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Abbreviations and Acronyms:	

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1. A1.1 State-of-the-art Analysis of Mobility Education-as-a-Service Models and Portals Supporting these Models (TTI)

1.1 Introduction

The creation of the European Digital single market without restrictions or barriers to access is a principal objective of Digital Agenda for Europe. Education at the vocational and tertiary levels should comply with such dynamic changes so that graduates can meet the needs of employers and the market [1, 2].

The pandemic has opened new challenges for the education market and revealed new needs of society. One of the contemporary safety nets for the workforce is provided by the opportunities of the Gig economy with its vast opportunities of flexible self-employment, often viewed as the next level of development of freelancing, and which can be defined as the economic opportunities that link any service providers and customers on a marketplace on specific demand instances [3]. In case of education, the Gig economy allows for the creation of networked information structures facilitating a direct linkage between student clients, education providers and teachers outside of rigidly limited formal educational structures. Such transformations form new mobility requirements for education - receiving educational services without changing the participants' location, possibility of receiving such services at any time and agility of education mobility.

Obviously, there is a need to create a new education ecosystem - the education mobility as a service (henceforth - EMaaS). The EMaaS concept is proposed in [4] and is an extension of the education as a service (henceforth - EaaS) model. The paper describes the results of the study, the aim of which was to create an information model of EMaaS offering Gig education services to the academic workforce, students, and institutions to meet educational and employment needs by solving job and course search problems within the common EU education space.

1.2 Education-as-a Service Concept

The EaaS concept is currently being actively developed. The rapid development of modern technology is now outstripping the ability of universities to adapt their curricula to these requirements. The EaaS model offers students an alternative or addition to standard university programs and internships, on the one hand. On the other hand, the EaaS model helps enterprises formulate the actual requirements for the competences of future professionals, which increases the efficiency of adapting university programs to the dynamics of the labor market.

Some universities have already proposed to view learning as a service with all parties co-creating the service [5]. Students can become co-creators only if universities adopt a student-centered

approach on the condition of students' taking responsibility for co-creating the learning process. To bridge the gap between universities and students' actions, it is suggested that marketing-oriented approaches be used with the focus on creating the academic environment that will satisfy students' needs [5].

Some researchers consider that in the future students will definitely know a set of competences they will have to have to obtain a job and their choice of programs will depend on whether universities will be able to offer programs consistent with students' expectations of competences and universities' abilities to convince students they develop such competences, indeed, and universities' agility to rapidly and continuously renew their courses and curricula [6]. Some features of the EaaS approach are already being implemented for computer sciences education, some specifics, and recommendations of the transition to an EaaS education model for both universities and IT companies have been proposed [6].

Digital designs for EaaS have already been created [7]. Many authors focus primarily on technical aspects of the implementation of the EaaS concept, describing cloud technologies as the technical basis for its building, for example, by using Infrastructure-as-a-Service model [8]. Some researchers focus on the practical application of the concept at specific universities, for example, at the AP University Competence Center of the Technical University of München [9]. The EaaS model is considered as a service superstructure over the service models, such as Infrastructure-as-a-Service (IaaS), Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) [9].

Overall, the current research mostly describes various aspects of the EaaS model either from a conceptual or technological angle. However, there is no description of the model from a holistic perspective, including pedagogical and organizational features, enabling the interaction of all users on EaaS platforms. Once EaaS platforms are described comprehensively, new opportunities for evolution of EaaS platform ecosystems emerge leading to EMaaS platform solutions.

1.3 Remote Mobility of Education during 4th Industrial Revolution

Another important prerequisite for the creation of EMaaS model is the ever-growing trend towards remote mobility of international students and teachers. Education being digitized, like other sectors of the economy, is a consequence of the 4th industrial revolution whose aim is to develop high-level professionals and students' competences consistent with societal needs [10]. Educational mobility is a component of internalization of education, also known as borderless educational services, offering flexible curricula [10] and which, therefore, might be more attuned to the immediate and foreseeable needs of the market. Traditional forms of higher and vocational education are subject to formal constraints of certification, licensing, and accreditation, which impede education agility in contrast to educational platforms outside of formal education. The creation of EMaaS model on the European scale might be viewed either as the next level of development of formal education or an educational form that is alternative to formal education.

The context of COVID-19 pandemic has propelled the development of remote education when face-to-face training has been replaced by remote learning activities and globally more than 90% of higher education colleges and universities moved their on-site instructions to online teaching in 2020 [11]. The fact that education has not collapsed but has continued to offer its services proves the good capacity of remote education and points to business sustainability of the EMaaS concept.

Although there are various business models underlying the Gig economy services, on which the EMaaS model can be based, the basic concept on which such business models are built is rooted in the relationship with the Gig workforce that is viewed as independent contractors using Gig platforms to offer services when needed and in the amount needed, at a reduced cost of market entry, if at all, and with hardly any spending on marketing [3]. In line with the EMaaS concept of services on-demand, which is clearly a feature of Gig platforms [3], the EMaaS platform might be viewed as a platform-company, which can be viewed as part of the platform economy [12].

As for-profit generation, such platform-companies generate revenues via cloud digital intermediation and by substantially reduced costs of operations managed by algorithms, by transferring some business operation costs to platform users, by creating attractive network of markets for investors [13], by managing business operations [12]. The business growth of platform-companies typically proceeds via diversification of offered services and increasing the market share for the offered services [13]. Some other business models of educational platforms evolve around small tuition fees imposed on certification and registration of courses, paid offers of head hunting, generation of paid products based on user networking, e.g., conferences, paid offers of student performance data [14], examination charges, additional study resources [15]. Often education platforms, such as Massive Open Online Courses (henceforth - MOOC) platforms, do not generate sufficient revenues for their producers, as it is the case with edX [14], [15]. The motivation of such platform commissioners, who tend to be public authorities and educational institutions, is to provide education to the population that otherwise might not be in the position to receive education [14], [15].

The existence of various business models of EMaaS educational platforms indicates business viability of the current project.

1.4 MOOC Platforms and Technological Capacities

The roots of the MOOC model lie with a new path of education launched in 2012 by P. Norvig and S. Thrun, professors of Stanford University, who decided to put their classes online free of charge. This gave impetus to the development of Massive Open Online Courses platforms, first of which were the online educational platforms Coursera, established by Stanford University as for-profit business, and edX, jointly opened by MIT and Harvard University as a non-for-profit platform [16]. Such platforms create public goods and benefits [16] and democratize education, thus,

providing more opportunities for most members of the public irrespective of their location or personal and professional circumstances to fill in the gaps with their education.

As for the technical capabilities of technologies, they can fully satisfy the requirements of an educational ecosystem. Artificial intelligence (henceforth - AI) has been used for more than 30 years as an educational instrument capable of creating adaptive and customized learning environment integrating logical algorithm-based operations [17]. For example, the educational platform Cloud e-Lab runs scalable contents and accommodates extendable study modules [17]. Research has found that students' motivation to learn and students' understanding of the subject improve once computer technologies promote learning [18]. Computer technologies have introduced various forms of virtual reality simulation-based training and telementoring, which are considered to lower the negative impact of the human factor of inexperienced professionals and enhance learning experience [19].

The EMaaS model is the next step in development of such an approach to education because it introduces the concept of competences, mostly focuses on matching service provides not only of higher education but also of vocational and further education, and students and interns, is open to individual professionals independent of their institutions and institutions across Europe and offers internship options, which is particularly important for some sectors of economic activities, such as health care and technologies.

1.5 Cloud Computing and Education-as-a-Service

Cloud computing represents a new IT-provisioning model [20] and is usually characterized by keywords like on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service [21]. Following a definition of the National Institute of Standards and Technology (NIST), cloud computing is defined as a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction" [21]. On the bottom line therefore, cloud computing means consuming IT-services in an "on demand"-fashion at a low cost without having to maintain an own IT-environment and the accompanying large pool of IT-specialists.

Cloud computing services are classified according to the nature of the facility they provide. These can be categorized as e.g. Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS) and further service layers [21, 22], to name only a few examples. According to [22] the cloud computing delivery concept may also be summarized using the term Everything-as-a-Service (XaaS).

Transferring this notion onto the educational context, EaaS seems to be a feasible solution for meeting the already laid out demands of higher educational institutions in teaching analytics and big data. Specifically, EaaS implies provisioning the whole hardware and software stack as well as

suitably teaching materials for this endeavor. The term EaaS has been mentioned by various authors. [23] explain this term as the sum of architecture, applications, and services for education in the form of lectures, quizzes, assignments, marking, tutorial, discussions, debates, and student support [24]. They also expect a high benefit by using cloud service for higher education. Fogel in [25] introduces an EaaS-model featuring four cloud layers. The 'physical hardware services' and the "virtual resource services" are grouped together under the generic term "IT services". "Generic services" and "education services" are grouped under the term "user services". Chang and Wills in [24] note "that EaaS is not only a new way of delivery of education but also an economical and sustainable business model."

Institution employing EaaS can utilize the provided teaching materials as starting points for their lectures and access the required software services via Internet. Technical and teaching material related support is included in the proposed EaaS-concept as well as the required trainings to use the educational environment and the teaching materials. Therefore, EaaS is a combination and extension of the classic IaaS, PaaS, and SaaS layers. The concept can also be employed in the scope of academic research endeavors, effectively decreasing the entrance barrier for aspiring projects, which would demand a high front-up investment in hardware. Based on the four-layer model presented by Fogel [25], in [9] proposed a more detailed and more complete model. This model is structured according to the four basic service layers IaaS, PaaS, SaaS and EaaS (each layer includes the underlying layers).

