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

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Abbreviations and Acronyms:			















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# 1. A2.1. Development of Service Delivery Model (TTI)

# **1.1 INTRODUCTION**

A service delivery model describes the service to be provided under the model.

As economic change has accelerated, the industry is increasingly demanding job-ready graduates rather than training them locally; expectations of graduates from employers are not justified. Many employers say they are primarily looking for things that universities don't directly teach, such as social skills, emotional intelligence, teamwork, communication, and time management.

The digital revolution is bringing new competition to education compared to classical universities, especially in the form of more accessible online education. At the same time, interest is growing in the mobility of educational services, which is designed to bridge the gap between businesses that require new competencies, the inertia of universities in providing them within the framework of classical programs, and the student's desire to instantly receive services to master new competencies.

The eMEDIATOR platform is one of the solutions to the above problem.

# **1.2 eMEDIATOR USE CASE DIAGRAM**

A use case diagram is a graphical depiction of a user's possible interactions with a system. A use case diagram shows various use cases and different types of users the system has. For the eMEDITOR model, the Use Case Diagram is shown in Fig.1.1.

Among the potential users of the platform, there are two categories of users - individual and corporate. Individual users of the platform include students who want to expand personal competencies outside the standard programs of their universities, as well as teachers who have an additional individual mobility resource to work outside their universities.

The main element of the platform is a search engine, which provides information for each of the potential users within the framework of the services provided. The services provided by the platform are defined by the Service Delivery Model described in the next section.







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# Figure 1.1. eMEDIATOR Use Case Diagram



# **1.3 SERVICE DELIVERY MODEL**

The service delivery model provides the framework within which users receive services. The arrangement or configuration of time, resources, location of services, and collaboration among all actors makes up the service delivery model selected that will best meet individual user needs.

The general structure of the eMEDIATOR platform services for all users is represented by taxonomy in Fig. 1.2.

Success in service delivery is usually measured from the customer's perspective—whether they are satisfied with the service received and the provider's efforts in delivering it.

Successful service delivery requires an understanding of the required competencies and the amount of required resources for each competence. The ITIL 4 CDS publication [1] informs us that the four dimensions of service management (organization & people, information & technology, partners &







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suppliers, value streams and processes) must be holistically considered, to identify the right resource needs in terms of amount as well as quality.

Fig. 1.2 shows a basic set of services that can be refined and detailed during platform development and testing of its capabilities.



# Figure 1.2. The general structure of eMEDIATOR services













# **Table 1. Description of services**

Users	Services	Brief description of services		
Individual students	List of potential mobility places based on student requests	Universities have dozens of partners in numerous student mobility programs. At the same time, for each student, if there is an individual request, it is quite difficult to determine the place of potential foreign study under the mobility program, taking into account his personal request for competencies. The portal allows you to solve this problem with any level of detail.		
	Formation of groups of students with the same requests for mobility	Individual students on mobility programs may have access restrictions for certain courses. This happens, for example, when the course is elective, and there are not enough people who want to study it. If there are requests for the same courses/competencies from several foreign students from different countries, they can be combined into a group, which makes the organization of the corresponding course possible and expedient.		
	Online processing of documents required for mobility	As the pandemic has shown, there are situations in which the personal participation of students in the preparation of documents necessary for mobility is limited or impossible. In addition, there may be some features of the passage of mobility programs in individual countries or universities, in contrast to typical ones. The portal allows you to process all documents online, taking into account all institutional and national features.		
	Formation of a digital trace of a student's mobile activity	When implementing mobility programs, a student has the opportunity to visit several universities in one country or several countries, for example, within the framework of a cross-border partnership. A similar situation arises when a student is studying abroad at the same time at a university and a vocational training center. In any case, there is a problem with the certification and reliability of the acquired learning outcomes. This service allows you to automate and legitimize the individual trajectory of student learning.		
	List of the required competencies to work in organizations of interest to the student	If a student wants to purposefully get a job in a particular organization, he needs to know the list of competencies that the specified organization requires when applying for a job. The organization itself is also interested in this. The service implements the specified functionality.		
	List of courses that form the required competencies	For the formation of some competencies, it may be necessary to study not one course, but some set of them. The service facilitates the solution of this task.		
	Formation of requests to employers to obtain a list of competencies required to work in the relevant organization	If a student wants to better prepare for a potential future job, the service helps him formulate a request for the competencies required for this.		
	List of training centers and universities offering courses of interest	Professional competencies can be formed not only by universities but also by specialized training centers. The formation of some competencies can be carried out exclusively outside the framework of academic programs. This service		









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		creates an opportunity to expand the set of courses and competencies that go beyond those offered by universities
	Course ratings	If it is possible to obtain the same competencies or take the same courses at different universities, the choice of a particular course in a particular educational institution can be made based on the rating assessment of these courses by previous generations of students. At the same time, this is an indirect assessment of the quality of the respective courses.
Individual academic staff	Formation of proposals about their pedagogical opportunities	Currently, due to the increasing specialization of courses, not all university teachers have a full load in their courses. They have the opportunity to implement their professional activities in other universities and training centers. The service allows you to launch a search to meet this possibility.
	The offer of courses and competencies that can be provided by the teacher in the guest university	When implementing mobility programs for teachers, the problem arises of finding universities that have appropriate programs and courses.
	Search for places to improve own skills of teachers in educational organization	As part of the mobility programs for teachers, they have the task of improving their professional level. The service provides an offer to universities and professional centers that implement this opportunity.
	Search for places to improve own skills of teachers at enterprises and organizations	As part of the mobility programs for teachers, they have the task of improving their professional level. In some innovative or highly specialized areas, such advanced training is possible not only in universities but also in leading organizations that are market leaders in their respective fields. The service provides an opportunity to implement such a task.
Universities	Proposal of programs and courses for mobility for foreign students	Universities offering mobility programs do not always provide detailed information about all the opportunities they provide. The service allows you to exclude personal questions and clarifications for all mobility programs.
	Proposals for special courses for the development of specific competences	Universities offering mobility programs do not always provide detailed information about all the opportunities they provide. The service allows you to exclude personal questions and clarifications for all mobility programs.
	Vocational training courses for enterprises and organizations	Not only students but also employees of organizations, as well as the universities themselves, need to acquire new competencies, especially in narrow professional areas. The service is focused on providing these features.
	Invitation of teachers to vacant positions	Almost all universities face difficulties in attracting academic staff to individual courses, especially in new and highly specialized fields. The service facilitates the solution of this problem by searching for available specialists in the field of interest of universities.
	Partnership with other universities in the field of required competencies	Currently, universities, especially in small countries, need to train specialists with competencies that a single university is not able to provide. The service helps to find partner universities for the joint implementation of programs and courses that cannot be implemented by the university on its own.
Business organizations	Formation of a list of competencies required from employees	In order to obtain workers with the competencies required by a particular enterprise, it can form a list of such competencies to orient students to work at their place in the early stages of their studies at the university.
	Providing internship places for students as potential future employees	The presence of competencies according to the formal data of certificates and diplomas is not always sufficient for their inclusion in work teams. A good way to solve the problem is to







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		train students directly in enterprises. The service allows employers and students as potential employees to receive mutually important information during the internship process.	
	Provision of internship places for academic staff	The universities themselves, need to acquire new competencies for academic staff, especially in narrow professional areas. The service is focused on providing these features.	
	Formation of a list of competencies and courses where they would like to send their employees to improve their skills.	When recruiting new employees and developing areas of activity, organizations are interested in improving the skills and retraining of their employees both in local educational organizations and abroad. The service makes this possible.	
ProfessionalProposalofprogramsandTrainingcourses for the development ofCentresspecific competences		Small, highly specialized training centers face the problem of informing potential clients about the opportunities they have to develop fairly narrow competencies. The service expands opportunities for them in this area.	
	Partnership with other training centers and universities in the field of required competencies	Currently, training centers in especially small countries experience a need to train specialists with competencies that a single education establishment is not able to provide. The service helps to find partner organizations for the joint implementation of programs and courses that cannot be implemented by a single training center.	
Public professional organizations	Development of professional standards	At the national level, professional associations and associations are entrusted with the functions of developers of national professional standards. The involvement of professionals from the academic sphere and industry for this purpose solves this problem more successfully.	
	Organization of events (seminars, workshops,) to identify new competency needs and close the gap between business and the education community	In the modern world, the intensive development of new technologies in all industries brings to life the need for intensive information exchange between the academic community and business. Creating platforms for such information exchange both face-to-face and virtually is the task of this service.	

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- 3. Kristine Uzule









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2. A2.2. Development of a model of portal integration with external systems (CRM, marketing platform, learning management system, Erasmus+ online platforms, etc.). (TTI)

# **2.1 INTRODUCTION**

The designed portal and its model are focused on the implementation of new educational and support services. In this regard, the portal is not unique. Some of its functions can be supplemented or jointly function with other information systems used in educational organizations, for example, Customer Relationship Management (CRM), Administrative management systems, Learning management systems, marketing platforms, Erasmus+ online platforms, and others. Each organization that is potentially a corporate client of the eMEDIATOR platform can use its own set of supporting information systems. For the effective functioning of the eMEDIATOR portal, the possibility of full or partial interaction of information systems at the level of data and services should be provided.

# 2.2 FRAMEWORK OF THE INFORMATION ENVIRONMENT

As a basis for the functional structure of the information environment of any educational organization, one can choose Higher Education Digital Capability (HEDC) Framework by Holon IQ company [1]. An open-source framework to map and measure digital capability in Higher Education. Developed by HolonIQ and Higher Education leaders around the world to support practical and sustainable approaches to digital services and online learning.

Institutional capabilities have been mapped to four connected dimensions across the lifecycle (Fig.2.1), from Demand & Discovery (DD) to Learning Design (LD), Learner Experience (LX), and Work & Lifelong Learning (WL). The framework encompasses current capabilities such as recruitment, curriculum design, assessment, and career planning, but also looks ahead to future and emerging capabilities for successful digital learning.







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The structure has a hierarchical architecture. The top level of the architecture reflects the student's life path in an educational institution, which underlies the cooperation of all participants involved in the student's learning process, the acquisition of the required competencies, and their application during the practical activities that the student chooses.

The first element of the structure is "Demand and Discovery" (DD) defines the strategy of an educational institution for the development and maintenance of a client-oriented approach to student learning, taking into account the student's personal educational experience at each stage of his education.

The second element of the structure is "Learning Design" (LD), which focuses the attention of the student on the acquisition of the required competencies in the process of realizing his expectations in the professional field.

Another element of the framework is the "Learner Experience" (LX). Many skills and abilities that are important for the development of professional competencies are formed not only during training but also in an environment that supports education. This functionality supports this component of the framework.

The fourth element of the framework is "Work and Lifelong Learning" (WL), which focuses on considering how students can be supported as they choose and change careers throughout their lives with continuing education needs.



# Figure 2.1. Institutional educational capabilities

Within the framework of the indicated institutional capabilities of the educational framework, it is possible to formulate the main potential functionalities of the portal, which are presented in Fig. 2.2.







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Those services that contain the functionality of the portal may be provided by third-party information systems that corporate clients already own, or which they can use as a service of external providers.

One of the examples of interaction with external information systems is shown in Fig. 2.3.



In each specific case of using the portal, the issue of using external information systems should be decided individually, depending on the readiness and preferences of the corporate client.

For greater flexibility in interconnection with external systems, the portal should provide a data interface module that allows, based on the agreed formats, to provide an M2M interface for the interaction of all portal blocks and related external information components.









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# 2.3 HIGHER EDUCATION DIGITAL CAPABILITY FRAMEWORK

The presence of external information systems is not a prerequisite. With a full-featured development of the portal, it can perform the entire range of necessary functions that implement the services required for customers.

In this case, a Higher Education Digital Capability Framework by Holon IQ company [1] can be used as a basic functional model. This model is shown in Fig. 2.3 [1].

The model includes several blocks for each functionality. Some of them are traditional for use in educational structures, and some characterize new, still developing opportunities in the area under consideration.

Not all functional blocks are of interest to each of the potential users of the portal. Much will depend on the degree of maturity of corporate users both in the field of educational services and in the field of their digitalization.

Opportunities at this level can be defined in more detail in the process of designing a demo portal, as well as when moving on to designing a full-featured version of the portal, which can be implemented outside the eMEDIATOR project.



