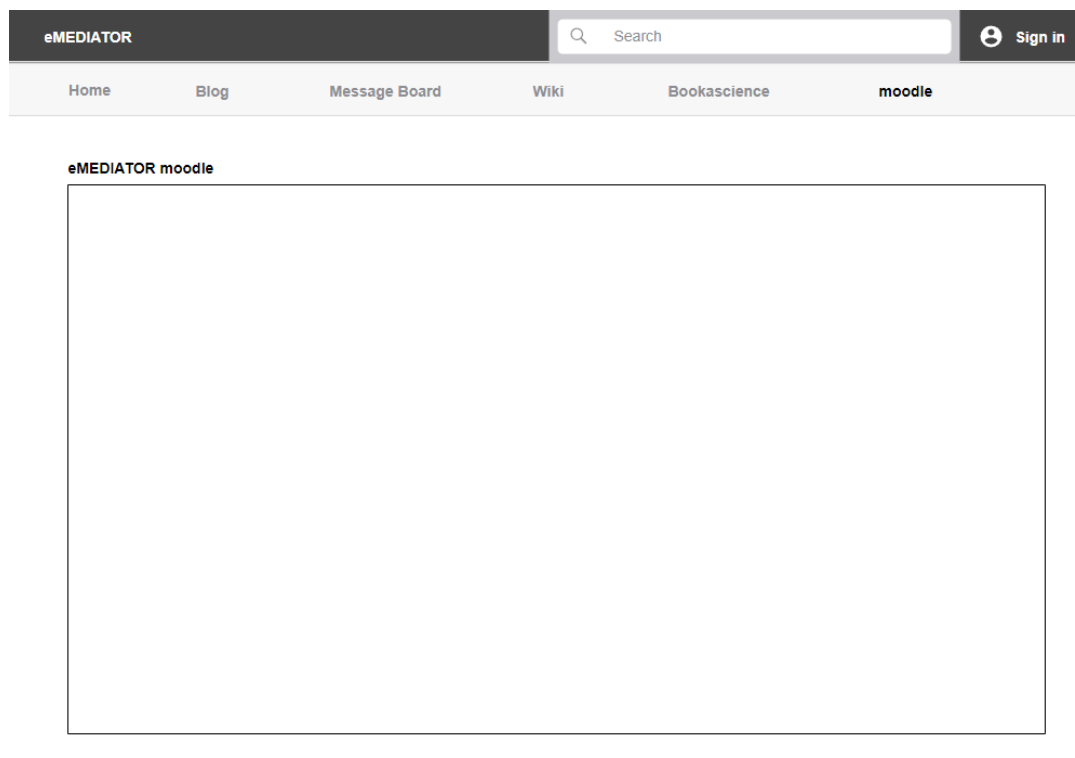


Figure 17: Moodle mock-up

REFERENCES

- Centric Digital. 2021. "What Is User Experience?" <https://www.centricdigital.com/blog/what-is-user-experience>.
- Zegkinoglou, Tereza. 2023. "What Are the Differences between UX Design and UI Design." <https://blog.wedia.gr/webdesign/poies-oi-diafores-metaxi-ux-kai-ui>.

LIST OF AUTHORS

1. Vasia Liagkou
2. Katerina Florou

5. A6.4 Mock-up integrations in the Alpha Portal Demo (AU)

This section covers the activities of Aalen University according to the implementation of the emediator Demo Portal Mock-Up Integrations.

5.1 MOODLE INTEGRATION

The first activity of this period was to implement a usable form of Moodle in the current demo application. Moodle is the OpenSource Learning Platform technology which provides intense capabilities to execute learning activities as well as online-courses. Furthermore, it covers as well functions for learning module creation. The most important modules and functions used for eMEDIATOR portal will be:

1. Fully customizable learning platform
2. Easy accessibility from everywhere
3. Ability to create or import competence frameworks
4. Safe and secure online spaces¹

Moodle has been setup on the eMEDIATOR server and it has been integrated into the portal via direct integration.