The service layers can be distinguished between service layers which are visible for the customer (customer view) and service layers which are invisible for the customer (operating view). However, the service provider must maintain and support both types of service layers in a holistic approach. The services of the various layers must be well synchronized. Therefore, the EaaS-provider must act as a service aggregator as mentioned Offering Big Data Services in an Educational Context [26] and must ensure that the different services work together neatly. This includes aspects of security, availability, backup & recovery, fire protection, and so on across all service layers. Next, the service provider must assure the ability to use the offered EaaS by skilling the customers accordingly as mentioned before.

In a bottom-up view, the network layer covers all the network resources which are necessary to provide the connectivity needed for any type of cloud-based service. Based on this, the storage layer represents the sum of technology and software to provide storage as a service. The server layer stands for the computing power, memory, and I/O capacity in terms of IaaS. Virtualization is one of the basic concepts of cloud computing and encompasses the introduction of an additional layer of abstraction between hardware and operating system, which in turn can dynamically manage and distribute physical computing resources to software instances running on top of it, thus making the resources "virtual" to its consumers. On the operating system layer, the provisioning of a (server) operating system is implicated. The middleware layer provides additional services to software applications additional to those included in the operating system

service layer. Especially in combination with the runtime layer, libraries, services, and tools for using programming languages are provided to the costumer [21]. In such a PaaS-environment, the customers have control over their deployed applications and configuration settings. The teaching dataset layer comprises sample data as the general basis of the teaching materials, e.g., a model company to describe common business process. On the application layer, the use and the functionality of software is provided to the customer in terms of SaaS. "The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings" [21].

In [25] Fogel lists 'content management services' and an 'online community service' as education-specific user services. Accordingly, [9] identified two additional layers as extension to the SaaS-concept: teaching material and community. Teaching material includes slides, case studies, student exercises, information for lecturers, and many more things which may be useful for teaching. Finally, on the community layer, the EaaS provider provides access to e.g., communication platforms and organizes e.g., networking events. The communication platforms can be useful for both, getting in touch with other lecturers and to interact with students.

It is important to note that services from a higher service layer include all the services of the layers subservient to them. For example, IaaS includes the provision of storage, networks, and other fundamental computing resources [21]. Therefore, EaaS includes the whole set of service layers.

1.6 Conclusion

The creation of an ecosystem for mobile learning contributes to solving several long-overdue tasks of higher education, which include the following aspects:

- Meeting individual educational needs of students, lecturers, and employees of businesses for the development of specific competences on the base of education mobility services during university studies and life-long learning.
- Promoting career development of lecturers which have their own values independently of academic institutions, their mission and vision which might not be aligned with the values and career aspirations of lecturers.
- Implementing a competence-based model of higher education into a digital reality offering service-based Gig borderless educational and employment opportunities
- Creating an economic environment for implementing academic competences.
- Enabling lecturers to develop their professional competences in another European context, when the local market is either not interested in their knowledge and

competences or is already saturated with professionals with such competences developed in the past when such competences were in demand.

- Developing knowledge and competences required on the European market, not only on their local market, thus, enhancing the quality of current and future education and competitiveness of students, staff and institutions.
- Offering mobile opportunities for individuals and corporate structures to obtain and offer services from other countries, thus, merging education and business into a single agile "eduwork" space created by online activities.
- Providing academic institutions with an opportunity to recruit specialists with specific competences that they cannot find on the local market.

The creation of a single digital cloud-based platform integrating independent online services related to education and employment will create the basis for the development of a flexible, adaptive educational environment with open access. Based on the state-of-the-art analysis a set of best-practice guidelines for running an educational service cloud as MEaaS can be proposed:

1. There would be strong ties to hardware and software partners as a best practice for EaaS-provides. State-of-the art hardware infrastructure is a prerequisite for providing flexible cloud solutions in an efficient way. Above that, educational institutions strive to use latest software products in the classroom, therefore it is important to cooperate with software partners to keep the provided software solutions and curricula up-to-date.
2. A further best practice is a flexible IT-infrastructure that can support a broad range of software solutions as well an easy sizing through virtualization.
3. A pro-active community management is another vital best-practice. Through adept community management, an EaaS-provider can communicate with connected educational institutions on new services and identify chances to co-innovate with them.

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2. A1.2 Benchmarking and Formulation of Requirements for Portal (TTI)

2.1 Benchmarking for eMEDIATOR Platform

Assuming to launch a new product on the European educational market - the eMEDIATOR platform for providing mobile educational services, we must not only conduct a market study, but also determine quantifiable characteristics for assessing competitiveness.

As an approach, we propose to use benchmarking in the sense that it is formulated in work [1]: "Online competitor benchmarking is a structured analysis of the online services, capabilities and performance of an organization within the areas of customer acquisition, conversion, retention and growth".

Quantitative benchmarking criteria can give you benchmarks against which you can compare your potential to real competitors and try to improve on them. Examples include the potential size of the market segment for the offered online services, or statistics reflecting the offering of individual services by competitors in the education market.

Naturally, in this study, for comparison, we can use only publicly available sources of information.

For implementation of the benchmarking analysis, we have selected so called RACE model depicted on the Fig. 2.1.

Fig. 2.1: RACE model [1]

The model may be characterized by the following description:

1. Reach – Website unique visitors, Viewable impressions on media sites
2. Act – Key website outcomes for lead generation: Registrations and leads
3. Convert – Sales – online or online-referred sales
4. Engage – Customer satisfaction and ongoing engagement

As part of our research, we have identified several examples of the most popular web measurement tools that will be used to benchmark the eMEDIATOR platform. The following tools seem to be the most suitable for the purposes of the project:

1. **WhatRunsWhere** (https://www.whatrunswhere.com/) - provides you with the Digital ad intelligence you need for access the most complete and accurate picture of the digital advertising ecosystem.
2. **Similarweb** (https://www.similarweb.com/)is the fastest, easiest way to discover what's really happening online.
3. **Socialbakers** (https://www.socialbakers.com/) is unified social media marketing platform - drive growth by understanding your audience, creating content they love, analyzing engagement and improving cross-channel care.

In accordance with (Sprinklr Team. 2021), benchmarking lets you compare your company's performance against competitors and other best-in-class brands [2]. Competitive pre-defined benchmarking measures where and how your organization differs from the competitor.

It should be noted that the benchmarking approach used in the trading business does not correspond well to educational activities. The existing system of university ranks characterizes the scientific capabilities of the university more than its attractiveness as a mass educational institution [3]. The most suitable for comparison of higher education institutions oriented to mass and diverse students is U-Multirank [4]. The following Fig. 2.1. represent and example of university benchmarking by U-Multirank.

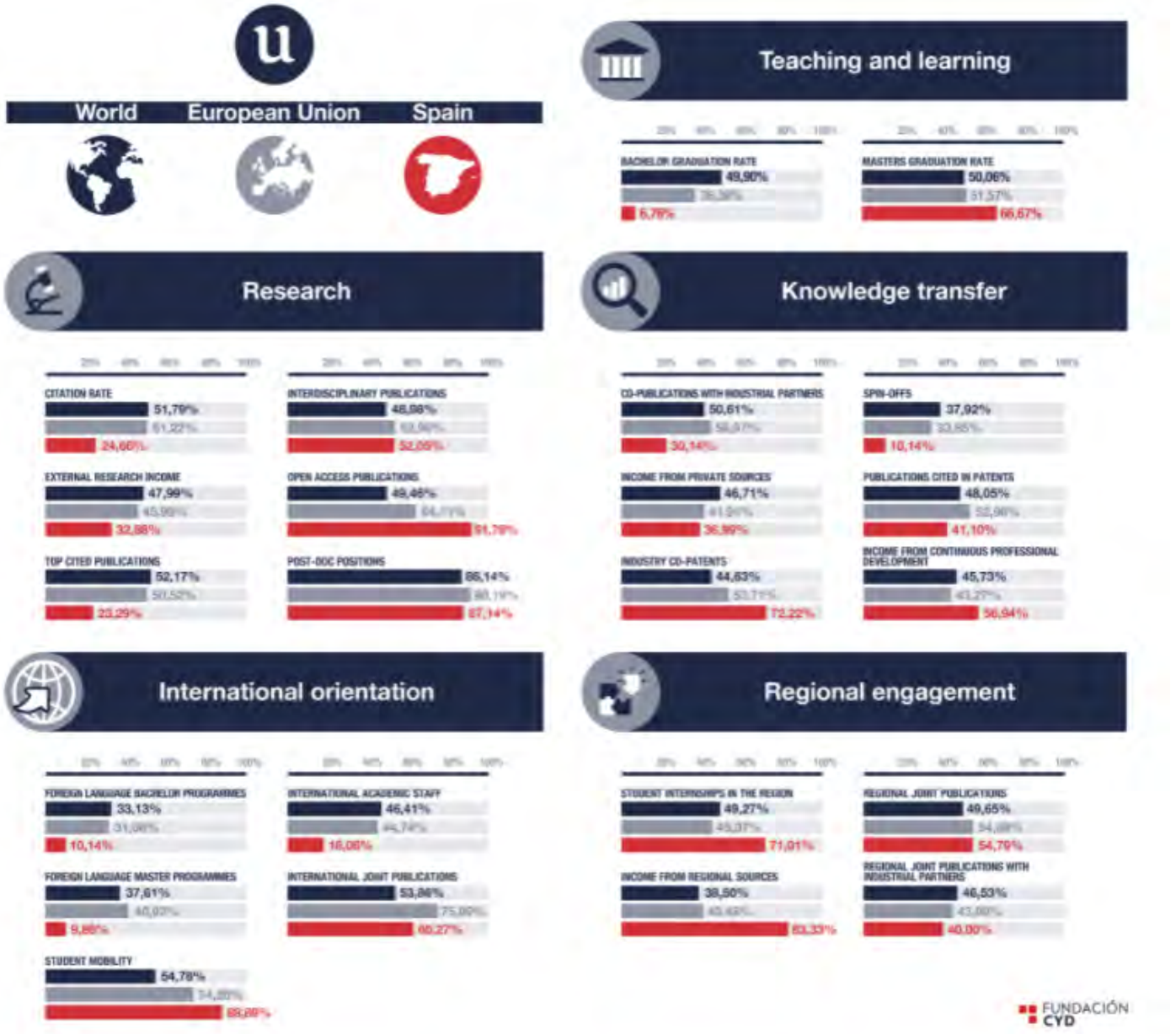

Fig. 2.2: Example of university benchmarking by U-Multirank [5]

2.2 eMEDIATOR Project Work Product Version Naming CONVENTION

The presence of a file naming system for the eMEDIATOR digital portal is very important for the consistency of all its parts, as well as for the coordination of all work between the performers. At its core, the portal is an integrator of various cloud services and should be built on standard interfaces. This is not only to make it look clear to the user, but to make things easier when you

need to make a change and extend functionality. This improves readability and clarity, and points the way to integration with a file management system or enterprise software.