# Figure.2.3. Mapping of main education functionality with digital capabilities [1]



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# 3. A2.3.2. Development of model of portal learning environment (UL)

# 3.1 Introduction

The role of ICT and digital tools in education is well recognized and is still investigated. It is believed that properly ICT usage encourage students to think, create and solve problems in new, unconventional and innovative ways. In this sense, ICT should be seen as modern aid and support of teaching and learning. It is inextricably linked with the school as a social institution. According to the British Educational Supplier's Association's (BESA):

"ICT in UK State Schools research, over half of UK schools anticipated that more than 53 per cent of teaching time would incorporate ICT by this year, and this growth is expected to increase to 57 per cent by 2017. The Learning through Technology Zone has been developed to address the importance of technology in education, with a series of free-to-attend seminars and an opportunity to try and test the latest and most innovative classroom technologies. In the Learning through Technology theatre, Microsoft and Tablet Academy will be hosting a programme of workshops, designed to help teachers develop their skills and keep up with tech-savvy students! For teachers seeking guidance on the BBC micro: bit, and ideas on how it can be used in the classroom, the BBC micro: bit session will provide an introduction to the handheld, programmable computers that are being given free to every Year 7 (or equivalent) child across the UK. Another practical, hands-on session, will teach delegates the fundamentals of Minecraft and explore ways in which it can be used in the classroom. Participants will become familiar with the Minecraft Edu environment and receive hands-on training on everything from building objects and creating a new world to setting up a secure classroom server. In other sessions, teachers can also find out how FlashSticks help increase engagement and retention for students learning new languages (including EAL), or discover the benefits of LEGO Education's solutions, WeDo and Mindstorms, which can be used to empower learning across the whole curriculum" (http://www.ictineducation.org/home-page/learningthrough-technology-at-the-education-show). ICT issues related to both the formal learning at school and informal learning outside the school: "Spaces learning, physical and virtual, together they form a structured environment in which he is learning. But learning in the twenty-first century requires a new space, which will connect learning in school, home and in the community, which will increase flexibility and will support learning beyond the physical dimensions of school buildings and outside of traditional



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school hours in the school day" (Learning Spaces Framework: Learning in an online world, MCEETYA, 2008, p. 4).

Taking into account the presented examples, ICT can be used as a space and tolls for learning. ICT seems to meet young and adults expectations, concerning time, style and content. They provide a new, outstanding learning possibilities.

Building a perfect platform (portal) for mobility purposes is our aim. Therefore, in this report, we will try to establish key requirements of the platform. The report consists of two parts: a theoretical part will concentrate on the analysis of the state-of-the art solutions. The second, an empirical part will be based on the mixed-method approach: answers from interviews will be analysed with NVivo software (Word Frequency Query) to identify the most prominent expectations regarding platform's layers: organization, competence, pedagogy, and technology. Recommendations concerning the basic requirements will be presented at the end of the document.

# 3.1 Theoretical part

# Information and communication technologies (ICTs) as digital teaching tools in education. Typology and specific features

# Education as a life long learning supported by ICTs

The first attempts to analyze the education were made in a philosophical context as part of the study of knowledge, which was treated as a result of learning. In his *Theaetetus* dialogue, Plato argued that knowledge is true belief, or convictions justified by earlier experiences and reflections. Almost two thousand years later, the Cartesian concept of the mind as an autonomous individual and John Locke's concept of *tabula rasa* created opposition to the scientific thinking of the individual and society. Thus, a strict division was introduced between humans as individuals and humans as a collective (society). It was soon noted that a person's environment is the basis for formation of their qualities and means of survival. Therefore, the need also arose to create synergies between people and their environment. The answer to this need was the phenomenon of education. Education and learning throughout life appeared as an integrational mechanism, which explains how individuals behave, what regulates their behaviour and how it does so.

Nowadays, education is an interdisciplinary field and the subject of intense and ever-growing interest from researchers in various sciences and fields of knowledge. It is also highly appreciated by practitioners in formal and informal (nonformal) education, such as teachers, educators, social workers, institutions and companies. This increase in research interests and the social importance of learning was







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noted in the middle of the last century by American psychologist, outstanding researcher and expert on the subject of learning, Ernest Hilgard, who explained this situation in the following way:

"The scientific study of learning is carried on primarily by psychologists. Psychology's claim to the field was staked in part by masterly pioneers such as Ebbinghaus (1885), Bryan and Harter (1897, 1899) and Thorndike (1898). Those who have followed in their footsteps have been primarily psychologists. Professional educators have been welcomed educational psychology as a foundation science upon which to build their practices, and studies of learning have gone on concurrently in laboratories of general psychology and laboratories of educational psychology, which interplay between pure and applied fields. Under the circumstances, it is very natural for psychologists to feel that the study of learning belongs to them. In addition to historical reasons, there is another basis on which to account for psychologist's interest in learning. This is centrality of learning in the more general systems of psychological theory. A scientific, along which the desire to satisfy his curiosity about the facts of nature, has a predilection for ordering his facts into systems of lows and theories. He is interested not only in verified facts and relationships, but in and parsimonious ways of summarizing these facts. Psychologists with a penchant for systems find a theory of learning essential because so much of man's diverse behaviour is the result of learning. If the rich diversity of behaviour is to be understood in accordance with a few principles, it is evident that some of these principles will have to do with the way which learning comes about" (Hilgard 1956:1).

Therefore, the role of education has always been greatly appreciated, but it is only modern man who has begun to realize that one can learn not only at school, but also (and perhaps above all), outside school, thus becoming a being that accomplishes by acquiring knowledge. Furthermore, the conviction that education does not end with the completion of a formal (school) education is burrowing deeper and deeper into the social consciousness. Education and human learning ability lasts a lifetime, is a necessary condition for adults to keep pace with rapid technological, social and cultural changes, and above all, to cope with social and economic demands. Of these latter, the most important include competitiveness on the labor market, entrepreneurialism, the ability to operate on the free market in an atmosphere of uncertainty, and a readiness to change jobs or professions. Thus, the phenomenon of education is now characteristic not only of a person's school days, but also throughout their life. The educational renaissance, both during and beyond school, has already begun. It is a process aimed at making huge qualitative changes in individual and social life, and is a difficult and irreversible process. It is also characteristic that in education, both children and adults, learning process (not teaching) plays an increasingly important role. Teaching becomes less important, relegated to the background, and begins to be understood as organizing learning. As a result of this, we are now standing in the twilight of the primacy of teaching over learning (at least, outside of school), due to the low effectiveness of 'teaching' compared to the enormous potential of 'learning'.





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Peter Jarvis (2006: 13-17), a prominent researcher and expert on learning, argues that it occurs through stimulation of human senses by their external environment, both natural and physical, social and cultural. This contributes to the integration of the individual with the world. Over the centuries, a different understanding of learning has appeared that generally fits two perspectives: the psychological and pedagogical.

From the psychological perspective, learning is the emergence of a relatively permanent change in the behaviour of individuals (behaviourism), or assimilation of messages indicating the process and adaptive nature of learning (the cognitive approach). From a psychological point of view, even if learning occurs in relation to one's surroundings, and so has the character of an internal mental process in the mind of the individual learner, it still results in behavioural changes or acquisition of new knowledge, skills and habits. The pedagogical perspective points to the more humanist nature of learning and its relationship with school. In this perspective, learning is associated with a specific type of attitude to knowledge and to life, which requires personal commitment and initiative. Pedagogical learning is the more powerful figure in comparison to its original, psychological counterpart. It is frequently planned with the intention of achieving a particular purpose, for example, solving contemporary educational issues such as behavioural problems, lack of motivation for learning, a lack of desire for self-improvement, prevention of addictions and early school-leaving. This kind of learning is accompanied by the use of various symbolic systems, including language, concepts and theories.

Learning is not the only activity undertaken deliberately to assimilate knowledge or acquire skills. According to the world's leading educational researchers, learning is a mechanism of general human development, a kind of continuous response to events in order to achieve a sense of control over life (Biesta and others, 2010: 6). Today, there are many epithets, definitions and concepts of learning. In the intention of its creators, each new theory or concept of learning is designed to overcome the limitations of the previous theories.











Figure 1. The main theoretical perspectives of learning

Source: original study

Regardless of our understanding of education and learning, today their common feature is the ever stronger connection with ICTs and digital tools. The importance of modern technologies in education and learning has been significant for over a dozen years, but it has increased significantly during the pandemic and it seems that there is no turning back from this tendency. It is believed that proper ICT use encourages learners to think, create and solve problems in new, unconventional and innovative ways. In this sense, ICT should be seen as a modern teaching and learning aid. ICT touches on both formal learning at school, and informal learning outside school. Spatial, physical and virtual learning together form a structured environment in which learning can take place.

But learning in the twenty-first century requires a new kind of virtual space, professionally prepared and friendly for users.

A example of such virtual space are educational platforms. They are an interactive computer systems that enables the organization and support of education and learning on the Internet. Their basic







functionalities include: collecting learning materials, the division of learning materials on the basis of logical criteria that facilitate the familiarization with the material and making materials available to learners via the Internet.

# ICTs in education and lifelong learning

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ICTs are often referred to new technologies term. New technologies can play the role of didactic resources supporting the acquisition and consolidation of competencies in education. However, the importance of these tools relates to the organization of the teaching and learning process that will guarantee the best possible equipment with competencies necessary at a given stage of education. The variety of tools supports the transfer of content and, on the other hand, its assimilation and contributes to the achievement of the educational goal. Their function is, among other things, on the perception of the education process, i.e., extending the form of the learner's contact with reality, facilitating thought processes, helping students perform exercises and gaining practical skills, displaying materials provoking students' experiences.

The range of teaching resources may include the following tools and applications: Web 2.0, 3.0, 4.0. and 5.0. and social media, including virtual worlds (Jantjies et al., 2018), machinima<sup>1</sup> (Checa-Romero & Pascual Gómez, 2018), systems for distance learning (educational platforms) (De Domenico & Cohrs, 2016), including authoring tools (Ma et al., 2018), and other advanced technologies creating virtual, augmented reality, or mixed reality (Ficarra, 2020).

Tools and applications can be divided into synchronous: requiring the presence of participants (teacher, students) of the learning process at the same time; and asynchronous, in which the learning process does not require the presence of participants (teacher, students) at the same time (it is independent of the learning time of individual participants). A detailed breakdown of the selected tools takes into account:

- Web 2.0, 3.0, 4.0, and 5.0 and social media and virtual worlds,
- authoring tools,
- videoconferencing systems,
- educational platforms,
- mobile applications/devices.

It is worth noting that the above typology only considers the frequency of using a given tool synchronously or asynchronously. Although categorized as a means of synchronous communication, video conferencing systems can also be used in non-real-time. Similarly, educational platforms - as a means of asynchronous communication, can be used in group projects organized at a specific time. It is possible to

<sup>&</sup>lt;sup>1</sup> Movies created in virtual worlds.









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install asynchronous teaching modules in mobile applications, play videos, and conduct micro lessons. Hence, assigning a given tool to only one category is impossible in some cases.

# From Web 2.0 to 5.0. Social media and virtual worlds

Several stages of Web development should be highlighted (Kambil, 2008):

- Web 2.0 The Social and Co-created Web,
- Web 3.0 The Semantic and Intelligent Web,
- Web 4.0 The Mobile, Machine and Object Web,
- Web 5.0 The Sensory-Emotive Web.

Web 2.0 connects people and creates human-efficient technologies; all users can generate content, not just read it. It is a colloquial term for social networking sites established after 2001, in which the content generated by users of a given site plays a fundamental role.

Related to Web 2.0 are social media, which are defined as a group of web-based applications that are based on the ideological and technological foundations of Web 2.0 and that enable the creation and exchange of user-generated content (Kaplan & Haenlein, 2010).

The Internet is constantly evolving, and the world is already operating with a different version of the term - Web 3.0. This term, referring to the semantic web, describes the activities and concepts leading to the conversion of the current knowledge transfer system to the model of a generally understood database. It consists of the use of databases, applications, artificial intelligence, e.g., to recognize the intentions of the Internet user based on the context of the data transferred, thanks to which it will be possible to speed up data transfer.

In the review of the mechanisms of common resource co-creation content publication, the following should be mentioned:

- Wikipedia,
- blogs,
- social bookmarking (meaning recommendations or social sharing of a collection of links to websites and messages on the web cataloged by users),
- media-sharing services,
- Internet community websites,
- virtual worlds (Dąbrowski, 2008).

Web 3.0 makes it possible to increase content available for applications other than browsers, artificial intelligence, geospatial information, and three-dimensional visualization. Web 3.0 uses neural networks and genetic algorithms, emphasizing the acquisition, analysis, and ability to process user-generated data.





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Web 4.0 connects different devices in real-time, is equated to an ultra-intelligent, electronic agent, and equates to a symbiotic network. The leitmotif in this ubiquitous network is interaction and symbiosis between people and devices. An example of Web 4.0 technology is websites that identify users and can personalize the information provided.