Users, registered on the eMEDIATOR demo portal can setup an own moodle account on the server and they will be able to access all basic functionalities of moodle out-of-the-box. Currently, the registration is done by the project team as the user management is not properly configured and linked to the eMEDIATOR user management yet. For setting up the moodle account, project participants should write an e-mail to christian.wilhelm@hs-aalen.de (Senior Software Engineer of eMEDIATOR) with the following information:

Mandatory information:

1. Username
2. First name
3. Surname
4. E-Mail Address

Optional Information:

- City/Town
- Country

¹ www.moodle.com

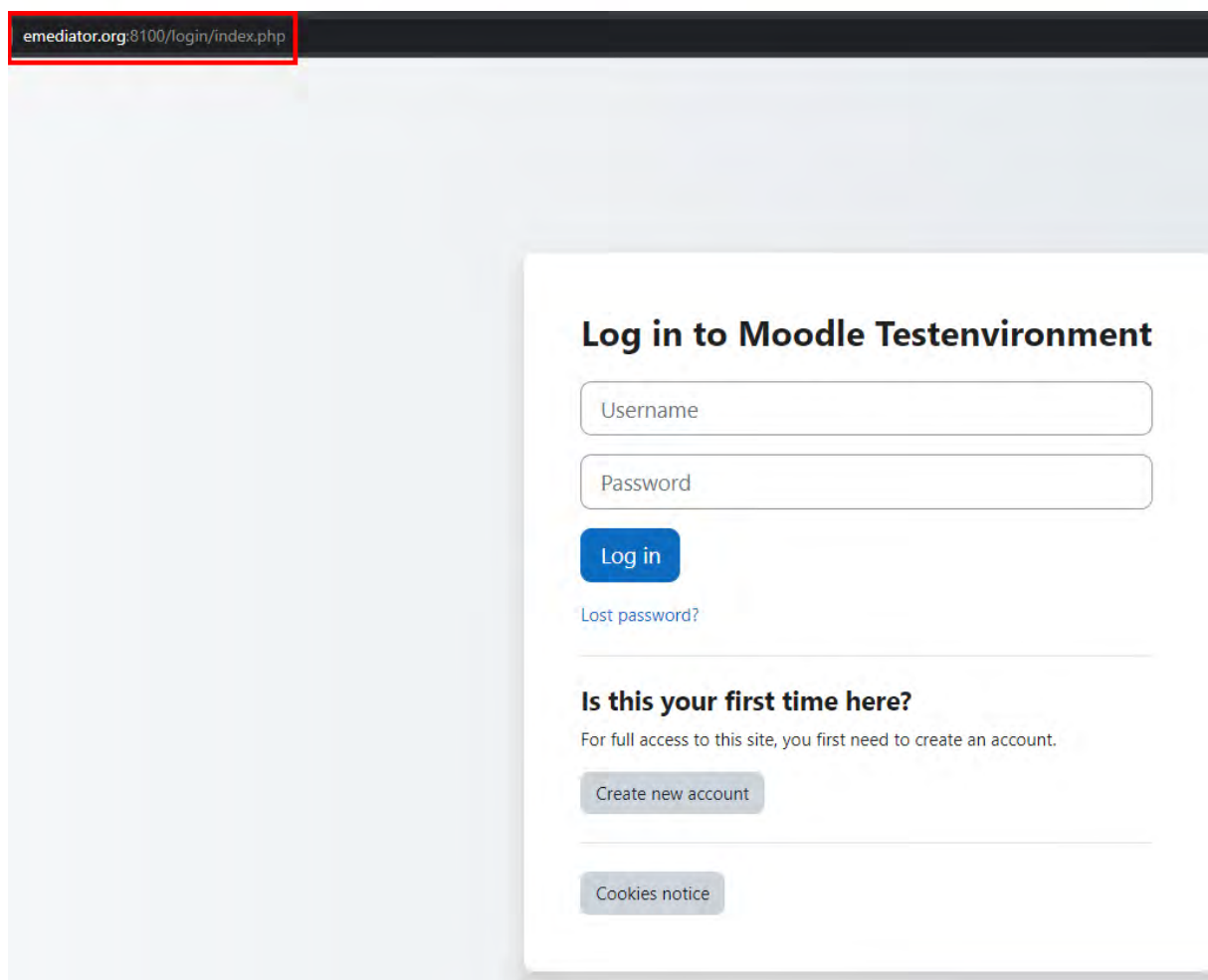


Figure 1: Moodle Test Environment Login Screenshot eMEDIATOR

As shown in the image above, moodle is fully linked to the existing eMEDIATOR portal demo application. Registered users can already work with moodle without any restrictions as integrated component of the eMEDIATOR demo portal.