For the unification purposis the following general Naming system requirements were selected from [6]:

- The simpler the better. The names should be short.
- The naming system should be future proof with virtually unlimited names.
- The naming system should have unique file names.
- The naming system should have the same pattern for all classes of components.
- The naming system should use minimum words.

2.2.1 The Main Rule for Work Product (WP) Files Naming

The naming rule is the following:

<Meaningful title>_<Country code>_<WP code>_<Period>_<WP form>_<Version.subversion>_eM.ext

Examples:

- Internal_Report_1_LV_Arc_PR1_Txt_1.3_eM.docx
- Search_Use_Case_GR_Tec_PR1_Pic_2.3_eM.png
- Registration_Interface_Mockup_GE_Demo_PR3_Txt_1.3_eM.pdf
- eMEDIATOR_Application_GE_Demo_PR6_Prg_2.8_eM.exe

2.2.2 Requirements for Work Product Presentation Forms (WP Forms)

Requirements for the Work Product (WP) presentation forms are presented in the Table 2.1. below:

Table 2.1: List of accountable WP presentation forms

No.	Presentation type	WP Form
1	Text Document	Txt
2	Any type of graphical image	Pic
3	Executable code	Prg

2.2.3 Requirements for Work Product Codes

In the project, the development is distributed among the partners in separate components, which will then be integrated. Therefore, it is proposed to introduce the following requirements for the naming (coding) of work products, which are presented in Table 2.2 below.

Table 2.1: List of accountable WP presentation forms

No.	Work Product	WP Code
1	Architectural model	Arc
2	Pedagogical model	Ped
3	Organizational model	Org
4	Competence model	Cmp
5	Technological model	Tec
6	Demo implementation	Demo
7	Whole ecosystem	Gen
8	Management document	Mgt

2.3 Formulation of General eMEDIATOR Platform Requirements

This project is carried out in Agile technology and implements an evolutionary development strategy. This means that as development iterations progress, the requirements for the final product will change. This fact requires increased attention to the requirements management process. To do this, we introduce a fixed form of product requirements description with Unified Service ID (USID), presented in Table 2.3 below.

Table 2.3: Initial requirements for eMEDIATOR services

Requirements Description		
Unique Service ID	**Service Name**	**Brief Service Description**
XXX-YY-NNN		

Legend (USID): XXX-YY-NNN (XXX – Work Product code, Y – Service type, NNN – Service number withhin the product)

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3. Conducting Surveys with Customers (TTI)

A1-3. Survey Description

3.1 Introduction

There are various platforms offering training, internship and work opportunities both nationally and within the European Union context. For example, in Latvia, such portals are https://cv.lv, https://prakse.lv, while in the EU, it is https://ec.europa.eu/eures/public/jobseekers_en, and others. Such portals, however, have some gaps that need to be bridged in the context of the development of the common digital EU training and employment market and the need to match competences to training and employment offers because currently available portals do not fill such gaps.

3.2 Shareholders of the Portal

As any portal, this one also has its shareholders, which could be divided into two major categories – primary and secondary shareholders. The primary shareholders consist of three major groups – higher education institutions, employers and students. These are the parties for whom the demo portal will be developed and whose direct needs will be addressed. The secondary shareholders are represented by national and the EU institutions promoting education, competences and the integration of the market needs with educational contexts. Within the hierarchical structure, the secondary groups of shareholders certainly dominate the primary counterparts. However, this project focuses on satisfying at least some needs of the primary shareholders, which is why the research will address the needs of this group. Furthermore, it is the premises of this research that if the needs of the primary shareholders are met, the related issues that are faced by the secondary shareholders are solved.

3.3 Aim of the Survey

In order to identify the needs of the primary shareholders, it was important to collect the information on their views regarding the demo portal. Therefore, three surveys addressing the needs of each specific group were created – Survey of Educational Organizations, Survey of Employers and Survey of Students. The aim of each survey was to collect information on training, internship and work opportunities under the umbrella of competences and the common European digital space mostly enabled via the information exchange and offers in English.

3.4 Structure of the Questionnaire

3.4.1 Overall Structure, Notation and Questions

Each survey was divided into two major blocks – information about the participants' background and their interests in the demo portal. The former block constituted some 30-35% of the entire survey. These major blocks were visibly separated from each other in order to easy the visual perception of the survey. Each major block contained sub-blocks. Although some sub-blocks were similar, they were not integrated into one sub-block due to differences in the nuances of questions. Not always did the questions included in the sub-blocks immediately follow each other. The occasional distribution of the questions belonging to one sub-block across a few other sub-blocks was implemented in order to ensure that the respondents' answers are not primed by the context of one specific sub-block. This was done to boost the objectivity and reliability of the submitted answers. The creation of the sub-blocks facilitated the interpretation of the obtained results.

As for the notation principle, the questions in Block 1 were numbered in the increasing numerical order at the interval +1 and were preceded by the letter "G", which referred to the notion of "General (questions)", for example, G1, G2, G3, etc. The questions in Block 2 received their numbers in the increasing numerical order at the interval +10, which was done in order to ensure the possibility of the expansion of the surveys in the future. To indicate the reference of the questions to the specific information about the platform, these questions were preceded by the letter "S", which stood for "Specific (questions)".

In terms of the types of questions, they were multiple-choice questions with the possibility to choose more than 1 answer in most cases. Only the last two questions in each survey were open-ended questions targeted at the elicitation of information from the respondents. Such types of questions were important to ensure that the respondents had an opportunity to fully express their opinion on the theme of the survey.

3.4.2 Survey of Educational Organizations

The summary of the structure and questions of the Survey of Educational Organizations is provided in Table 3.1.

Table 3.1. Contents of the Survey of Educational Institutions

Major block	Sub-block	Questions	Total number of questions
Participants' background	Institutions	G1. Which types of educational institutions and other employers have you worked for? • Research institute • University • University College • College • Vocational Education Institution • Other type of an independent training center • Training center of a company • Companies • Public, municipal and governmental organizations • Military services • Charity • Other: _____ G5. How many institutions have you worked for? • 1 institution • 2-3 institutions • 4+ institutions • Other: _____	2
	Positions and areas of employment	G2. Which positions have you held? • Chair or member of the board • Rector or director • Vice-rector • Dean • Director of the research department • Director of an administrative department • Program director • Professor/lecturer/teacher • Administrative and management positions • Customer service representatives • Human resource staff • Other: _____ G3. Have you held one or multiple positions at educational institutions? • One position (teaching, research or administrative) • Multiple positions G4. Which employment areas have you worked in at educational institutions? • Management • Administrative areas • Teaching • Research • Other: _____	3
	Years of experience	G6. How many years have you spent working in education? • 0-1 • 2-3 • 4-6 • 7-10 • 11-19 • 20+ Other: _____	2

		G7. How many years have you spent working in research? • 0-1 • 2-3 • 4-6 • 7-10 • 11-19 • 20+ • Other: _____	
Participants' interest in the demo platform	Online services	S1. Which online services are most important for you? (Select up to 5 options) • Work opportunities • Recruitment • Training opportunities • Studying the educational market • Studying the research market • Updating knowledge about competences • Matching training opportunities and competences • Matching work and recruitment to competences • Development of digital competences • Obtaining information on competence frameworks • Self-marketing • Marketing of the institution • Links to international examinations and certification opportunities • Providing access to specific professionals • Surfing courses • Providing access to databases of courses matched to competences, instructors, institutions • Other: _____	1
	Job and training search options	S10. Which of the following job search options would you like to have implemented in the platform? • Teaching • Administrative and management • Research • Full-time • Part-time • Online training • Online jobs • Specific courses • Work exchange programs • Other: _____ S40. Which mode of training, offered by the platform, would you find particularly useful? (Select up to 3 options) • Full-time • Part-time • Online • Blended (mix of on-site and online training) • Other: _____ S50. Which model of learning, offered by the platform, would be more important for you? • Asynchronous (off-line, when all participants cannot meet at the same time) • Synchronous (online, when all participants meet at the same time) • Other: _____	3
	Training components	S20. Which levels of training opportunities are most attractive/useful for you (Select up to 2 options)? • University and college (specific programs, courses, instructors)	2

		• Vocational education (specific programs, courses, instructors) • Training for companies (further education) • Secondary school education • Other: _____ S30. Which type of training, offered by the platform, would you find particularly attractive? • Academic • Research • Professional • Other: _____	
	Search options	S60. Which search options would be particularly important for you? (Select up to 5 options) • Institution • Specialization area • Competences • Mode (full-time, part-time, online, blended) • Courses • Type of training • Levels of training • Duration of work/training • Geographic location • Language of work and training: English • Languages of work and training: national • Other: _____	1
	Scopes and preferences for the platform	S70. Which work and training scopes should the platform offer to be useful for you? • National • European Union • The entire Europe • Europe and the USA, Canada • Europe and other parts of the world • Other: _____ S80. Which reasons would motivate you to use the platform? • Developing national work experience • Developing international work experience • Bridging the gaps in personal training • Bridging the gaps in personal career development • Networking • Boosting the development of my institution • Recruiting students • Marketing the institution nationally • Marketing the institution internationally • Other: _____	2
	Elicited views on the offers of the platform	S90. What other features would you like to have implemented in the platform to use the platform's services? S100. What would discourage you from using the platform?	2
		Questions in total	**18**

3.4.3 Survey of Employers

The summary of the structure and questions of the Survey of Employers is provided in Table 3.2.