Web 5.0 is referred to as a "symbiotic" network. Web 5.0 uses neurotechnology that allows for interpretation of selected biometric indicators and reading users' emotions, thanks to which web applications can, for example, change the facial expressions of avatars in real-time.

Web 2.0 - 5.0 tools are still under development, while integrating their various functionalities gives a wide range of didactic possibilities, especially for people who would like to share knowledge and skills in an exciting and accessible way. The use of commonly available tools can bring the desired didactic effect because the knowledge of popular media allows for their efficient implementation in the didactic process - students and trainees have no problem navigating the resources. What is more, knowledge can be readily available to interested audience.

# Authoring tools

Rapid authoring tools require at least minimal knowledge of using a computer and allow the creation of elearning courses and virtual teaching resources for people who do not have specialist knowledge in programming or graphics. Programs of this type often enable the creation of individual interactions or entire e-learning courses (usually self-taught), which can be implemented on an educational platform. Such tools include, among others: Adobe Captivate, Lectora, or Articulate. The use of some proprietary tools (e.g., Raptivity) is very often associated with the English term " rapid e-learning." The presented term means both one of the forms of e-learning and the methodology of fast and maximally optimized preparation and implementation of remote training. Authoring tools can support other software or constitute an autonomous element of training.

# Videoconferencing systems

These tools can be a great help in creating visual instructions, which are extremely important when designing the didactic process. These so-called LCS (Learning Communication System) systems are most often used for real-time communication, i.e., with live classes (text and voice contact with the possibility of video transmission, sharing documents, virtual board/desktop, saving recordings from sessions/videoconferences). It is worth noting that an alternative name for this system is the so-called system - Virtual Classroom System (VCS). The LCS system is often a component module of LMS and LCMS platforms. Tools that allow a course participant to communicate with lecturers or other course participants or edit graphic or text files (in most popular formats) on a shared virtual board are helpful





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when conducting webinars or group work methods in the form of discussions (brainstorming). An example of an LCS system is Adobe Connect or Microsoft Teams. Both of these tools allow educators to:

- conduct classes for any number of recipients,
- participate in courses without traveling,
- teach classes without traveling,
- participate in courses without leaving home (important for sick and disabled people),
- run facilitation classes thanks to a keyboard server with additional software.

A joint virtual meeting of many participants, connecting using various devices and videoconferencing systems is also possible using other, more or less recognized systems, such as Skype or TrueConf. Tools for remote meetings using videoconferencing terminals can also take the form of a "cloud" service.

# E-learning platforms

E-learning platforms are prevalent teaching aids, as, among several dozen platforms. Two most known examples are Moodle and ILIAS. The Moodle Platform (Modular Object-Oriented Dynamic Learning Environment) is one of the most popular e-learning platforms. It is an open type of software made available for free under the GNU GPL public license. It allows for course evaluations, survey, questionnaires, tasks and reviewing work; chats, forum posts, workshops, and also the ability to create collaborative texts (Da Costa, 2011; De Domenico & Cohrs, 2016). Similarly the ILIAS LMS (Learning Management System<sup>2</sup>) platform is used to administer education and training processes. The platform includes the Personal Desktop and Available Resources (repository). While the resources available include courses and other structured materials described in the metadata, the Personal Desktop is the personal space of each platform user, teacher, author, and administrator. The personal dashboard includes selected items from the repository (e.g., courses a learner visits regularly or interesting forums) and tools such as e-mail, tags, calendar, e-portfolio, and private blogs. The essential functions of both platforms are: student management (registration, progress reporting, evaluation of results, competency analysis), training management (access to training plans, access, and distribution of teaching materials). Platforms meets the requirements of both the SCORM (Sharable Content Object Reference Model<sup>3</sup>). Currently, a modernized version of SCORM that frees us from the obsolete constructs of the past is The Experience API - xAPI. It is designed as a successor to SCORM at the most basic level. It allows educators to record any learning experience, including informal learning, giving us a much richer picture of an individual's learning path (Kattenberg, 2020).





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<sup>&</sup>lt;sup>2</sup> LMS is a system that allows for the analysis of users' progress (in tests, surveys, or reports).

<sup>&</sup>lt;sup>3</sup> SCORM is a technical standard that ensures compatibility between e-learning and the learning platform. It defines the technical requirements that must be met by e-training to be able to embed it on any platform and does not define the substantive quality of the course





Online e-learning platforms can be used to conduct independent online training or support or complement traditional forms of exercise. They are viable tools for teachers and administrators.. They may be open-source software, available for download and installation on a given system, but it also happens that some organizations, with the help of their own IT staff, create plans solely for their own needs. They can adopt private solutions. It should be noted that most of platforms are available in versions for mobile devices.

# **Mobile applications**

Mobile applications are the general name for software that runs on mobile devices. They are written using a variety of platforms and programming languages. Increased mobility in access to information, data, and knowledge (independence from place and time) causes e-learning services to be more often adapted in terms of sending and publishing content on mobile devices. This form of teaching is called m-learning and is mainly used to support learning (e.g., applications supporting learning a given subject) or popularizing knowledge. More advanced applications use augmented reality that can serve as an additional asset for knowledge and skills acquisition, or reinforcement (Bacca et al., 2015).

### Features of new technologies

The use of various tools in the didactic process depends on understanding its features. Frequent failures result from treating them too superficially not understanding their functioning. Disturbances in the interaction between the participants of the classes and the tool may result in stressful situations and be a source of conflicts. Identifying the characteristics of the devices is therefore essential to recognize their (general) capabilities. The main feature indicated in the literature is interactivity, i.e., a fascination with what technology brings to the dynamics of the student-teacher relationship, which triggers active participation in the learning process (Siess et al., 2019). Authors also suggest in turn: the possibility of testing (Ilgaz & Afacan Adanır, 2019), access to information, presentation of didactic material (Abdusalomovna, 2020), learning progress monitoring (Akhtar et al., 2015), social or individualized learning, innovativeness (Kümmel et al., 2020). Taking into account the basic characteristics of didactic tools presented above and their capabilities in the last section, as well as attempts to select the features of these tools by other researchers, the following categories should be taken into account:

- 1) access to teaching materials,
- 2) interactivity,
- 3) integration of various tools,
- 4) feedback and evaluation,
- 5) an attractive form of presentation (content),
- 6) the possibility of repeating the task,





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- 7) collaboration on content on the web,
- 8) painless learning from mistakes,
- 9) sensory simulation,
- 10) learning through play,
- 11) increased number of students (Gawlik-Kobylińska, 2016).

1) Access to teaching materials - posting teaching materials on the internet (on a platform, in the cloud, or other virtual resources) opens a world of possibilities for access to such materials.

2) Interactivity - working on didactic materials collaboratively on the web - regardless of geographical distance, it is possible to work on didactic materials together. Interactivity also includes communication (synchronous and asynchronous) between all participants in the education process.

3) Possibility to integrate new technology tools - information and communication technologies can be freely combined by the teacher, depending on the availability and quality of the teaching infrastructure. There are several options for linking new technology tools, such as learning platforms with applications or programs.

4) Feedback and evaluation tools - many of the available (and accessible) tools ( open source ) opensource) has built-in testing and evaluation tools. Undoubtedly, the student's answers to the questions asked during the course (control question) are an interactive element and allow them to solve some problems during the learning process. It is also an element that maintains learning motivation because the transition from prolonged reading to answering questions - i.e., independent thinking, stimulates mental activity and the willingness to study materials further. The possibility of receiving feedback is beneficial when checking students' knowledge, especially when conducting and reviewing the test for a large group of people seems to be a time-consuming task requiring the help of other people. An additional advantage of such tools is the possibility of electronically archiving test results and surveys.

5) Attractive content presentation is essential for maintaining learning motivation and content visualization. Exciting graphics, a clear layout of the content (including its hierarchy - hiding side threads under slogans, titles, or icons), intuitive use of the course can strengthen a positive attitude to this type of educational activity.

6) Repeatability of tasks - allows a learner to shape habits and consolidate the desired behaviour. Positive and negative stimuli in the form of feedback can consolidate and strengthen attitudes related to the correct response.







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7) Working on didactic materials collaboratively on the web - regardless of geographical distance, it is possible to work on didactic materials together.

8) "Painless" learning - in a virtual environment, it is possible to participate in activities or show dangerous situations in the real world, such as chemical experiments. Science and technology constantly evolve, so the reflected images become ever more realistic. The additional possibility of immersion in the learning environment (for example, software-generated and displayed images) makes the training conditions as natural as possible.

9) The ability to stimulate the senses - the use of pictures, videos, and interactive elements-- is essential in retaining or reproducing information. Sensory stimulation can significantly affect the level of learning motivation.

10) Learning through play is an element that diversifies education by engaging the student and arousing his interest through various forms, methods, and teaching techniques. An example of this is multiple games, puzzles, quizzes, humorous elements, which, when adequately applied to the content of the course, significantly motivate a learner to gain knowledge and skills.

11) Increased number of students - information and communication technologies provide teaching materials in the same form to all students; unlike traditional teaching conditions, their number may not be limited by physical constraints. However, it should be mentioned here that in some cases, for example, using a videoconference system implies a lower number of participants, preferably up to 10 people. It is mainly a matter of the nature of the classes and the software's capabilities.

In pilot studies, in a group of 26 educators carried out in 2015 (Gawlik-Kobylińska, 2016) the highest grades were given to the following categories: access to resources, interactivity, integration of various tools, feedback and evaluation, an attractive form of presentation ( content), the possibility of repeating a task, cooperation over the content on the web. It can be seen that a pragmatic approach is dominant, focused on the use of tools that will be available to both the student and the teacher.

# Conclusions

In education, didactic aids seem to play a vital role due to the nature of the acquired competencies. It relates to developing knowledge and forming habits or personal skills (competencies) in most cases. Correctly selected, they promote active learning, stimulate interest in education, and facilitate the learning process by answering problems. New technologies also support the organization of teamwork and

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communication, assessment, and support the tracking of learning. In addition, they may serve as the first point of entry into reality, augment observations of other teaching methods, provide visual representations of verbal information provided by the teacher, and organize functional exercises. Such a variety of tools in education can help create an optimal learning environment. The research results showed that the most frequently used ICT tools in education are widely available to all participants of the didactic process. Therefore, it is possible to answer a research question about experiences in the use of new technology tools: in education, all devices in the area of new technologies are desirable, which have features such as access to resources, interactivity, integration of various tools, feedback and evaluation, attractive form presentation (content), the possibility of repeating a task, collaboration on content on the web.

# 3.3 Empirical part

We created an interview questionnaire with open-ended answers and used NVivo software to analyse the answers of 147 respondents (not all questions were responded; no e-mail addresses were gathered). This qualitative approach allows for identification of the most desirable features (analysis based on Word Frequency Query for most frequent 25 items). Stop words were extracted from the dataset<sup>4</sup>.

All answers are available here <u>https://docs.google.com/forms/d/115\_yhfBDREvJQXFliYDaDpNneEY-6jPQ8fV5pM9Qfj4/edit#responses</u>

Terrain: Polish universities: Łódź University and War Studies University in Warsaw.

Participants: Others – 2 Students – 140 Teachers – 5

Detailed info about participants:







<sup>&</sup>lt;sup>4</sup> The list of stop words included for instance: *a*, *able*, *about*, *above*, *acquire*, *acquired*, *acquiring*, *after*, *again*, *against*, *all*.



 Please specify what kind of content would you expect to meet in the portal in terms of Competence (e.g. what kind of competence would you like to gain through the portal? knowledge, skills, dispositions – knowing why).









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# Table 1. The display of 25 most frequent items (Competence)

	Word	Length	Count	Weighted Percentage
				(%)
	knowledge	9	65	17,91
	skills	6	64	17,63
	gain	4	13	3,58
	learn	5	8	2,20
	help	4	6	1,65
	practical	9	6	1,65
	dispositions	12	5	1,38
	experience	10	4	1,10
	find	4	4	1,10
	competences	11	3	0,83
	develop	7	3	0,83
	future	6	3	0,83
	job	3	3	0,83
	practice	8	3	0,83
	<u>studies</u>	<u>7</u>	<u>3</u>	<u>0,83</u>
	<u>study</u>	<u>5</u>	<u>3</u>	<u>0,83</u>
	<u>training</u>	<u>8</u>	<u>3</u>	<u>0,83</u>
	<u>useful</u>	<u>6</u>	<u>3</u>	<u>0,83</u>
	<u>ability</u>	<u>7</u>	<u>2</u>	<u>0,55</u>
	<u>competence</u>	<u>10</u>	<u>2</u>	<u>0,55</u>
	<u>easier</u>	<u>6</u>	<u>2</u>	<u>0,55</u>
	<u>everyday</u>	<u>8</u>	<u>2</u>	<u>0,55</u>
	<u>expand</u>	<u>6</u>	<u>2</u>	<u>0,55</u>
	<u>field</u>	<u>5</u>	<u>2</u>	<u>0,55</u>
	<u>information</u>	<u>11</u>	<u>2</u>	<u>0,55</u>

Figure 1. NVivo word cloud generated from research results (Competence)









information competences practice practical expand future ability help gain learn studies knowledge job experience skills find develop study easier dispositions training field

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It can be observed that future users could be focused on gaining skills and knowledge (with a practical application, specifically for future perspectives, mainly getting the job). The platform should also support studying and training.