5.2 TECHNICAL SETUP AND CURRENT ARCHITECTURE OF EMEDIATOR PORTAL WITH ALL MOCK-UPS/APPLICATIONS

Currently, there are three main system components connected within the demo application portal.

1. Liferay eMEDIATOR Core – Liferay sets the basis of the eMEDIATOR portal and comes with all its integration capabilities.
2. Moodle Learning Plattform – 1st service connecting university users and students on the eMEDIATOR platform including all required learning capabilities. Moodle is integrated into the portal via direct link. Currently, there is still no Single Sign On (SSO) implemented.
3. BookAScience – ThirdParty ready-to-use platform for research project and funding acquisition, project management and connection between science and economy (www.bookascience.com). BookAScience is integrated as iFrame and it is directly reachable via the eMEDIATOR platform.

Currently, the system setup is completely dockerized as containered application. Docker offers the possibility to easily setup the eMEDIATOR platform architecture on any environment supporting Docker applications.

The following image shows the current architecture:

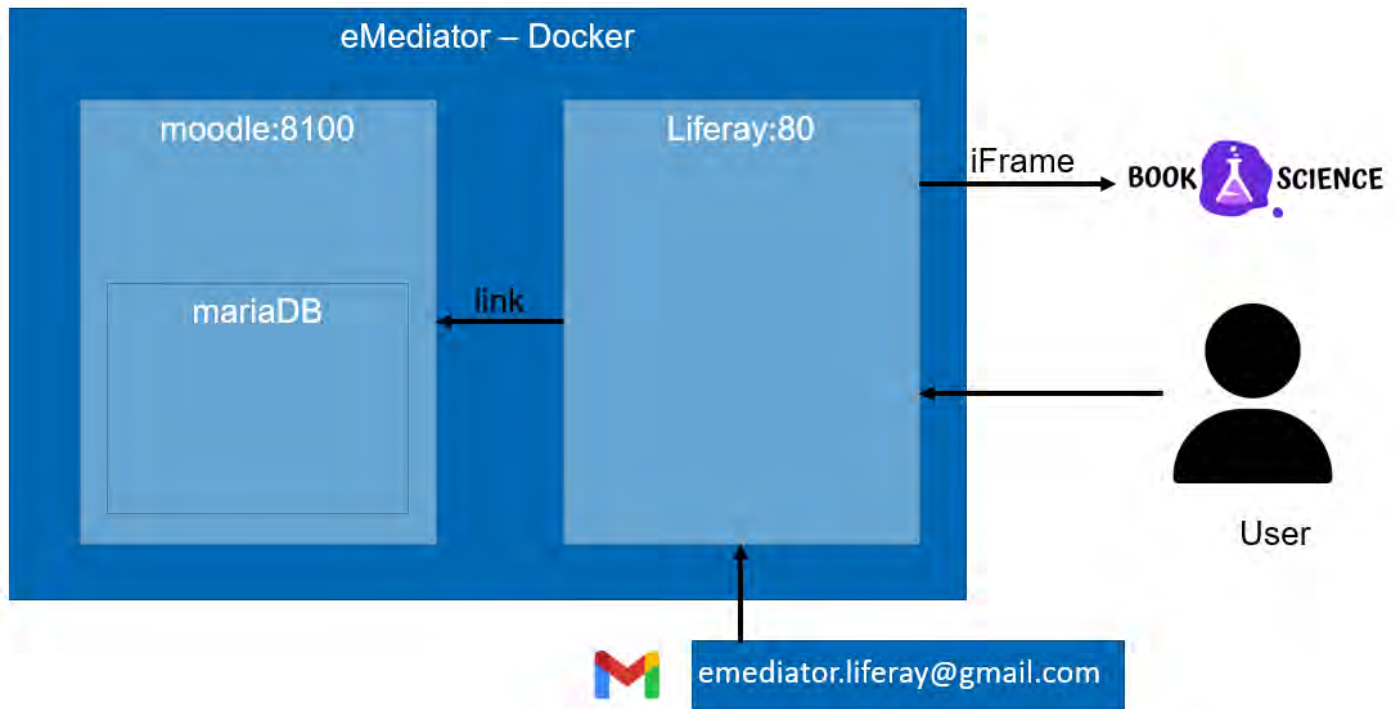


Figure 2: Current eMEDIATOR Architecture

5.3 SERVER ACCESS VIA PUBLIC DOMAIN

eMEDIATOR has been set up on the following domain: www.emediator.org

5.4 ROADMAP FOR FURTHER IMPLEMENTATION

This roadmap shows the current status of implementation and the further activities:

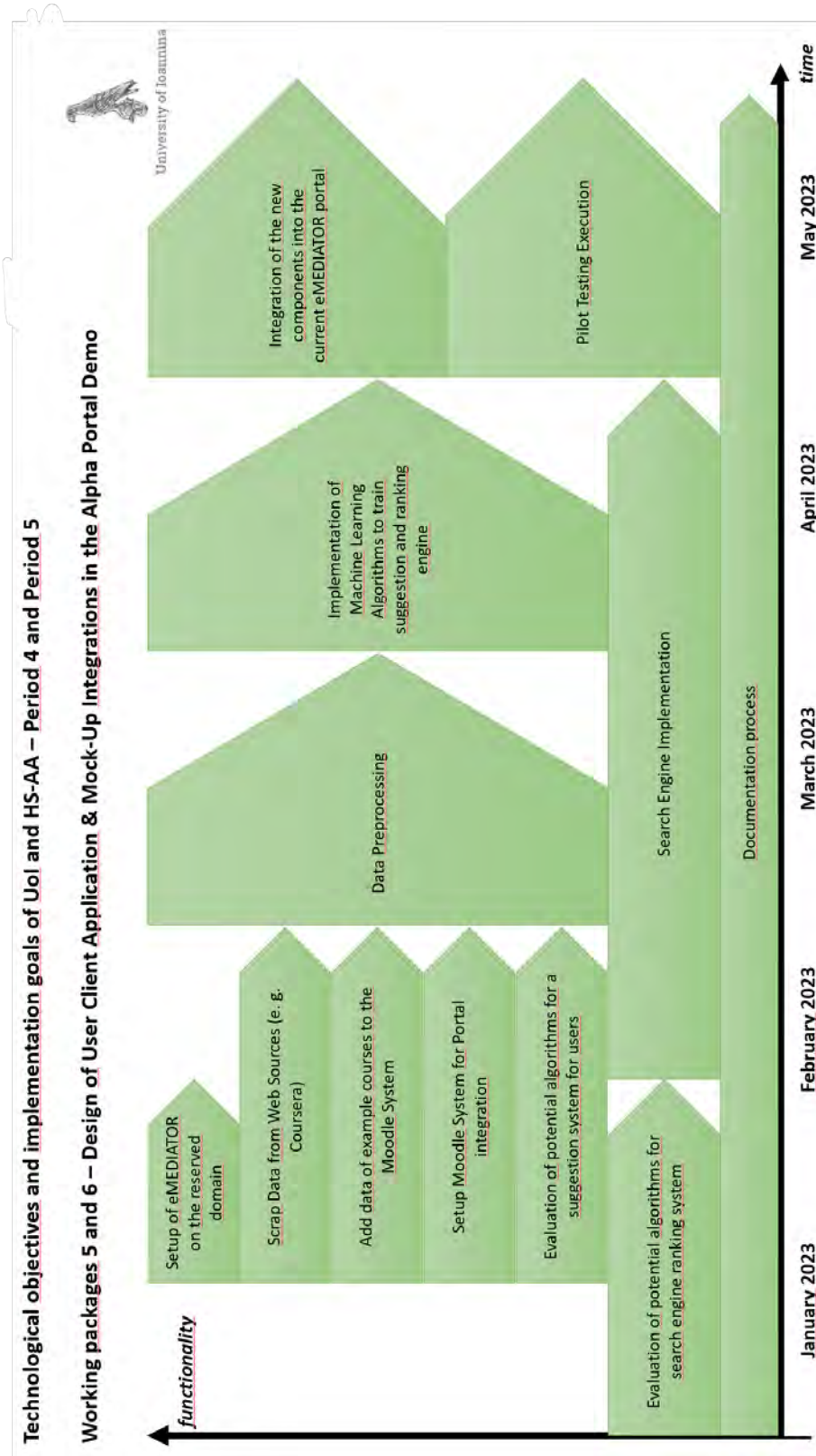


Figure 3: Ongoing tasks

LIST OF AUTHORS

1. Nicolas Dolle