Table 3.2. Contents of the Survey of Employers

Major block	Sub-block	Questions	Total number of questions
Participants' background	Employers' profile	G1. How would you characterize your company? • Public (state, municipal) • Private • Other: _____ G2. Which area/s does your company specialize in? • IT and technology • Transport and logistics • Banking and finance • Consulting • Tourism and hospitality • Healthcare and pharmacy • Trade • Entertainment • Infrastructure and real estate: construction and management • Agriculture and farming • Manufacturing • Other: _____	2
	Training at the company	G3. Which training options does your company offer to its employees? • The company's own training center • The company recruits external professionals to conduct training for its employees. • The company pays for employees' training outside the company • The company does not offer any formalized training to its employees • The company does not pay for its employee training: it is the responsibility of employees • Other: _____	1
	Areas of employment	G4. Which areas of employment have you covered over the span of your employment history? • Senior management • Business development • Research • Finance and accounting • Legal department • Customer service • Human resource • Marketing and communications • Other: _____ G5. Which employment types have you had in your career? • Permanent employment contract • Temporary employment contract • Self-employment • Entrepreneur • Other: _____	2
Participants' interest in the demo platform	Online services	S1. Which online services are most important for you? (Select up to 5 options) • Database of training options (programs, courses) matched to specific competences • Customized opportunity to search and select training options for specific competences • Recruitment • Publishing national calls for specified training of employees • Publishing international calls for specified training of employees	1

		• Publishing national internship calls • Publishing international internship calls • Ordering academic and research products • Ordering consulting services • Other: _____	
	Search options	S40. Which search options of the platform would you prefer? • Algorithm/mechanism identifying training needs of employees consistent with the selected competences in filters • Matching the selected competences to courses/programs • Matching the selected competences to specific instructors • Matching the selected competences to training to certification/ international examinations • Examination or another type of assessment of employees' competences • Examination or another type of assessment of job candidates' competences • Other: _____	1
	Training components	S10. Which mode of training do you find particularly important for you? • On site • Online • Blended learning • One-time event • Continuous (over a specified period) • MOOC (massive open online courses) training • Other: _____ S20. Which levels of training opportunities are most attractive/useful for you (Select up to 2 options)? • University and college (specific programs, courses, instructors) • Vocational education (specific programs, courses, instructors) • Specific training for companies (further education) • Secondary school education • Other: _____ S30. Which type of training would you find particularly useful? • Conducted by a specialist (face-to-face) • Online program with a specialist (blended learning) • Online program without a specialist • Training materials (software, manuals and textbooks, etc.) • Other: _____	3
	Recruitment	S50. Which professional recruitment options would you find particularly useful? • Teaching and training positions • Consulting • Research and development • Administrative and management jobs • Business and finance • Programming and ICT • Engineering and transport • Head-hunting options • Other: _____ S70. Which student and graduate recruitment options would you find particularly useful? • Internship positions • Student recruitment • Young talent discovery competitions • Other: _____	2

	Connecting science to businesses	S60. Which options for digitalization and connection of science and business on the international scope would you find particularly useful? • Project planning of research projects • Staffing of research projects • Management of research projects • Acquisition of research grants/budget • Simplified management of commercial cooperation agreements between companies and universities • Other: _____	1
	Scope of the platform options	S80. Which internship, training and work language options should the platform offer to be useful for you? • English • National languages • Other: _____ S90. Which recruitment, work and training scope should the platform offer to be useful for you? • National • International • Online (from participants' home countries, if necessary) • Blended (mix of locations: online, home country and company's location) • Other: _____	2
	Elicited views on the offers of the platform	S100. What other features would you like to have implemented in the platform to use it? S110. What could discourage you from using the platform?	2
		Questions in total	**17**

3.4.3 Survey of Students

The summary of the structure and questions of the Survey of Employers is provided in Table 3.3.

Table 3.3. Contents of the Survey of Students

Major block	Sub-block	Questions	Total number of questions
Participants' background	Educational context	G1. What is the education establishment of your current studies? • University • University College • College • Vocational Education Institution • Other type of an independent training center • Other: _____ G2. What type of educational program are you currently enrolled in? • Doctoral studies • Master's • Bachelor's • First-level professional higher education • Vocational education • Other: _____ G3. What is your age group? • 16-17	3

		• 18-25 • 26-30 • 31-35 • 36-40 • 40-49 • 50+ • Other: _____	
	Work experience	G4. What is your employment history? • I am currently combining studies and work • I am currently combining studies and self-employment • I worked in the past, not now • Other: _____	1
	Educational experience	G5. What do you think of the effects of education on your career development? • A degree is useful as a formal qualification or certificate • Education helps in career development via expansion of competences and areas of specialization • Everyone has education, and so should I • I am interested in learning and personal self-development • Other: _____ G6. What is your international education experience? • I have received a degree in a foreign country • I have been an Erasmus exchange student • I have been an exchange student in a program other than Erasmus • I have completed a professional course/s abroad • I have completed a foreign professional course/training online • None • Other: _____ G7. What do you think of the importance of international education experience for your career development? • International education experience is important • International education experience is NOT important • The importance of international experience or its lack depends on the area of specialization and country • None • Other: _____	3
Participants' interest in the demo platform	Online services	S1. What online services are most important for you? (Select up to 5 options) • Internship opportunities • Part-time student employment opportunities • Training opportunities • Matching training opportunities (courses, programs) to competences • Providing information on digital competences • Providing information on competence frameworks • Development of digital competences • Obtaining information on competence frameworks • Providing links to international examinations and certification opportunities • Providing access to a database of courses matched to competences, professionals, etc. • International study exchange programs • Other: _____	1

	Training components	S10. What mode of training, offered by the platform, would you find particularly useful? (Select up to 3 options) • Full-time • Part-time • Online • Blended (combination of online and on-site training) • Other: _____ S20. What levels of training opportunities are most attractive/useful for you (Select up to 2 options)? • University and college (specific programs, courses, instructors) • Vocational education (specific programs, courses, instructors) • Training for companies (further education) • Secondary school education • Other: _____ S30. What type of training, offered by the platform, would you find particularly attractive? • Academic • Research • Professional • Digital skills • Soft skills • Other: _____ S40. What forms of education would be the preferred option for you? (Select up to 4 options) • Degree programs • Certification and qualification programs • Vocational education programs • Specific courses • Internship training • Badge learning • Informal self-education • Other: _____	4
	Scope of offers	S50. What work and training scope should the platform offer to be useful for you? • National • European Union • The entire Europe • Europe and the USA, Canada • Europe and other parts of the world • Other: _____	1
	Elicited views on the offers of the platform	S60. What other features would you like to have implemented in the platform in order to motive you to use it? S70. What would discourage you from using the platform?	2
		Questions in total	**15**

3.5 Procedure of the Survey

All the surveys were created in English in google forms on the google drive of the eMediator project. They were not translated into local languages because the purpose of the creation of the demo portal is to create a common digital environment for the EU training, internship and work

market, which entails communication in English. Each participating country received its own set of surveys identical to the surveys of other participants.

The participants of all the surveys were to be contacted by e-mail containing a request to complete a survey and a link to an appropriate survey. The surveys were completed anonymously within 10-15 minutes. All questions were obligatory with the exception of open-ended (elicited) questions. Prior to completing the survey, the participants were informed about the aim of the survey and the project as well as the data security policy.

3.6 Participants of the Surveys

The participants of the survey included small groups of minimum 5 individuals. Because the purpose of the surveys was to obtain a general idea of the functions that would be preferable for the users of the portal, the small number of respondents was considered sufficient. The participants were not reimbursed for the completion of the surveys because their participation was voluntary. Each participating organization was asked to conduct these surveys in its home country. The engaged respondents were expected to form a group of relatively diverse characteristics, professional and academic experience.

A2-3. Summarizing the Results of the Surveys

3.1 Combining the Data of all Surveys

All three surveys – Survey of Educational Institutions, Survey of Employers and Survey of Students - were carried out the home countries of participating institutions. On average, the data on 35 respondents for each questionnaire was collected. The results of such data analysis is provided in the subsequent sub-sections.

3.2 Survey of Educational Institutions

3.2.1 Combined Results

This section reviews the obtained results.