2. Please specify what kind of content would you expect to meet in the portal in terms of Pedagogy (e.g. what kind of didactic activities would you like to participate; you may think of games, quizzes, case studies, watching short videos, etc.).

-	Word	Length	Count	Weighted	Percentage
		Lengen	ooune	(%)	
	quizzes	7	49	11,69	
	games	5	47	11,22	
	short	5	43	10,26	
	videos	6	40	9,55	
	watching	8	22	5,25	
	case	4	16	3,82	
	studies	7	13	3,10	
	think	5	12	2,86	
	films	5	8	1,91	
	activities	10	6	1,43	
	movies	6	6	1,43	
	participate	11	6	1,43	
	exercises	9	4	0,95	
	video	5	4	0,95	
	educational	11	3	0,72	
	interest	8	3	0,72	
	practical	9	3	0,72	

# Table 2. The display of 25 most frequent items (Pedagogy)





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	enjoy	5	2	0,48			
	interactive	11	2	0,48			
	interesting	11	2	0,48			
	play	4	2	0,48			
	remember	8	2	0,48			
	team	4	2	0,48			
	terms	5	2	0,48			
	virtual	7	2	0,48			
						-	

# Figure. 2. NVivo word cloud generated from research results (Pedagogy)



It can be seen that the most expected functionalities involve quizzes, games, short videos, case studies as well as exercises, or activities that enable students to think. The platform should be interactive and focus on teaming.

 Please specify what kind of content would you expect to meet in the portal in terms of Organisation (e.g. what critical tools should the portal poses? You may think of skill assessment, skill matching, job search, or others components).

Word	Length	Count	Weighted Percentage (%)
skill	5	25	7,96
job	3	18	5,73
matching	8	18	5,73
search	6	17	5,41
assessment	10	13	4,14

# Table 3. The display of 25 most frequent items (Organisation)







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	adjust	6	5	1,59		Canado
	expect	6	5	1,59		
	knowledge	9	5	1,59		
	learning	8	5	1,59		
	think	5	5	1,59		
	know	4	4	1,27		
	example	7	3	0,96		
	helpful	7	3	0,96		
	information	11	3	0,96		
	tools	5	3	0,96		
	useful	6	3	0,96		
	abilities	9	2	0,64		
	groups	6	2	0,64		
	practical	9	2	0,64		
	presentations	13	2	0,64		
	quizzes	7	2	0,64		
	account	7	1	0,32		
	activity	8	1	0,32		
	adaptation	10	1	0,32		
	age	3	1	0,32		

# Figure. 3. NVivo word cloud generated from research results (Organisation)

adaptation assessment knowledge job learning adjust expect skill search awree age know example matching tools account think information presentations useful.

It can be observed that skill(s) matching and search jobs, as well as assessment are the most prominent functionalities of the platform.







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4. Please specify what kind of content would you expect to meet in the portal in terms of Technology (e.g. would you expect 2D elements – using the portal like a website, or maybe you'd prefer virtual reality – 3D with goggles? Or, artificial intelligence to foster and personalise learning? Social media plugins? Others?).

Word	Length	Count	Weighted Percentage (%)
virtual	7	21	4,53
reality	7	19	4,09
intelligence	12	18	3,88
website	7	18	3,88
artificial	10	17	3,66
learning	8	16	3,45
goggles	7	12	2,59
think	5	11	2,37
media	5	10	2,16
social	6	10	2,16
plugins	7	7	1,51
technology	10	7	1,51
personalise	11	6	1,29
everyone	8	4	0,86
foster	6	4	0,86
interesting	11	4	0,86
great	5	3	0,65
new	3	3	0,65
option	6	3	0,65
better	6	2	0,43
classic	7	2	0,43
easily	6	2	0,43
possibilities	13	2	0,43
practice	8	2	0,43
progress	8	2	0,43

# Table 4. The display of 25 most frequent items (Technology)






From the WFQ it can be implied that virtual reality, artificial intelligence, as well as website features should be involved in the platform's functionalities.

5. What could motivate you to use the portal?

Word	Length	Count	Weighted Percentage (%)
knowledge	9	17	5,35
easy	4	11	3,46
interesting	11	11	3,46
new	3	7	2,20
clear	5	6	1,89
interface	9	6	1,89
learn	5	5	1,57
access	6	4	1,26
certificate	11	4	1,26
graphics	8	4	1,26
intuitive	9	4	1,26
motivate	8	4	1,26
activities	10	3	0,94
certainly	9	3	0,94
completing	10	3	0,94
develop	7	3	0,94
games	5	3	0,94
grades	6	3	0,94
increase	8	3	0,94







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	learning	8	3	0,94		
	motivated	9	3	0,94		
	simple	6	3	0,94		
	application	11	2	0,63		
	availability	12	2	0,63		
	broadening	10	2	0,63		

#### Figure 5. NVivo word cloud generated from research results (Motivation for using the portal)



It can be observed that the platform should provide interesting content (knowledge), should be easy, clear, intuitive, and simple in its use. Graded and certificated courses are welcomed (generating certificates).

6. What could discourage you from using the portal?

#### Table 6. The display of 25 most frequent items (discouragement from using the platform)

Word	Length	Count	Weighted Percentage (%)
difficult	9	8	3,64
nothing	7	5	2,27
technical	9	5	2,27
boring	6	4	1,82
graphics	8	4	1,82
incomprehensible	16	4	1,82
uninteresting	13	4	1,82
long	4	3	1,36
complicated	11	2	0,91







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	errors	6	2	0,91			
1	functions	9	2	0,91			
]	hard	4	2	0,91			
]	hours	5	2	0,91			
j	interface	9	2	0,91			
j	jamming	7	2	0,91			
]	language	8	2	0,91			
]	load	4	2	0,91			
]	material	8	2	0,91			
]	monotonous	10	2	0,91			
(	old	3	2	0,91			
(	organization	12	2	0,91			
]	poor	4	2	0,91			
]	problems	8	2	0,91			
:	slow	4	2	0,91			
1	unclear	7	2	0,91			

#### Figure. 6. NVivo word cloud generated from research results (Discouragement from using the portal)

incomprehensible

functions boring hours organization slow errors nothing complicated uninteresting difficult long old Interface technical hard poor language monotonous graphics load unclear material problems

It can be noticed that some of the respondents claim that they would not be discouraged by any difficulties related to the platform. A lot of answers concern difficulties, errors, problems, jamming, slow processing as well as boredom, lack of clarity in the content and structure.









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#### 3.4 Recommendations for the eMediator project

- 1. Combine 2D and 3D elements as well as social media channels to provide richer communication opportunities. Plug-ins or direct links to educational areas can be given.
- 2. Mobile version of the platform will be an asset.
- 3. Online tools should be available in the platform.
- 4. AI-based recommending systems will serve as a great proof for having a state-of-the art platform.
- 5. Differentiated tools for creating tasks for learners.
- 6. The platform should be jam-free, working fast, should present interesting content (maybe evaluated by a specialised teams), intuitive and clear.
- 7. Graded and certificated courses are welcomed.
- 8. Skill(s) matching and search jobs, as well as assessment are the most prominent functionalities of the platform.
- 9. Both children and adults prefer to learn than to be taught. The platform should therefore be based on the interests and cognitive passions of learners so that they can learn on their own, and not offer a extensive system of advanced teaching tools.
- 10. Learning is a product of cognitive, social and emotional activity. The platform should provide learners with the opportunity to learn in each of these dimensions.

Gen-TEC-002	Versatile technology tool	2D and 3D displays as well as social media channels, online tools will provide richer communication opportunities. AI-based recommending systems and will be an asset.
Org-FUN-001	Award system	Graded and certificated courses.
Gen-TEC-004	Accessibility (anytime, anywhere)	Mobile version of the platform.
Ped-TEC-001	Learner and teacher friendly	Differentiated tools for creating tasks for learners.

#### 3.5. Case Uses









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		Contraction
Gen-TEC-005	Competence-focused	Skill(s) matching and search jobs.
Tec-FUN-001	HCI design standards	The platform should be jam-free, working fast, intuitive and clear.
Gen-TEC-006	Possibility of evaluation of the content	A room for content evaluators – the platform should present high-quality content that could be evaluated by a specialised teams – within an institution(s).

Gen-TEC-002Versatile technology tool

Normally, the system works in 2D environment; but it has plugins or buttons for displaying a 3D worlds. The system can redirect users to social media channels, which will provide richer communication opportunities.

The system relies on AI-based recommendation of the content, grades, competences, courses.

#### Org-FUN-001 Award system

The system allows for generating a certificate after the completion of the course. Optionally, there can be a grade (or percentage) switched.

Gen-TEC-004 Accessibility (anytime, anywhere)

Scalable screens allow for using the platform on mobile devices.

#### Ped-TEC-001 Learner and teacher friendly

The platform has a spectrum of asynchronous and synchronous functionalities, which allow for task differentiation (introduce a text, media, links to external sources, set of questions, interactive maps (mark an object in the picture), recording the answer, short lecture (video, voice), live chat, video online communication).

Buttons are visible, details are hidden under the menu "asynchronous" and "synchronous" tools.

#### Gen-TEC-005 Competence-focused

The system has a developed menu where the knowledge and skills (acquired while a course) can match certain job proposals (which were introduced to the system and valid).











Tec-FUN-001 HCI design standards

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The platform should be jam-free, working fast, intuitive and clear. It should rely on software which is not problematic for the devices.

(UX) walkthrough could be an asset to finalise the design of the user's screen.

Gen-TEC-006 Possibility of evaluation of the content

1. The platform should present high-quality content that could be evaluated by a specialised teams – within an institution(s). Therefore, an additional role "evaluator" could be added (apart from an administrator, teacher, student...).

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# 4. A2.4. Development of models for the organization of

## synchronous and asynchronous learning (TTI)

#### **4.1 INTRODUCTION**

E-learning is the main form of learning that accompanies the acquisition of competencies by students in the context of the mobility of education as a service.

There are different types of e-learning, the most general taxonomy of which is shown in Fig. 4.1 [1].



Figure. 4.1. Taxonomy of e-learning types

One of the most important methods for mobility education within the frame of Erasmus programmes is collaborative e-learning of foreign students with local ones. There are two types of collaborative e-learning – synchronous and asynchronous.

Synchronous learning is any activity in an online course that happens in real-time, like a Zoom meeting or a chat. It requires all participants to be in the same online environment, actively participating at the same time. It is typically characterized by opportunities for interaction between the instructor and students and amongst students, such as questions and answers, class discussions, and others.















Asynchronous learning is all the other activities in an online course that students can complete on their own schedule. While there may still be due dates, students can generally complete those at any time within the given timeline for the task. These activities can include video lectures, readings, assignments, and group discussions or collaborative tasks.

#### 4.2 USE OF SYNCHRONOUS AND ASYNCHRONOUS IN VARIOUS ACADEMIC ACTIVITIES

There are various academic activities within the framework of the pedagogical process at universities.

The main academic activities are shown in the taxonomy in Fig. 4.2.



#### Figure. 4.2. Taxonomy of academic activities

In the process of applying various academic activities, both synchronous and asynchronous e-learning methods can be used. Each of them can have its own strengths and weaknesses. Some comparative characteristics of both methods for each of the academic activities are given in Table 4.2 [2].









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#### Table 4.1. Comparative characteristics of synchronous and asynchronous e-learning methods

#### Synchronous method

#### Lectures

- Effective with lectures that are 'chunked' into smaller segments (7 – 10 minutes segments are ideal, with a maximum of 15 – 20 minutes)
- Lecture segments are interspersed with student interaction (e.g. Zoom Poll, Q&A session, Chat Q&A, Breakout Rooms, etc.)