Block 1: Participants' Background

Sub-block 1: Institutions

- **Question G1**

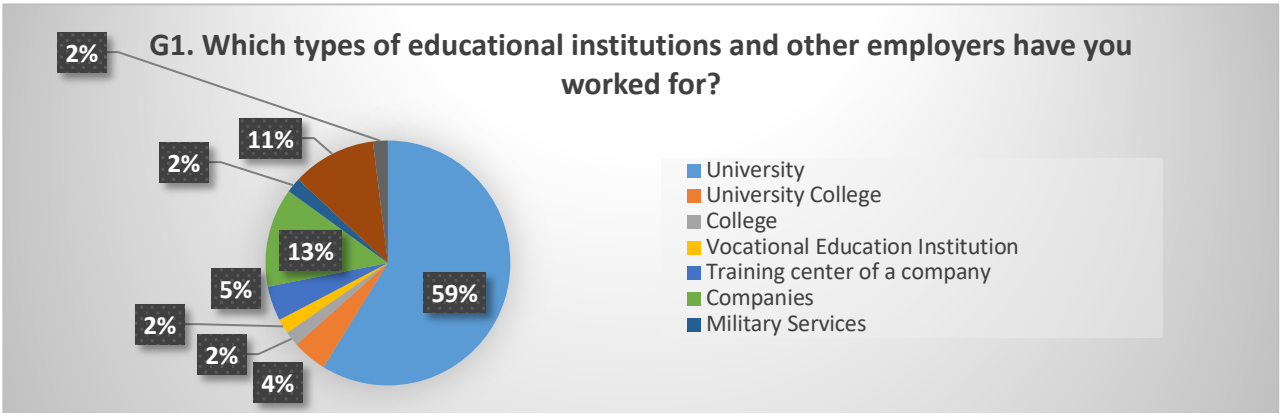

Fig.3.1. Question G1

The majority of the respondents (74%) have worked for higher education institutions, such as universities and university colleges, and research institutions. However, the professional experience of further education has been represented on the limited scale since there have been obtained only 26% of relevant responses. Therefore, the produced responses in block 2 optimally reflect on the views of higher education institutions and their staff; while the needs and opportunities in professional training and further education will be represented under a narrower perspective.

– **Question G5**

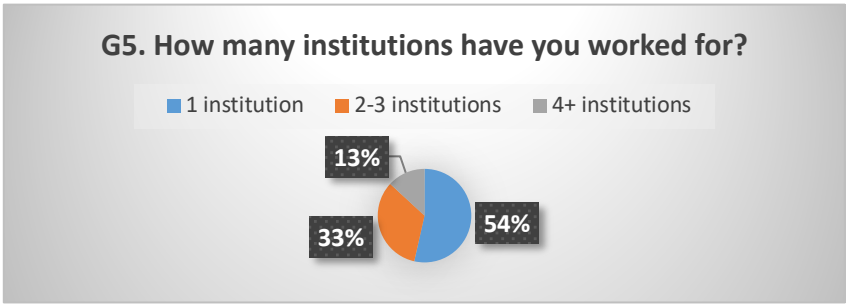

Fig.3.2. Question G5

The majority of the respondents have worked only for 1 institution, while the vast minority of the respondents have provided their services to four and more institutions. This implies that the breadth of educational experience of the respondents has been quite limited and could be averaged to 2 institutions. However, the diverse geographic locations and cultures of the respondents, who come from Latvia, Poland, Germany, Spain and Greece, make up for such limited experience at the level of diversity of educational experience overall of this group of respondents.

Sub-block 2: Positions and Areas of Employment

– **Question G2**

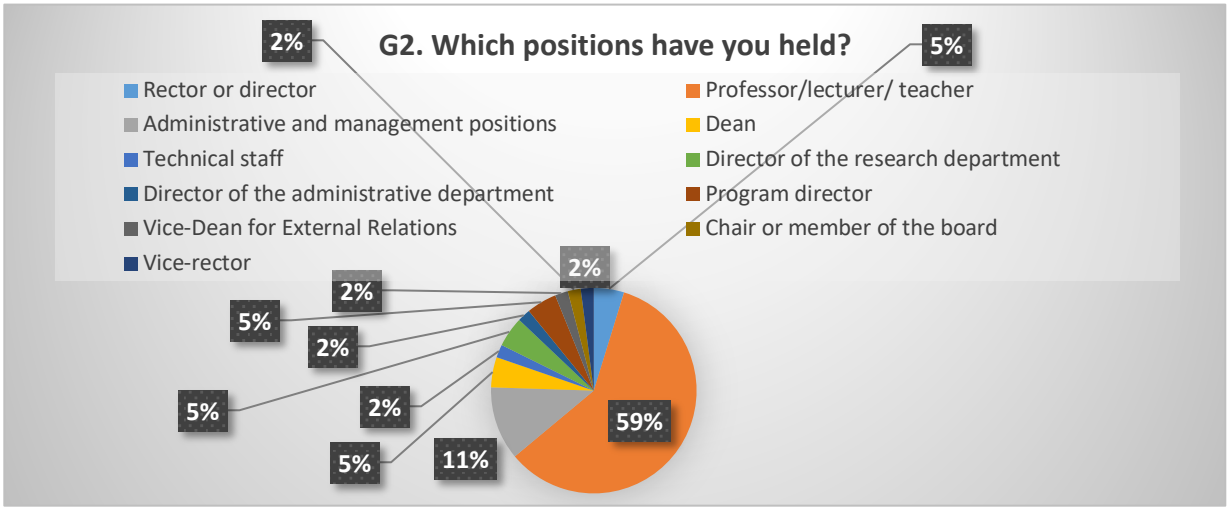

Fig.3.3. Question G2

The majority of the respondents have held various academic and teaching positions. Overall, 11% indicated having held administrative and management positions, but in fact this number is higher because 11% have taken senior management and board positions, 12% middle management

positions and 5% - junior management posts, all of which amount to 28%. Such distribution of positions indicates that the responses to the questions in block 2 convey the perspectives of the teaching and management staff of various levels, and therefore, provide a comprehensive perspective on the views of educational organizations.

- **Question G3**

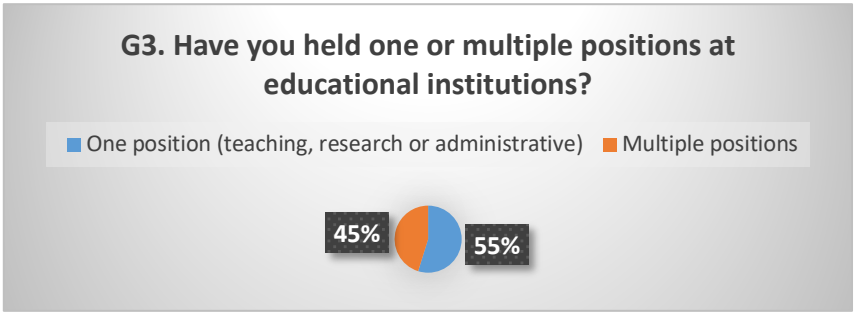

Fig.3.4. Question G3

The distribution of the number of positions held by an individual was almost even with those having taking just one post outnumbering those with the history of the multiple positions by only 10%. This means that the answers provided in block 2 will reflect on diverse education-related experience.

- **Question G4**

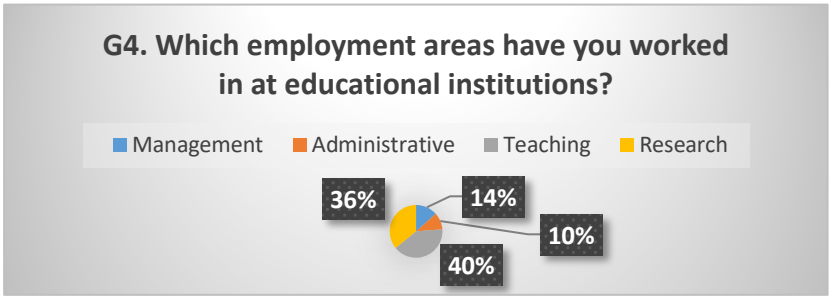

Fig.3.5. Question G4

The answers to this question indicate that the respondents have been engaged in research and teaching to a similar extent, which has overall accumulated to 76% of employment areas. The remaining 24% have been engaged in management and administration. These answers are consistent with the general perspective created by the previous questions.

Sub-block 3: Years of Experience

– **Questions G6, G7**

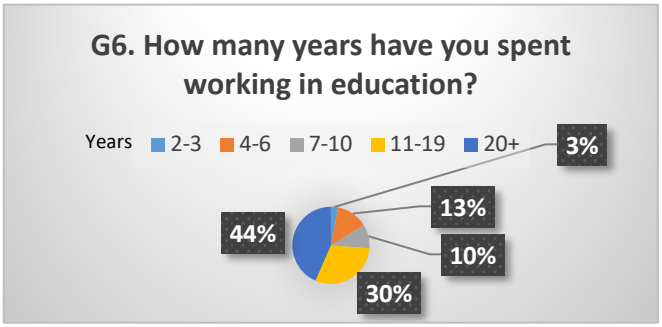

Fig.3.6. Question G6

Fig.3.7. Question G7

The distribution of years spent in education and research is somewhat similar, thus, suggesting that those taking academic positions have engaged in research activities, too, which is consistent with the answers to the previous questions. If the years spent in education and research are averaged, it emerges that 38% of the respondents have spent 20+ years in education and research, and 29% have worked in these areas for 11-19 years. Considering the fact that the average percentage of the combined employment for the period of 1 year or less constitutes only 3%, this group of respondents can be concluded to have had a longitudinal work experience and therefore is knowledgeable about the needs and opportunities of educational institutions and the education and research markets.

The overall profile of the group of respondents that has completed the Surveys of Educational Institutions could be suggested to have the following major features: (1) extensive and longitudinal work experience in education, (2) combination of academic, research and administration duties ranging from senior to junior positions, and (3) fewer engagements on the market of professional training and further education. The collective output of this group of respondents, produced in block 2, can be considered comprehensive and therefore reasonable for the implementation into the demo portal.

Block 2: Interests in the Demo Portal

Sub-block 1: Online Services

- **Question S1**

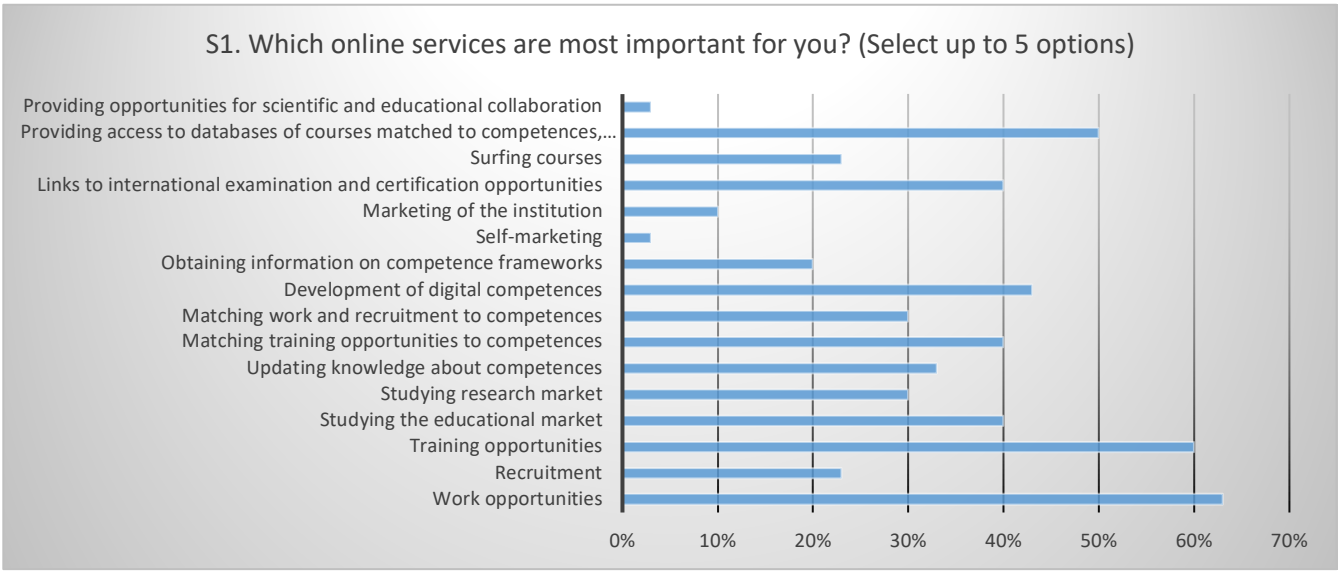

Fig.3.8. Question S1

Sixteen online services were selected for the demo platform, ranging from 3% demand for the options such as self-marketing and provision of opportunities for scientific and educational collaboration, to 63% of demand for work opportunities. The demand for the online services could be divided into three categories by the degree of demand. The services of the highest demand (50%-63%) mostly related to work and training opportunities linked to the databases of courses matched to competences. The second category of services with the average demand ranging between 20% and 43% comprised options of courses, examinations and certifications, various aspects of competences and competence frameworks, information on research and education markets as well as recruitment. The category of the services of the lowest interest covered the options of academic collaboration (3%) and marketing (3%-10%). Overall, the demo portal should include the following online services of three major blocks: (1) training, recruitment and work opportunities of research and academic markets; (2) databases of courses matched to competences; and (3) various competences and competence frameworks.

Sub-block 2: Job and Training Search Options

– **Question S10**

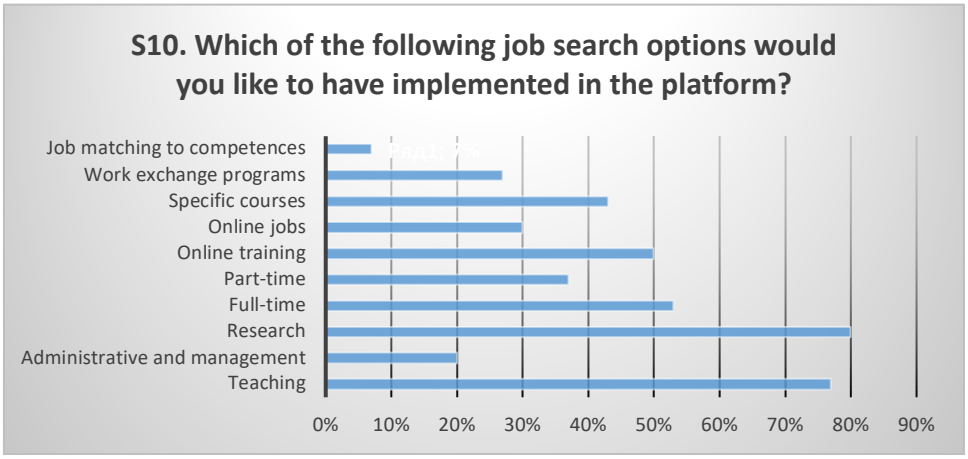

Fig.3.9. Question S10

This question focused on job search options, which could be grouped into the following key categories: (1) job offers matched to competences; (2) course offers; (3) various modes of jobs (full-time, part-time, online); and (4) all basic areas of activities of educational institutions (research, teaching, administration). The categories (1), (2) and (4) of this question correspond to the preferences expressed in the previous question.

– **Questions S40, S50**

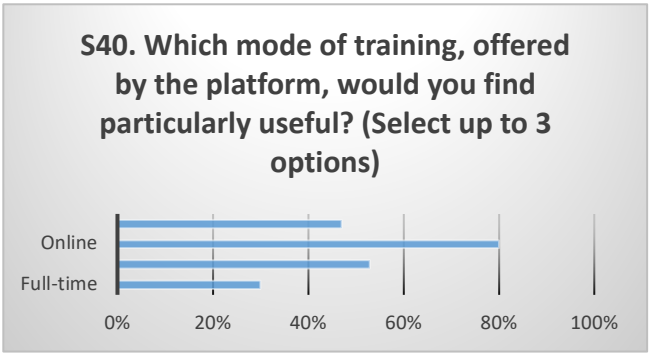

Fig.3.10. Question S40

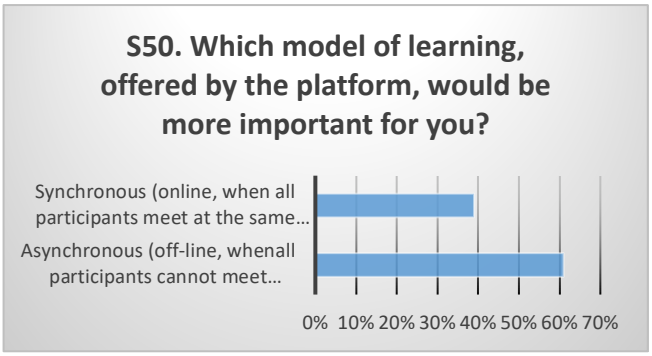

Fig.3.11. Question S50

The answers to question S40 are consistent with the replies of category (3) of question S10. Thus, both work and training opportunities should be linked to full-time, part-time, online and blended options. Question S50 reveals that training opportunities should be divided into synchronous and asynchronous learning, which entails need for the storage sections for uploading training materials.

In general, job and training search functions should include the search options matched to competences, online and offline offers and storage facilities for learning materials.

Sub-block 3: Training Components

– **Question S20**

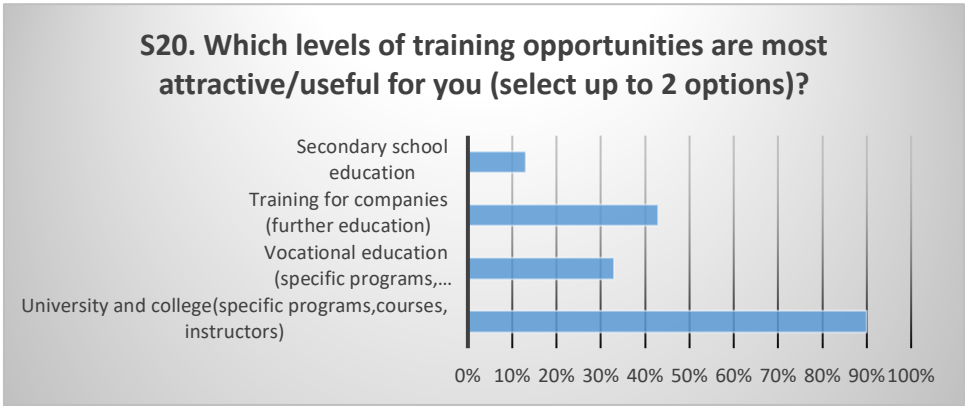

Fig.3.12. Question S20

The majority of the respondents postulated the need for training opportunities at the tertiary level. More than a third of responses indicated the interest in further education at both specialized training centers and companies. There was minor interest in secondary education offers, which is why the demo platform can specialize in higher and further education training and work opportunities.

– **Question S30**

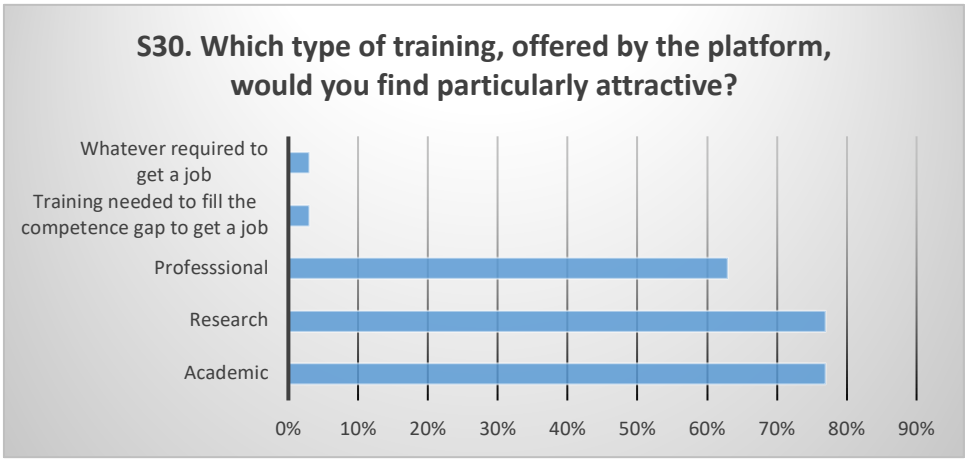

Fig.3.13. Question S30

As for the type of training, it should focus on academic, research and professional skills linked to competences and the demands of the labour market. These answers are consistent with the outputs of the previous questions.