#### Asynchronous method

- Effective for longer lectures and/ or more complex information so students can pace their viewing and review 'sticky points' as needed
- Recorded lectures can be narrated PPTs, videos, demos, etc.
- Where possible, lectures should be chunked into 15-30minute subtopics to facilitate study and review for students
- More inclusive for students with accessibility needs, second language, etc.
- H5P plug-in can be used to create interactive videos & presentations

#### CHALLENGES

- Interfering factors (distractions, internet connectivity, etc.)
  - keep segments short so students don't miss too much if their participation is interrupted
- · Equalizing participation
  - include short, frequent low-stakes interactions to encourage participation
  - Initiate a system to ensure you invite different students to share their thoughts by alternating forms of interaction

#### CHALLENGES

- Time management
  - identify deadlines for viewing and share with students and send reminder with your weekly check-in announcement
- Work completion
  - assign tasks & submission deadline for each presentation (1-paragraph summary of the main points, journal reflection on the content, 1-page of lecture notes, etc.)
- Questions that arise while working on lectures, assignments, etc.
  - create a class discussion thread per topic for students to pose questions and share answers
  - include links to extra resources for anticipated trouble spots









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Asynchronous method



#### Synchronous method

#### Videos

- Most effective when under 10 minutes and directly related to topic and task during class
- Most effective for longer videos, especially if students are required to take notes or use the content for an academic task
- H5P plug-in can be used to create interactive video presentations

#### CHALLENGES

- Copyright concerns
  - ensure all material has copyright permission to use
- ensure all material has copyright permission to use
   Accessibility

· Copyright concerns

CHALLENGES

- favour clips that provide captioning and described video where possible
- · Interfering factors (distractions, internet connectivity,

#### etc.)

 provide students with a link to the video in case they need to watch again later

#### **Experiential / Labs**

• Most effective for authentic interactions (e.g.: interviews, timed problem solving, etc.)

#### CHALLENGES

- Coordinating participants
  - plan all events during your scheduled course time

• Most effective for authentic tasks (e.g.: design a complex research experiment, conduct a literature review, analyze experimental data, etc.)

#### CHALLENGES

- Task/Process clarity
  - provide models and rubrics to clarify expectations
  - create a class discussion thread for students to pose questions and share answers









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Asynchronous method



#### Synchronous method

#### **Case Studies**

• Most effective for discussing case analysis, sharing findings, and Q&A session

#### CHALLENGES

- Interfering factors (distractions, internet connectivity, etc.)
  - keep activities low stakes
- Equalizing participation
  - include short, frequent low-stakes interactions to encourage participation
  - initiate a system to ensure you invite different students to share their thoughts by alternating forms of interaction
- Monitoring participation
  - visit each Breakout Room
  - include a peer evaluation grade for contribution to the group

• Most effective for reading cases, analyzing information, sharing ideas, and finetuning analysis

#### CHALLENGES

- · Lack of direction / misunderstanding of task requirements
  - ensure instructions are clearly written, keep activities low stakes
  - create a class discussion thread for students to pose questions and share answers
- · Equalizing participation
  - clarify expectations for student participation
  - create roles to ensure each student has a specific contribution to the work (Facilitator, Synthesizer, Critic, etc.)
- Monitoring participation
  - monitor student posts
  - include a peer evaluation grade for contribution to the group

Suggested Technology: Moodle Discussion Forum using "Separate groups" and/or a collborative document (such as Moodle wiki or Google Docs) to document analysis.

#### **Performance / Creation**











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· Meeting 'live' criteria

the task

- Most effective for spontaneous interaction, audience participation and small groups
- Most effective for recorded performance or technical demonstrations

#### CHALLENGES

- Lack of materials
  - adjust requirements to allow for a range of materials
  - create a class discussion thread for students to pose questions and brainstorm innovative replacement materials

#### Synchronous method

adjust requirements to allow for innovative responses to

#### **Collaborative Work**

**CHALLENGES** 

 Most effective for brainstorming tasks, short focussed discussions, as an initial touchpoint for more complex tasks, as a wrap-up activity, etc.

#### CHALLENGES

- · Ensuring participation
  - $\circ~$  provide clear direction prior to initiating Breakout Rooms
  - visit each Breakout Room
  - open a Google doc for each group and monitor work while in Breakout
  - require groups to share results (either in plenary time permitting, or a written summary to the instructor)
  - include a peer evaluation grade for contribution to the group (if group compilation is constant)
- Equalizing participation
  - clarify expectations for student participation
  - create roles to ensure each student has a specific contribution to the work (Host, Scribe, Synthesizer, Critic, etc.)

• Most effective for more complex tasks that require critical thinking, analysis, reflection, etc.

Asynchronous method

- Most effective for peer editing and collaborative writing tasks
- More inclusive for students with accessibility needs, second language, speakers, etc.

#### CHALLENGES

- Ensuring participation
  - provide clear direction prior to initiating task
  - create challenging, but achievable tasks
  - require groups to share results
  - use an activity that can be monitored (Eg: Discussion Forum, Workshop, Wiki, etc.)
  - include a peer evaluation grade for contribution to the group (if scope of work merits)
- Equalizing participation
  - clarify expectations for student participation
  - require students to divide work and report on their own contribution

Suggested Techonology: Moodle Discussion forum using "Separate groups" and/or a collaborative document (i.e. Google Docs) to document analysis







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#### Tutorials

 Most effective for short reviews and Q&A sessions – focused on work previously shared with students

#### CHALLENGES

- Monitoring for comprehension
  - include frequent knowledge checks (Zoom Poll, Q&A session, Chat Q&A)
- Most effective for sharing problems and tasks with students that they complete and prepare questions on prior to the live session

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#### CHALLENGES

- Task/Process clarity
  - provide models and links to resources

Asynchronous method

 create a class discussion thread for students to pose questions and share answers

#### Synchronous method

#### **Group Discussions**

- Most effective for smaller groups, with guiding questions to complete and share, and a reasonable time limit to keep students on-task
- Most effective for groups ranging from 4 9, depending on number of discussion posts to create and number of responses required
- Most effective for confirming student understanding / progress
- More inclusive for students with accessibility needs, second language, etc.

#### CHALLENGES

- Ensuring participation
  - · provide clear direction prior to initiating Breakout Rooms
  - visit each Breakout Room
  - open a Google doc for each group and monitor work while in Breakout
  - require groups to share results (either in plenary time permitting, or a written summary to the instructor)
  - include a peer evaluation grade for contribution to the group (if group compilation is constant)
- · Equalizing participation
  - clarify expectations for student participation
  - create & model roles to ensure each student has a specific contribution to the work (Host, Scribe, Synthesizer, Critic, etc.) & rotate the roles to give each member practice with each role

#### CHALLENGES

- · Ensuring participation
  - provide questions that require higher-order thinking (analysis, comparison, application, etc.)
  - require groups to share results
  - $\circ~$  monitor student contributions
  - attribute participation grades (for simple participation and/or quality of contributions)
  - include a peer evaluation grade for contribution to the group (if scope of work merits)
  - consider assigning a discussion facilitator for each group on a rotating basis to keep the discussion going

Suggested Techonology: Moodle Discussion forum using "Separate groups"

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#### Synchronous method

#### Presentations

- · Most effective for presentations under 20 minutes
- Best executed if student audience has a cognitive task during presentations (eg: apply criteria to peer review presentation)
- Should be limited to 3 presentations within a session with intermittent breaks in between
- Can be done in Breakout Rooms and recorded for grading purposes

#### CHALLENGES

- Interfering factors (distractions, internet connectivity, etc.)
  - keep presentations short so students don't miss too much if their participation is interrupted
- Ensuring participation
  - require students to evaluate the presentation using set criteria
- · Validating use of student time
  - stagger audience members

#### **Research Assignments**

#### Asynchronous method

- Most effective with larger classes
- Can be peer reviewed (eg: assigning each student specific presentations to watch and review)
- Can provide comments at specific points with Audio (in Moodle Discussion Forum)

#### CHALLENGES

- · Ensuring participation
  - require students to evaluate the presentation using set criteria
  - Validating use of student time
  - assign each student to view specific presentations





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- Most effective for individual or small group Q&A sessions to report challenges, etc.
- Most effective when executed with specific milestones to ensure students stay on task (Eg: written summary of research topic, annotated bibliography, paper outline, postassignment reflection, etc.)

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#### CHALLENGES

- · Validating use of student time
  - $\circ~$  keep sessions short and focused
  - hold individual meetings

#### CHALLENGES

- Direction and guidance
  - provide models and rubrics to clarify expectations
  - set deadlines for milestone deliverables
  - attribute a portion of the grade to each deliverable
  - create a class discussion thread for students to pose questions and share answers

#### Synchronous method

#### Assessment

· Most effective for oral presentations and demonstrations

#### CHALLENGES

- Validating use of student time
  - keep sessions short and focused
  - hold individual evaluation meetings

Asynchronous method

 Most effective for auto-graded quizzes, essays, research reports, problem-solving tasks, participation grades

#### CHALLENGES

- Academic integrity
  - create alternate test versions for a single group
  - randomize question order
  - $\circ~$  set time limits for test completion
  - create questions that are highly contextualized and require students to answer from a more 'personal' perspective (Eg: discuss specific to the context, provide justification, examples, etc.)
  - offer a creative option whereby students can meet the academic criteria with their own choice of artifact











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#### 4.3 MODEL OF JOINT APPLICATION OF SYNCHRONOUS AND ASYNCHRONOUS METHODS

Prior to the COVID pandemic, the main e-learning courses were online courses based on the asynchronous learning method. Most of the online courses were created to be able to study them at any time convenient for the student with any sequence of studying the educational material.

The pandemic and the widespread shift from face-to-face learning to the use of video conferencing have shown that the synchronous learning method can be a good addition to courses built on the classic asynchronous learning methodology.

Depending on the course, its subject area, and content, various combinations of both methods can be used. An example is provided in Fig. 4.3. It presents a model for constructing an online lesson based on the use of various academic activities with both online learning methods used [2].



# Figure. 4.3. Model for constructing online courses with synchronous and asynchronous e-learning methods







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# 5. A2.5.2. Development of model for competence-based job skill building (UM)

Competence-based job skill building can help students to select the subjects that best match their interests. Providing this information may take away the uncertainty that arises when a student chooses which degree to study. In this section, a competence-based job skill building model is developed. It aims to align the academic and professional scenarios in terms of competences in order to address the interconnection of both worlds. In the construction of the model, current bibliographical sources for skills development have been analysed. This model is an incremental iteration of the competence model presented in Section 6. A1.6.

#### **5.1 JOB SKILLS FUNDAMENTALS**

Skills define what is expected of professionals in jobs. In this sense, education skills should be linked to the career requirements (Meganck, Smith, & Guidry, 2020). People trained in job skills improved employment and earnings for more than 30 years (Oh, DiNitto, & Powers, 2020). In addition, skills are at the heart of hiring processes, which in today's digital world have become costly, labour-intensive and time-consuming. In fact, the use of natural language processing techniques to automatically extract skills from CVs and streamline the screening of job candidates is being studied (Wings, Nanda, & Adebayo, 2021). As a result, selection processes remain accurate despite the high burden of work.

Any ability to perform a task correctly is considered a skill. Skills can be broadly classified into soft and hard skills. The former are related to interpersonal interactions, while the latter are related to the application of knowledge. There are countless skill taxonomies depending on the subject in which they are applied. Paquette et al. propose that soft skills can be divided into the domains of Bloom's Taxonomy [ref]. These domains are Cognitive or Knowledge-based with skills such as selective attention, long-term memory, logic; Affective or emotion-based with examples such as stress management, constructive feedback, commitment; and Psychomotor or Action-based with skills can also be subdivided. The most basic categorisation is based on the way companies organise their work teams. There are two broad subgroups, Skill-based and Role-based. In the first of these, the groups are equally divided by skill, examples being negotiation, administration, prioritisation. In the latter, depending on the position held by the workers, systems administrator, developer, scrum master. It is common to see in literature when defining a skill



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that skill, knowledge as well as competence are used interchangeably. The differences between these concepts are remarkable.

- **Skill (***Know-How***):** practical qualities that people develop and learn over time with practice and through interactions with others (Frezza et al., 2018).
- **Knowledge (***Know-That***)**: cognitive or intellectual qualities that refer to mastery of core concepts and contents (Frezza et al., 2018).
- **Competence:** a statement of principles that determines a ternary relationship between a public target or actor, knowledge and a skill (Paquette, 2020).

In the definition of competences it is common to find models that cover at least knowledge and skills. In addition, a third component is added which varies depending on the model (see Figure 1). Sources of skills were reviewed, finding that the well-known Knowledge, Skill, Attitude model (KSA model) was present in DigComp (Carretero, Vuorikari, & Punie, 2017). In Computing Curricula 2020 a competence is defined as the set of Knowledge, Skill and Dispositions (Clear, Impagliazzo, Parrish, & Zhang, 2019). In another model proposed by Paquette et al. a competence is defined as the combination of Knowledge, Skill and Performance (Paquette, Marino, & Bejaoui, 2021).