Sub-block 4: Search Options

- **Question S60**

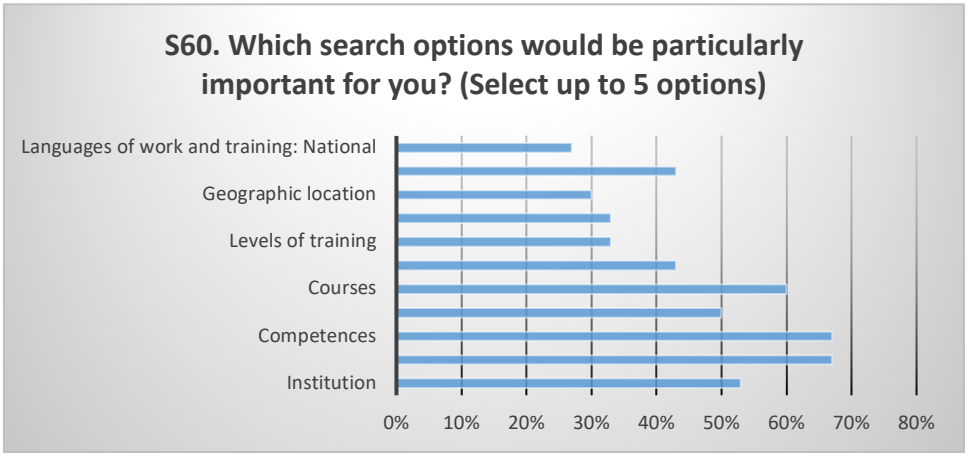

Fig.3.14. Question S60

The answers to this question have revealed the need to integrate the following components into the search options: (1) English as language of training, recruitment and work opportunities; (2) national languages of training, recruitment and work opportunities; (3) various filter options: (a) geographic location, (b) level – type – mode of training, (c) competences, (d) specialization area, (e) courses, (f) institution.

Sub-block 5: Scopes and Preferences for the Platform

- **Question S70**

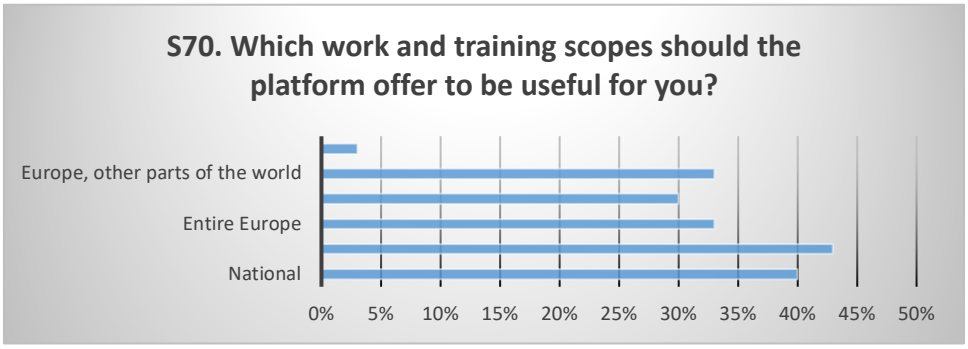

Fig.3.15. Question S70

The answers to this question are consistent with those of question S60 and indicate the need to publish offers of the national, European and North American scopes.

– **Question S80**

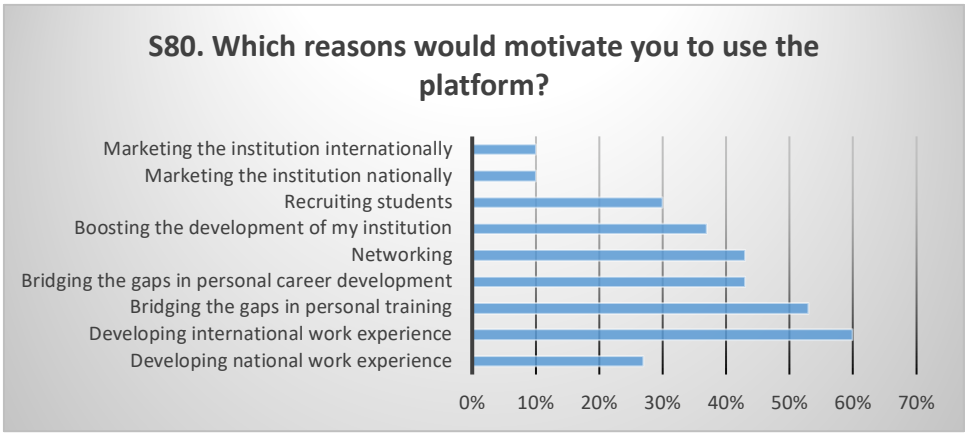

Fig.3.16. Question S80

The prioritized reasons for using the platform include the intention to boost professional competitiveness on national and international markets through developing international work experience, networking and further training. Another set of reasons pertains to the development and marketing of the home institution.

Sub-block 6: Elicited Views on the Offers of the Platform

– **Question S90**

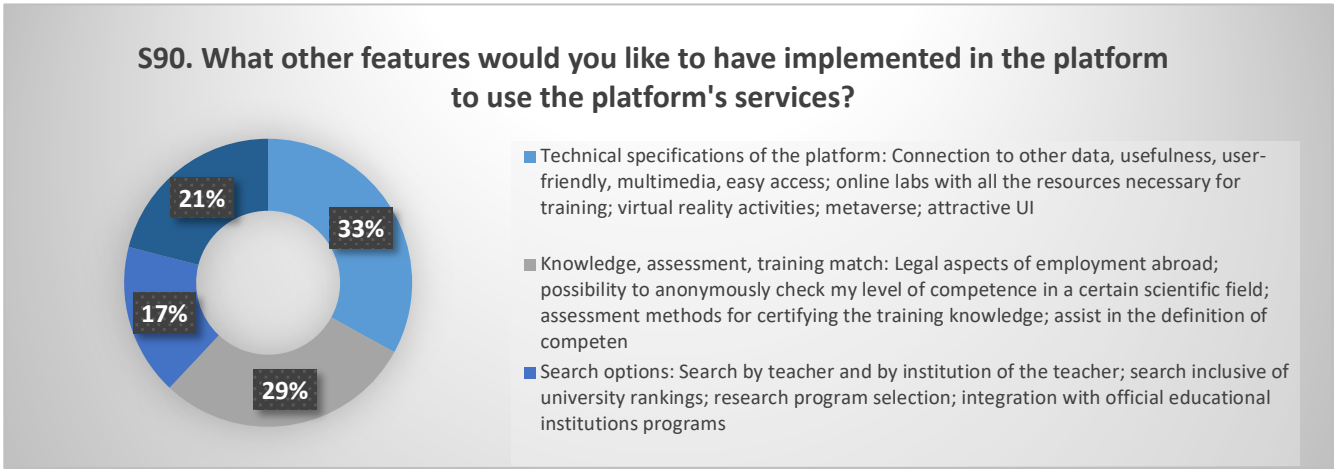

Fig.3.17. Question S90

The features that could enhance the quality of the demo portal could be grouped into 4 categories: (1) technical specifications focusing on user-friendly interface and operating

functions of the platform; (2) knowledge and assessment; (3) search options; and (4) work and research features. Some of these suggestions are consistent with the earlier produced answers, for example, in relation to competences, whereas others provide new information.

– **Question S100**

Fig.3.18. Question S100

The features that might discourage the use of the demo platform could mostly be grouped into 3 sets: (1) technical issues, such as poor interface, lack of expected functions, etc.; (2) high costs of use; (3) poor content; (4) aggressive advertising.

3.2.2 Conclusion

This section focused on the description of the combined outcomes of the Surveys of Educational Institutions conducted in the participating countries. These outcomes suggest the following features for the demo portal: (1) good quality offers: academic, research and professional training and work opportunities of academic and research markets; (2) content filters: competences, courses, institutions; (3) organizational filters: mode, type and level of training; (4) technical specifications of the platform: user-friendly interface, fast access to information, storage sections, etc.; and (5) affordable solutions.

3.3 Survey of Employers

3.3.1 Combined Results

The results of the combined surveys and their brief interpretation are provided below.

Block 1: Participants' Background

Sub-block 1: Employers' Profile

- **Question G1**

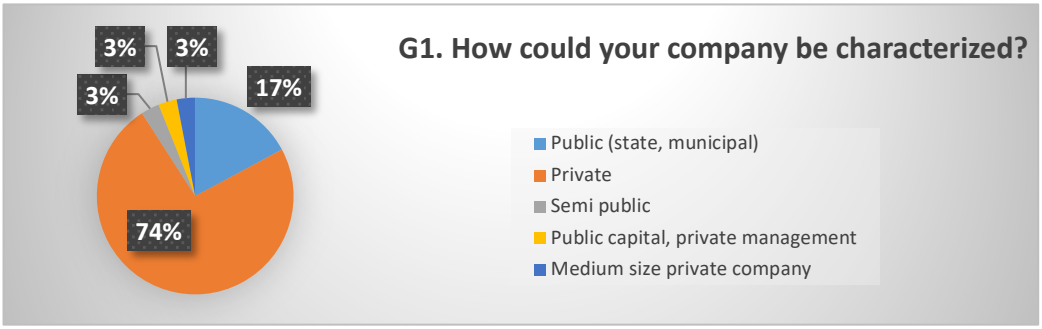

Fig.3.19. Question G1

The vast majority of the respondents work for private companies.