The differences between the wildcard elements found in literature are subtle, and are detailed below. In DigComp, attitude is considered to be a mindset to act, motivating performance and the basis for generating competent and sustained results over time. It concerns those characteristics related to values, aspirations and priorities (Vuorikari, Kluzer, & Punie, 2022). Examples include being proactive, being able to get along with others, being optimistic, being critical of others. On the other hand, in the case of Computing Curricula 2020, a disposition prescribes a temperament of character quality in the performance of a task. In addition, it shows values and motivation in the application of knowledge, indicating a level of professional performance (Clear et al., 2019). Examples include being self-aware, creative, collaborative, inclusive, open, flexible. As for the competence model proposed by Paquette et al., performance refers to a definition of the level of acquired knowledge. This model considers performance indicators such as frequency, context, autonomy, scope and complexity, which can be combined to classify competences within a set of four performance classes defined in the model: Awareness, Familiarisation, Productivity or Expertise (Paquette et al., 2021). Examples include developing code quickly, being resolute, practical, simplistic, agile, and stubborn.

The definition of competences with the mechanisms presented above allows to describe in a high level of detail the concepts encompassed by the competence. Paquette et al. give as an example the following competence, *diagnosing engine failures for any type of car*. This statement separates *diagnose* as a skill, *engine failure* as knowledge, and *for any type of car* as a disposition (Paquette et al., 2021). It is immediately noticeable that this model allows the concepts covered by the statement of the competence to be broken down into specific categories. However, in this example, it would be possible to combine the









skill and the disposition into one, becoming a major skill, *diagnose for any type of car*. In the development of the model for competence-based job skill building, these competence components were simplified. A priori no mechanisms to automate the categorisation of the concepts in the statement of a competence was evaluated. Thus, attitudes, dispositions and performance were considered as skills.

Figure 1. Comparison of different models to define a competence



#### **5.2 INFORMATION SOURCES IN JOB SKILLS**

Skills are important in recruitment processes. Despite their importance, no standards were found on how to define them. This may be because they are basic elements that form a larger whole, which is a competence. Although no standards recognised by international bodies were found, there are a multitude of standards of local compliance that are worth mentioning in order to extract some ideas on the definition of skills. The following sources were found:

- Texas Skill Standards Repository. A collection of skill standards in different industry domains. Developed by the Texas Workforce Investment Council (TWIC), which was established in 1993. It aims to analyse strategic planning in order to evaluate the Texas workforce system. All standards are delivered by industry groups, and must be changed whenever necessary due to substantial developments in the industry. For each standard, information is presented as the ITAC Convenor, which is the group of authors and/or author who drafted the standard. Whether they are fully recognised, i.e. presented in the repository format or conditionally recognised when presented in another format. Sector and code, which identify the industry sector to which the standard applies; and finally the cluster, which also identifies groupings of sectors. The standards have an application in the US state of Texas, and can be downloaded at <a href="https://www.tssb.org/texas-skill-standards-repository">https://www.tssb.org/texas-skill-standards-repository</a>.
- The European Foundational ICT Body of Knowledge. The European Foundational ICT Body of Knowledge. The European Union actively promotes e-skills. This paper looks at the growing lack of







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e-skills in the European workforce. There is currently a shortage of highly skilled ICT experts, which can be a barrier to economic progress, job creation and competitiveness. The number of ICT professionals needed in Europe will continue to grow, with demand estimated to increase by around 3% per year. However, the number of ICT graduates fell by 10% between 2006 and 2010. This manuscript proposes a framework for ICT professionalism. It consists of four components that are also present in other professions: a body of knowledge (BOK); a competency framework; education and training; and а professional code of ethics https://itprofessionalism.org/app/uploads/2021/02/The-European-Foundational ICT-Body-of-Knowledge-2015-11.pdf.

- The Digital Competence Framework for Citizens (DigComp). The Digital Competence Framework for Citizens (DigComp). The aim is to show the potential of digital technologies for innovation in education, improving access to lifelong learning in order to acquire new digital competences for employment, personal development and social inclusion. DigComp is a reference for the development of digital competence initiatives. It offers a tool to improve the digital competence of citizens. The document can be downloaded at: https://publications.jrc.ec.europa.eu/repository/handle/JRC106281.
- Skills Framework for the Information Age (SFIA). SFIA is a reference model of skills for the efficient use of Information Tecnologies (IT). It was created by the SFIA Foundation more than 10 years ago in the United Kingdom. It organises the needs of companies, showing the importance of having a standard that establishes the positions associated with the technologies in various sectors. To do this, it uses a simple language that is common between companies and academic training. It has a framework that identifies and measures the IT skills workers. With this guide, the average time for professionals to adapt to a new job can be shortened, increasing the company's success. It is a living model, which in its eighth version now incorporates new technological trends, outlining the competencies required for its application. It is accessible at: <a href="https://sfia-online.org/en?set\_language=en.">https://sfia-online.org/en?set\_language=en.</a>

#### **5.3 COMPETENCE MODEL EVOLUTION**

This section shows the development of a model for competence-based job skill. This work builds on an earlier model which will be described in the next section. The resulting model allows to represent both academic and vocational skills. Such models are in demand in online environments for educational







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organisation and job advertisement. However, representing skills from both worlds, professional and academic, can result in an unbalanced model, giving too much weight to one side instead of both equally. Both worlds, although different, are closely linked by skills. However, the way in which skills are defined may be different. Perhaps in the academic environment skills may be explained in more detail in order to attract students' attention, whereas in job advertisements, skills are usually presented in a terse way.

#### 5.3.1 PREVIOUS COMPETENCE MODEL

OF LODZ

In Section 6. A1.6. a competence model based on the harmonisation of IEEE 1484.20.1 and CWA 16655-1 standards was presented. This model has the parameters shown in Table 1 for defining an academic competence. However, the model is limited as it does not consider the Knowledge and Skills components that are necessary to define a competence. This previous model can be used to represent core competences where knowledge and skills are embedded in the textual definition of the competence. However, it may be interesting to extend the model in order to better classify the information of a given competence. This was one of the main objectives of the work carried out.

Mandatory elements			
	<ul> <li>Competence identifier</li> </ul>		
	<ul> <li>Title or name</li> </ul>		
	<ul> <li>Description</li> </ul>		
Optional elements			
	<ul> <li>Definitions, specified in much</li> </ul>		
	the same way as in CWA		
	16655-1 standard, to define a		
	competence from a set of sub-		
	competences		
	<ul> <li>Implicit metadata</li> </ul>		
		<ul> <li>Extra identifier(s)</li> </ul>	
		<ul> <li>Abbreviations</li> </ul>	
		<ul> <li>Date of creation</li> </ul>	
		<ul> <li>Date of modification</li> </ul>	
		<ul> <li>Validation start date</li> </ul>	
		<ul> <li>Validation end date</li> </ul>	
		<ul> <li>Date of issue</li> </ul>	
		• Author	
		• Topics	
		• Credits	
		• Level	
		Version	
	<ul> <li>Explicit metadata</li> </ul>		
	Explicit metadata	• Version	

#### **Table 1. Harmonised model**



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• Section where other metadata can be added from an external model

#### 5.3.2 ONTOLOGY LANGUAGES AND TOOLS

The implementation of the competence model in Table 1 was carried out with XML-Schema. This language is ideal for interoperability between systems. However, it does not offer the possibility to add semantics to the model. It is thought that providing semantics to the system would widen its potential adoption, as it would allow interconnections of skills from both the academic and professional worlds to be established automatically. In this iteration of development, model languages have been explored. The aim is to make it possible to extract the semantics of the competences and to do this, semantic metadata will need to be added into the system. The main modelling languages are the Resource Description Framework (RDF) and the Web Ontology Language (OWL).

In the RDF language, a classical conceptual entity-relationship modelling approach is used together with class diagrams. In addition, subject-predicate-object expressions are used in what is known as the RDF tern. In particular, the subject indicates the resource and the predicate indicates the characteristics of the resource, expressing a relationship between the subject and the object. On the other hand, the OWL language allows complex knowledge of things and their relationship to other things to be represented. This language allows all the knowledge expressed in a piece of code to be analysed by computer applications. OWL ontologies can be published on the Internet so that they can be used by other OWL ontologies.

The output of a conceptual modelling programme is directed graphs that allow particular types of data to be described. In general, the ends are real-world concepts or entities that are represented along with their properties, and the arcs show the relationships between the entities. The graphs discussed above can be represented with modelling tools that automatically convert the diagram into code in the desired modelling language. For the evolution of the model the G-MOT tool was used (Paquette et al., 2021). This piece of software was developed by Paquette et al. In the following iterations Protégé will be used to further refine the model, which is one of the most popular applications for model development.

#### 5.3.3 EXTENSION OF THE HARMONISED COMPETENCE MODEL

The extension of the model began by defining a set of dimensions on which to group the concepts of a competence. These dimensions are based on those proposed in DigComp (Carretero et al., 2017). This framework is organised into the following dimensions:









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- **Dimension 1:** Competence areas
- Dimension 2: Competence descriptors and titles
- **Dimension 3:** Competence levels
- **Dimension 4:** Knowledge, Skills and Attitudes
- Dimension 5: Examples of use

Of all the dimensions, number 5 was discarded, as it was not considered relevant to add examples within the model of its use. Figure 2 shows the broad outline of the blocks that make up the model. In dimension 1, the concept of competence area was adapted to the context. This dimension together with dimension 3 is necessary for competence matching (De Coi et al., 2007). On the other hand, dimension 2 was considered already completed from the initial iteration of the model and was not extended. Dimension 4 was the new section where new attributes on knowledge and skills were added.

In the composition of dimension 1, *Context*, studies and academic level were taken into account to indicate the degree of complexity of the competence. A total of 4 attributes were added: certificate, certificate level, skill-knowledge pair and keywords (see Figure 3). Certificate is the name of an individual's qualification. Certificate level allows to indicate the academic level of the degree an individual holds (De Coi et al., 2007). In order to match academic and professional competences, it has been proposed to construct skill-knowledge word pairs (Clear et al., 2019). These word pairs can be classified into groups identified by a particular action verb (see Figure 4). This allows skills to be organised according to their meaning, which can help to find similarities between academic and professional competences. Additionally, key words of the competence were taken into account to facilitate the search (Paquette, 2007).















Figure 3. Context dimension of the competence model















Generic Skills Classes			Active meta- knowledge	Generic	Cognitive	Skills cycle	
1	2	3	(Pitrat)	(KADS)	(Bloom)	(Romiszowski)	
	1. Acknowledge		1.0.000			Attention	
Receive	2. Integrate	2.1 Identify 2.2 Memorize			Memorize	Perceptual acuteness and discrimination	
Reproduce	3. Instantiate/ Specify	<ul><li>3.1 Illustrate</li><li>3.2 Discriminate</li><li>3.3 Explain</li></ul>	Knowledge Search and Storage		Understand	d Interpretation	
	4. Transpose/ Translate		1.27.2			Procedure	
	5. Apply	5.1 Use 5.2 Simulate	Knowledge Use, Expression		Apply	Schema Recall	
ate	6. Analyze	6.1 Deduce 6.2 Classify 6.3 Predict 6.4 Diagnose	Knowledge Discovery	Prediction, Supervision, Classification, Diagnosis	Analyze	Analysis	
	7. Repair			Repair		0 d 1	
Produce/Cro	8. Synthesize	8.1 Induce 8.2 Plan 8.3 Model/ Construct		Planning, Design, Modeling	Synthesize	Synthesis	
	9. Evaluate		Knowledge Acquisition		Evaluate	Evaluation	
Self-manage	10. Self- control	10.1 Inititiate/ Influence 10.2 Adapt/ control				Initiation, Continuation, Control	

#### Figure 4. Skill taxonimies comparitive

The content of Table 1 was transfered to the new version of the model for dimension 2, Descriptors and Titles. This involved adding the attributes in the diagram (see Figure 5). Of all the attributes, the ID, Title and Description are considered the minimum information necessary to complete a competence. The rest of the attributes in this domain can provide detailed information on the competence.











#### Figure 5. Skill taxonimies comparitive



For level 3, *Competence Levels*, proficiency levels and scales were taken into account. It was observed that it is common in job offers to request a number of years of experience for a given competence. In order to cover this information in the model, the attribute ExperienceLevel was generated with the variable Years (see **Figure 6**). In addition, the proficiency level and the scales were taken into account. In DigComp, four levels are defined, ranging from basic (A), intermediate (B), advanced (C) and specialised (D). On the other hand, within each level, a scale from 1 to 2 is defined. Therefore, the proficiency level is represented for example as A1, B2, C1, D1. This way of expressing the level of a competence is similar to that used in the Common European Framework of Reference for Languages: Learning, Teaching, Assessment (CEFR) for languages (https://www.coe.int/en/web/common-european-framework-reference-languages) (Carretero et al., 2017; Valtonen et al., 2021). Finally, the following variables were added concerning this dimension, proficiency level, maximum, minimum and threshold levels. For the proficiency scale, the following attributes were added, proficiency scale, minimum, maximum and threshold. In both cases, the threshold determines the acceptable level of a competence.









Finally, with regard to the last dimension, number 4, Skills and Knowledge, two sources of information were taken into account. In the case of skills, we looked for attributes that could represent a skill in the model. The SFIA schema discussed above provided a collection of attributes that reflected the level of detail sought to represent a skill in the model. No other source was found with attributes to define skills (see Figure 7). In order to build the knowledge section of the competence model, the Technological Pedagogical Content Knowledge model (http://www.tpack.org/) was taken into account. This model is specifically designed to adapt teaching to technological means. TPACK consists of 3 blocks technology, pedagogy and content for knowledge (see Figure 8). Combinations of all these components are defined. A total of 4 attributes were defined within the knowledge domain in the model. The first 3 were technology, pedagogy and content, and a fourth attribute was created to reflect combinations of the previous 3. Figure 9 and Figure 10 show how skills and knowledge were included in the model.















#### Figure 7. Attributes for the definition of a skill in SFIA

		Skill name	Digital forensics		
Level	7 Set strategy, inspire,	mobilise Skill code	DGFS		
Level	6 Initiate, influence	Skill Description	Activities may include — but are not limited to: • collecting, processing, preserving and analysing material		
Level	5 Ensure, advise	Guidance notes			
Level	4 Enable				
Level	3 Apply		<ul> <li>presenting forensic evidence based on the totality of findings.</li> </ul>		
Level 2 Assist Level 1 Follow Generic level definition			The scope of digital forensics includes finding evidence on computers and any device capable of storing digital data. The evidence may be used in support of security		
		Skill at a level	vulnerability mitigation, criminal, fraud, counterintelligence, or law enforcement investigations.		
	Autonomy	Works under general direction within a clear framework of accountability	DGFS Level 4: Designs and executes complex digital forensic investigations on		
	Influence	Influences customers, suppliers and partners at account level	devices. Specifies requirements for resources and tools to perform investigations. Processes and analyses evidence in line with policy, standards and guidelines and supports the production of forensics findings and reports.		
	Complexity	Work includes a broad range of complex technical or professional activities, in a variety of contexts			
쁙	and the second second second	Communicates fluently, orally and in writing,			
Enable	Business skills	and can present complex information to both technical and non-technical audiences			

Figure 8. TPACK model













Figure 10. Knowledge definition in the model







#### **5.4 CONCLUSION & FUTURE WORK**

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This section has presented an extension of a competency model to cover skills at work. The aim of this model is to address both academic and professional competences. One of the main objectives is to try to find matches between competences from both domains. For this purpose dimension 1, Context, was proposed, which with keywords tries to classify the concepts expressed in the competences. Work will continue on this pathway in order to seek mechanisms to automate the construction of Skill-Knowledge pairs. Among the alternatives being considered is the use of natural language processing (NLP). NLP mechanisms will allow the automatic selection of the words that make up the Skill-Knowledge pair. In line with NLP, work will continue on the semantics of the model. The aim is that based on the descriptions of the competences made by the users of the system, the system will be able to auto-complete itself, choosing the most suitable attribute to store the information of the competence. The next step in the development of the model will be to transfer it to the protégé programme in order to have the OWL code for the system. Finally, we want to validate the model with teaching guides of computer science courses, as well as with descriptions of online job offers.

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## 6. A2.6.2. Development of portal architecture (UiO)

#### 6.1 Introduction

Organizations of all sizes worldwide have dedicated their time to building and maintaining comprehensive portals to serve their customers, employees, trading partners, and constituents. Corporations from every industry, governments at every level, and nonprofit organizations representing every interest have all joined the portal hype. The number of websites that are considered as portals has increased exponentially, as has the number of organizations building portals for internal or external use.

A portal is a web-based platform aggregating information from various sources into a single user interface and displaying the most relevant information for the user's context. Simple web portals evolved into portal platforms that support digital customer experience initiatives over time.

In the early days of the internet, portals attempted to solve the problem of content discovery. In the face of the vast amount of information available online, the most convenient way for the average user to discover information was through a portal, which was a human-curated content hub. Portals could display customized content to provide users with a more personalized experience.

Portals represent an early paradigm shift for enterprises online: to build customer-centric websites rather than business-centric ones. A portal, in theory, allows an enterprise to create sites and navigation based on the user's needs, rather than an organizational structure that only makes sense internally(What is a Web Portal? | Liferay, 2022).

As the market for portals has matured, leading portal vendors have added broad features that help enterprises create these user-centric digital experiences for web, mobile, social, and connected devices. Content management, marketing, workflow, targeting, and mobile support are among these features. As a result, some portal platforms are evolving into digital experience platforms that leverage their strengths in integration and personalization to drive organizational change.

#### 6.1.1 From Web Portals to Portal Platforms

The common user can now handle the issue of content discovery by using search engines, which have gotten more adept at giving appropriate results. Because of this, as well as the information sharing possibilities provided by social media, human-curated compilations of information are no longer a necessary starting point for most users. However, portals' three distinguishing characteristics —







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integration, consistency, and personalization — are critical components of an increasingly vital aspect of business today: digital customer experience.

These three strengths support digital customer experience in the following ways:

- **Integration** features enable businesses to connect systems and customer data on the back end.
- An emphasis on **consistency** across digital touchpoints gives these integrated solutions a unified front-end look and feel.
- **Personalization** by combining biographical data (who they are) and behavioral data (what they did on the site) enables organizations to contextualize experiences, typically helped by a login procedure.

Modern portal platforms, significantly when enhanced with new capabilities such as content management systems or marketing automation, can play an essential role in consumer interaction. Companies are rethinking the value of these three qualities in today's multi-touchpoint environment of digital customer experience in order to reap the competitive advantages of portal platforms.

#### 6.1.2 Types of Portals

To better understand the usages of portals, there is a need to classify them into groups based on their purpose. This section explains numerous sorts of portals aiming at distinct roles for different audiences (Types of Web Portals: Quick Overview, 2022).

#### **B2C portal**

A B2C portal is a standard e-commerce portal aiming to provide the best purchasing experience. It enables the creation of a purchasing journey from the first interest in of user's goods or service to the final purchase.

#### **B2B** portal

A business-to-business portal often deals with more expensive and complex items or services than a consumer-to-consumer portal. A buyer-owned portal, a supplier-owned portal, and independent marketplaces that bring together multiple buyers and providers are examples of B2B portal types. In B2B, there is less room for spontaneous purchases, and the purchasing journey gets longer and more complicated. As a result, the B2B portal must have enhanced personalization and collaboration features.

#### Service portals

A service portal (self-service portal) is a web-based platform that aggregates functionality and information from many sources to allow users to self-help and self-service. Customer self-service portals, employee self-service portals (which are sometimes part of a broader HR portal), government service portals, and patient portals are the most popular forms of service portals.











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#### **Partner portal**

Partner portals are intended for companies that sell through indirect sales channels. A partner portal is a tool for managing your partner relationships and persuading them to sell more of your products or services.

#### **Community portal**

A community portal is a fantastic market approach and boosts the company's visibility. It is also an excellent approach to determine what the target audience thinks about the products or services and receive objective feedback for future improvements.

#### eLearning portal

As individuals shift their learning activities to digital platforms, the need for eLearning portals is expanding. In the corporate world, learning portals may be utilized by firms that want to save money and time on in-person training of new or existing personnel.

#### 6.1.3 Benefits of Portals

The motivations for portal development are as diverse as portals themselves. Portals have been created for a variety of purposes, including:

- Improve information access
- Remove barriers to applications
- Bring order to an organization's data.
- Allow the reuse of information
- Reduce training time and cost
- Improve information access for decision-making
- Cultivate better relationships with customers
- Reduce overhead costs such as benefits administration
- Speed turnaround for processing such as expense reimbursement
- Enable searches over enormous amounts of diverse data (documents, pages, database, messages, multimedia)

Portals have inspired technology that has found its way into a wide range of items. The portal services that any firm deploys are directly tied to the business advantages that they are attempting to accomplish. As a result, businesses should prioritize their portal activities in accordance with their business goals.

#### 6.1.4 Attributes of Portals

Each form of the gateway has its own set of qualities. This unified architectural approach streamlines business application development and shares hardware, software, and security design investments. These combined portal functionalities are as follows(Townsend, Riz and Schaffer, 2004):








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- Funded by the Erasmus+ Programme of the European Union
- A consistent user interface. Users should be aware that they are on a portal and should be able to traverse it effortlessly. As far as feasible, a uniform look and feel should be imposed throughout the gateway.
- Improved access to both organized and unstructured data. Portals may consolidate data access while also providing reports, searches, and ad hoc inquiries. They should enable searching across different, disparate sources.
- An intense and all-encompassing search engine. Full-text searching is required, and a broad range of document types are supported, including HTML, text, word processing (Word, WordPerfect), Adobe Acrobat (PDF), and others.
- Portal maintenance tools (typically content management). Maintaining a portal is costly if all modifications must be routed through support desk and programming personnel. The task of updating is shifted from programmers to content owners through content management. Consequently, the material is refreshed more often, eliminating bottlenecks in the workflow. Content management also enables the establishment of review mechanisms to prohibit content from being published without the approval of one or more reviewers.
- Increased security and more accessible security management Moving apps to a portal framework enable the use of a single security framework rather than the numerous and incompatible security approaches utilized by separate applications. Password length and expiration regulations, for example, can be imposed globally.
- Individual and departmental customization. The portal allows users and departments to construct pages with their favorite material and apps in order to speed access and give a customized view of the data required to run operations.
- Rather than a stovepipe application design, a shared architecture to facilitate transactions is used. The site is the transactional backbone for internal and external e-commerce transactions. Catalogs, shopping carts, payment processing, and other business procedures related to these transactions are all included.
- Minimal client footprint, resulting in lower deployment and update costs. Browser-based apps often require more minor desktop settings than traditional client-server programs. This is especially true when desktop setups are standardized and "locked down."
- Availability via many channels. The gateway can help with content and program reuse on desktop and laptop computers, Pocket PCs, cell phones, and tablet PCs.
- Merging of numerous apps and data sources. The portal would be a one-stop shop for data and application requirements. Instead of linking many users to several programs, you must integrate the applications with the portal.

# 6.2 Portal Design

# 6.2.1 Architectural of Digital Portal

An essential factor influencing system performance is architecture. It is common for systems to fail to operate as planned due to poor design decisions. Liferay is a renowned open-source portal development platform that will be utilized in the eMediator Project. Defining a system's architecture from the ground up necessitates massive study, investigation, and decision-making (Bhatt, 2013). The following figure shows the architecture diagram of the Liferay-Portal-based solution.







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# Figure 11. Digital Portal Architecture



#### The Presentation tier

Users will be able to access the Portal through tablets, mobile devices, or PC browsers. Liferay supports a variety of devices, and no extra components are required to generate content for mobile devices. Liferay can even recognize and respond to individual devices with device-specific content. Liferay also allows the developer to create responsive site designs.

#### The Networking tier

Every request will be routed through a Firewall. The Firewall will filter unsecured requests and send all legitimate user requests to the Hardware Load Balancer. A hardware load balancer is a piece of hardware that distributes loads among numerous web servers. The hardware load balancer can also handle web server failure. In the event of a web server failure, the hardware load balancer redirects traffic to operational web servers. There are several hardware load balancers on the market, including Cisco, Radware, CoyotePoint, and Barracuda, some of the well-known hardware load balancer companies.













#### The Web tier

A collection of Apache/Tomcat/Nginx Web Servers comprise the Web layer. Each Web Server is linked to each Application Server, as indicated in the reference architecture diagram. For Application Servers, the Web Server serves as a Software Load Balancer. Web servers can also deliver static resources as components.

#### **The Application tier**

Different web applications are included in the Application layer. The Application servers communicate with web servers through the AJP or HTTP protocols. There is a communication link between Application Servers, as illustrated in the diagram. Each Application Server communicates with other Application Servers to duplicate session information and cache and/or search indexes. Each Application Server will be linked to a separate Database.

#### The Database Repository tier

The Liferay Portal server establishes a connection to the Database Repository layer. Multiple database instances with replication will be used for production applications. This configuration guarantees that Database Servers are always available. Liferay Portal is compatible with the vast majority of open source and proprietary databases.

#### 6.2.2 Portal characteristics

In this section are the benefits of the architecture of the Liferay-Portal created for the eMediator project.

#### **Scalability**

Horizontal scaling is utilized for both the Web and Application tiers. Because most of the components in the design are separated, the developers can scale up by adding more nodes as the user base grows. This allows us to extend the system's capacity by adding 'x' number of application servers, web servers, or database servers.

#### Performance

The reference architecture divides the load of the system to multiple tiers. A static resource's requests can be served by the Web tier directly. Also, the Web tier is load balanced using the Hardware Load Balancer. So, the load on each web server is also controlled. Similarly, all application requests will be served by the clustered Application Server tier. The Application Server connects with the Database tier which is again clustered to ensure the load is distributed. The reference architecture ensures that the architecture of the solution is robust enough for delivering high performance.

#### High availability and fault tolerance

The reference architecture separates the system's burden into numerous layers. Requests for static resources can be provided directly by the Web tier. The Web tier is also load balanced with the Hardware Load Balancer. As a result, the load on each web server is also managed. Similarly, the clustered









Application Server layer will handle all application requests. The Application Server communicates with the Database Tier, which is also clustered to share the load. The reference architecture assures that the solution's architecture is sturdy enough to achieve excellent performance.

#### Security

The Firewall is placed ahead of the Hardware Load Balancer, ensuring that all security threats are screened. Depending on the security requirements, installing a firewall between each layer is also recommended. The Web tier, for example, can access the Application tier, but the contrary can be forbidden. The design permits setting SSL-based access based on project requirements.

#### 6.2.3 Portal Elements

Although portals vary greatly, they all have some characteristics. This chapter outlines the portal's elements and examines how they appear and function from the viewpoints of users and portal developers. Users generally cannot see which goods or technologies are at work behind the scenes to offer the functionality they want, which is a good thing. Several servers operating web services, content management, database applications, collaboration tools, and other portal pieces are responsible for what seems to be a smooth, consistent user experience. The developers must be concerned with ensuring that all of the elements fit together properly (Townsend, Riz and Schaffer, 2004).

The key portal elements are:

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

#### Friendly User Interface

Like all the computer software that interact with humans, portals have a user interface (UI). The desire for enhanced user interfaces for content and applications is the source of portals. The eMediator portal aims to provide users with crucial information with as few clicks as possible.

#### Security

The security mechanisms that will be deployed on the site will be invisible to users, as they should be. There is no incentive to publish the security procedures to avoid inciting hackers and crackers. Of course, users should be able to notice the authentication procedures, the usage of encryption (secure sockets layer), and the use of cookies. The eMediator site has two layers of protection. The simplest and most basic level is support for the general public, anonymous users. The second level of security is the







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authentication of portal users. Before creating an account, users can have access to part of the data and become acquainted with the platform at the first level. Registered users have complete access to the site's content. The registered users have access to the entire content of the platform.

#### **User Profile**

A user profile is essential for every user. The profile must include the username and password used for authentication. It might also include data items like:

- Name
- Job Title
- Organization Name

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- Organization Industry
- Addresses (Mailing, Shipping, Billing)
- Email Address
- Language Preference

Users should have access to their profiles so that they may check and update their profile information.

# Taxonomy and dynamic navigation

A taxonomy is a classification system used to make navigation and search easier. It is also a handy tool for designing navigation. Moreover, taxonomy can be presented as a site map. Site maps can be shown as a tree view with branches that can be expanded or contracted as desired by the user.

# **Application Integration**

Portals are much more than extensive collections of static web pages with attractive visuals and easy navigation. Portals require "hooks" to facilitate the creation of such apps and their integration with the broader portal structure in order to engage users more deeply. When done correctly, application integration is invisible to end-users. Users frequently need to combine data from many, often conflicting sources.

# **Database and Other Repositories**

A database, often a relational database, sits behind the scenes in a portal. The database usually contains:

- Structured data for applications that demand it, such as online catalogs, inventory systems, and various line-of-business applications.
- Content maintained by the content management system (text and HTML tags).
- Documents managed by the content management system
- Profiles of users. This includes user information such as name, email address, contact information, and preferences.
- Metadata. The database contains data about the databases (metadata) such as the table structure, relationships among the tables, and data definitions.

# **Cross platform Support**

Most portals today support cross-platform usage. The portal should be available to all users through computers and smartphones. This requires the portal to be responsive.

# Search engine









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Because the volume of material makes it difficult to discover what users need by browsing alone, all portals require search features. Adding robust and easy-to-use search capability to the portal may give users instant benefits. It is one of the finest techniques to combine disparate data sources without requiring additional user training on data storage characteristics.

#### 6.2.4 User Interactions

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#### Use Case

The following figure shows the use case of the digital portal that will be created for the eMediator project. The portal's registered users have three roles: a simple user, a teacher, and an employer. The user is able to visit two platforms through our digital portal, the LMS platform, and the BookAScience. In the LMS platform, the user should be able to view the courses created during this project by teachers. In the BookAscience platform, users should be able to find jobs based on job positions employers created.



Figure 12. Use case of digital portal

Activity Diagrams

#### Registration

All visitors to the digital portal should be able to register. The following figure describes the actions required to complete the registration. Professional and research organizations are types of simple users that can search for a job through the platform. The clients are the employers that can post jobs.











# Figure 13. Registration to the digital portal



#### **User Profile**

Users that register should complete their profile page before continuing. This will allow potential employers to know their skills and background before hiring them. The figure below shows the procedure as well as the data that are required.









#### Job position creation

Employers should be able to create various job positions based on their needs. Each job position has specific fields that need to be filled. The following pictures show the required data for creating a job.











## Job position find

The registered user should be able to view available job positions based on their field of expertise. Moreover, if they find something they think suits them, they should be able to apply for that position.



















## **Course Creation**

Users with the role of a teacher will be able to create new courses. The steps required to create the course can be found in the following figure.

## Figure 17. Course Creation



#### Find a course

Registered users that want to gain new skills should be able to find courses and enroll in them. The following figure presents the available actions that users can take to find and enroll in a course.



























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# 7.A2.7.2. Selection of pilot services for demo deployment (AU)

This section describes the working package outcomes of Aalen University.

# 7.1 Pilot Services Selection Procedure

The selection of the pilot services has been done based on a secondary research methodology. There are already a lot of working portals in place in the world wide web (WWW) covering lots of functionalities which are needed to fulfill the tasks of a digital experience platform, which eMEDIATOR should represent. Usually, one can separate platforms into different categories. There are two main categories: (1) aggregation / integration platforms which have the responsibility to combine multiple sources into one platform; and (2) digital platforms that are focused on product and technological development, such as development platforms offering frameworks, services, and methods to further develop digital products (Tiwana et. al 2010; Boudreau 2010).

Whereas people often think that the platform thinking, or hierarchic structure firstly developed in the digital industry, the methodology itself started to develop in a completely other industry. The car manufacturing industry started to organize their facelifts and new car releases based on platform structures. This has been the case since Toyota was revolutionizing the "innovation cycle" in the automotive industry.

Coming back to eMEDIATOR, it is clear that, based on the requirements delivered in the first report period, **eMEDIATOR is an aggregation / integration platform project**. There are a lot of functionalities available already on the market considering digital learning, education, or other needed services in educational sector.

Well known software solutions are:

- 1. Learning Platforms (providing mainly digital learning activities):
  - a. Moodle Digital Learning System
  - b. Google Classroom
  - c. Blackboard Learn
  - d. Canvas
  - e. Chamilo





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- f. Docebo
- g. Schoology
- h. And many more...

Combined source: <u>https://www.capterra.com.de/alternatives/80691/moodle</u>

2. Higher Educational Software for Students

These software solutions are more focused on the studying workflow and all organizational subjects around. There are differences in between those software solutions. Some are designed to serve as general tool for institutions, some are designed for specific processes (like laboratory management systems). In the following list, the differences are shortly described behind the product itself.

- a. Workday Student (Campus management software, more focused on the institution's side)
- b. SalesForce for Higher Education (CRM based educational system providing workflows for the whole student's lifecycle)
- c. Pearson Education (educative learning in groups)
- d. Cerego
- e. Labstats (focused on Laboratory)
- f. And many more...

Combined source: https://www.softwaresuggest.com/blog/best-educational-software-for-students/

# 7.2 Selected Services for the eMEDIATOR platform development

Analyzing the existing portals, platforms and developed requirements during the first iteration, a list of services for the eMEDIATOR platform could be generated. The services are shown in the figure below as image and are described afterwards in a specific table. Important Note: Although a few aspects will repeat now compared to the requirements list worked out in the former project period, the focus is now only on the "user centered" services that have nothing to do with any backend or technical requirements.











The service blocks of the image are separated into three categories: (1) Services for academic or other institutions, (2) Services for students, and (3) Combined Services.

The displayed services are described in more detail in the following table:

# Table 2. Services Description

Pos.	Service	Description
1	Recruiting Service	Recruiting new employees, academic staff, and graduated students
		for economical or research challenges
2	Learning Service	Provide learning capabilities like existing e-learning platforms
3	Curriculum Creation Service	Create and manage curricula directly in the portal
4	Exam Service	Create and manage written and oral exams directly in the portal









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		Canadra
5	Profile Management Service	Manage and update your profile
6	Document Management	Create documents in collaboration such as new research papers
	Service	
7	Communication Service	Communication between students, academic institutions, and
		economical institutions
8	Research Project	Manage research projects, track invested times, and document all
	Management Service	done work for the funding organizations
9	Wiki-Service	Save every knowledge in the direct integrated wiki-system
10	Forum Service	Possibility to open new threads about education or new
		information like a black board in the academic or economical
		institutions
11	Rating Service	Rate the courses and course materials directly via the platform
12	Other Services	

The list of services will of course grow continuously during the period of the eMEDIATOR project.

# 7.3 Selection of "Pilot" Services for the eMEDIATOR platform demo

Between the described services are services than can be used directly technically for the prototype (demo) in development. These services are summarized in the following table with the reference to the integrative component:

Pos.	Service	Reference to existing solutions to be integrated
1	Recruiting Service	Integration of BookAScience Platform component
		( <u>https://bookascience.com</u> )
2	Learning Service	Integration of Moodle functionalities
3	Curriculum Creation Service	Integration of Process and Workflow Management
		functionalities, such as Alfresco BPMN or other tools
4	Wiki-Service	Adaptable out-of-the-box functionality of the most
		platform frameworks
5	Document Management Service	Adaptable out-of-the-box functionality of the most
		platform frameworks. Also realizable via Google
		Docs integration
4	Wiki-Service Document Management Service	Integration of Process and Workhow Manage functionalities, such as Alfresco BPMN or other Adaptable out-of-the-box functionality of the platform frameworks Adaptable out-of-the-box functionality of the platform frameworks. Also realizable via G Docs integration

#### Table 3. Services for eMEDIATOR demo implementation











6	Forum Service	Adaptable out-of-the-box functionality of the most
		platform frameworks
7	Research Project Management Service	Integration of BookAScience Platform component
		(https://bookascience.com)
8	Profile Management Service	Adaptable out-of-the-box functionality of the most
		platform frameworks

The displayed services will be the first services to be implemented for the eMEDIATOR demo application.

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# **APPENDIXES**















APPENDIX 1. Requirements of Service Delivery Models and portal integration with external systems (TTI)

# APPENDIX 2. Requirements for the portal learning environment (UL)

Digital capabilities in learning design, learning processes with emerging skill sets



Requirements Description











Project Code 2021	-1-LV01-KA220-HED-000027571	ERASMUS+ Project eMEDIATOR	
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Gen-TEC-002	Versatile technology tool	2D and 3D displays as well as social media channels, online tools will provide richer communication opportunities. AI-based recommending systems and will be an	
		asset.	
Org-FUN-001	Award system	Graded and certificated courses	
Gen-TEC-004	Accessibility (anytime, anywhere)	Mobile version of the platform.	
Ped-TEC-001	Learner and teacher friendly	Differentiated tools for creating tasks for learners.	
Gen-TEC-005	Competence-focused	Skill(s) matching and search jobs.	
Tec-FUN-001	HCI design standards	The platform should be jam-free, working	
		fast, intuitive and clear.	
Gen-TEC-006	Possibility of evaluation of the	A room for content evaluators - the	
	content	platform should present high-quality	
		content that could be evaluated by a	
		specialised teams – within an	
		institution(s).	

APPENDIX 3. Requirements of competence-based job skill-building (UM)

APPENDIX 4. Requirements of portal architecture (UoI)

APPENDIX 5. Requirements of demo services deployment (AU)















# APPENDIX 6. Requirements Miscellaneous

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