- **Question G2**

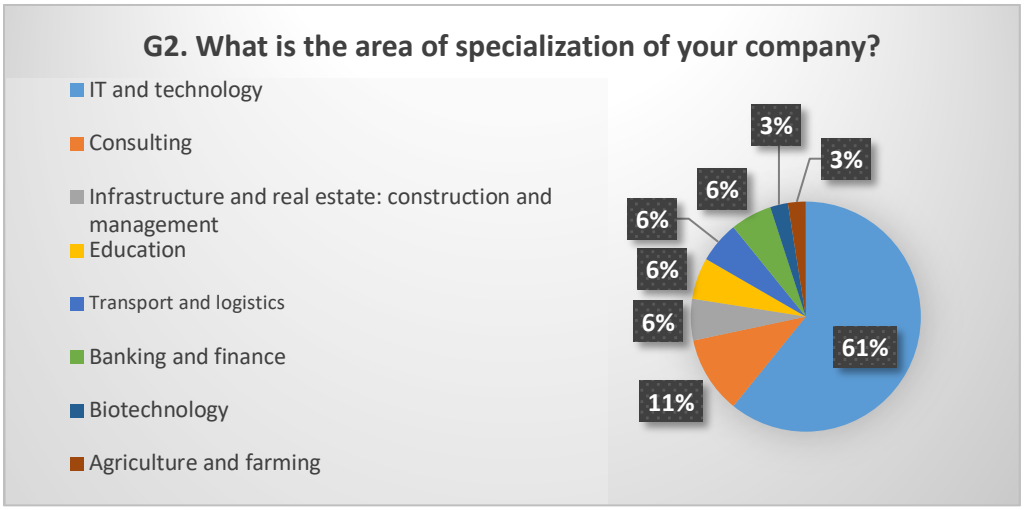

Fig.3.20. Question G2

A noticeable majority of the respondents have worked for IT and technology enterprises, whereas 39% of the respondents have worked in companies with other specialization, such as consulting, transport and logistics, education, etc. Therefore, it can be concluded that the respondents as one group represent diverse sectors of the economy.

Sub-block 2: Training at the Company

- **Question G3**

Fig.3.21. Question G3

Importantly, 95% of companies have been found to invest resources into the training of their employees with the majority of them having their own training centers, followed by almost an equal share of 27,5% represented by each type of training - the training outside the company and the recruitment of external professionals. Thus, companies are interested in the professional development of their employees.

Sub-block 3: Areas of Employment

- **Question G4**

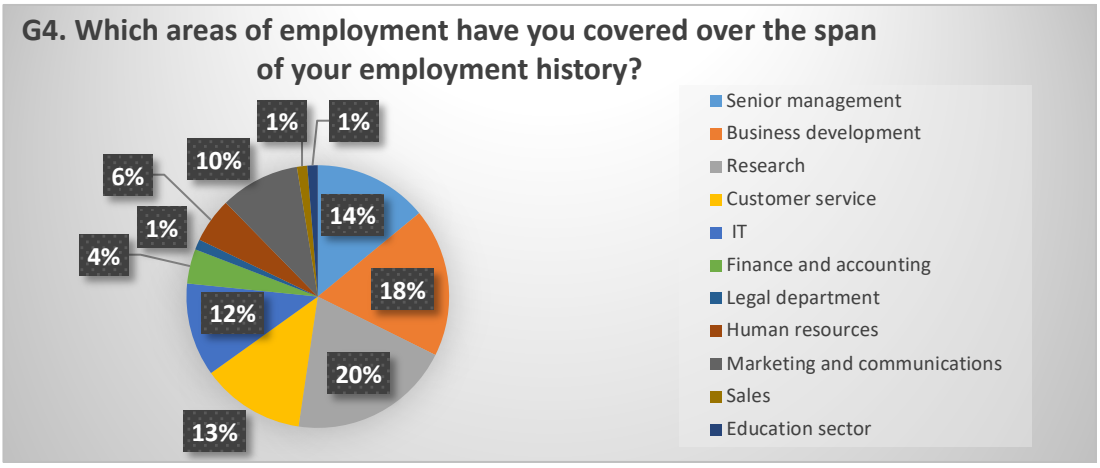

Fig.3.22. Question G4

This question related to the professional profile of the respondents. It turns out that the respondents have worked in various departments of a company. Between 10% and 20% are

represented by such departments, as marketing and communication, IT, customer services, senior management, business development and research. Therefore, the respondents have had a diverse work experience.

- **Question G5**

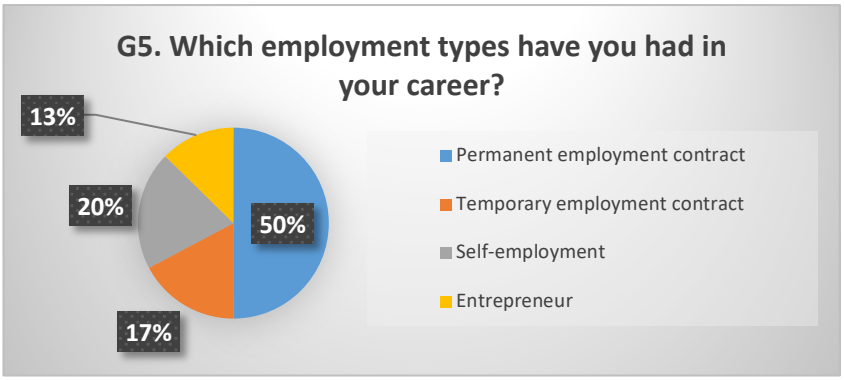

Fig.3.23. Question G5

As for the employment types, half of the respondents have had permanent employment contracts, whereas 33% have had entrepreneurial experience.

Overall, the companies represented by the respondents are mostly private enterprises specializing in IT and technologies with the minor representation in other sectors of the economy, such as consulting, banking and finance, education, agriculture and farming, etc. This indicates somewhat diverse representation of various sectors of the economy. Furthermore, almost all the companies promote employee training, which is why they are expected to be interested both in this survey and the portal. As for the group of the respondents, their work experience has covered a wide range of corporate departments, which indicates their understanding of the needs of various operating units of a company. The respondents have had diverse legal employment relationships with companies, which is why they can be suggested to have taken various positions and have engaged in various activities. Therefore, their answers cover various needs of businesses.

Block 2: Participants' Interest in the Demo Platform

Sub-block 1: Online Services

- **Question S1**

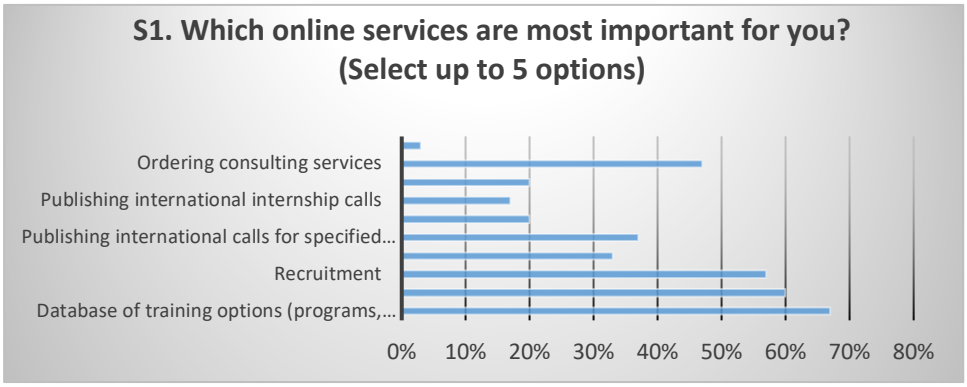

Fig.3.24. Question S1

More than half of the respondents expressed their interest in recruitment, customized opportunity to search and select training options for specific competences and database of training options (programs, courses) matched to specific competences. The key interest is linked to customization of search options via competence filters. Another group of interests concentrated on ordering various types of services and products. Finally, the respondents were interested in the opportunity to publish national and international calls for different needs, e.g. internship, training. Thus, the unique component that the respondents are looking for is the customization of search options via competences both on the national and international scales.

Sub-block 2: Search Options

- **Question S40**

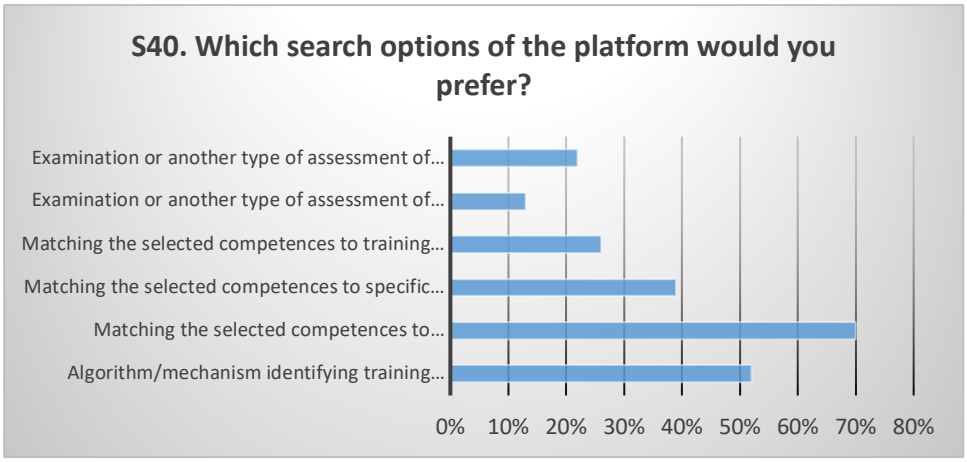

Fig.3.25. Question S40

The answers to this question were consistent with the previous question as the greatest interest expressed in the portal was related to training search options and identification of training needs consistent with specified competences. It should be possible to match competences to courses, programs, instructors, certification and examinations as well as conduct some assessment of competences.

Sub-block 3: Training Components

- **Question S10**

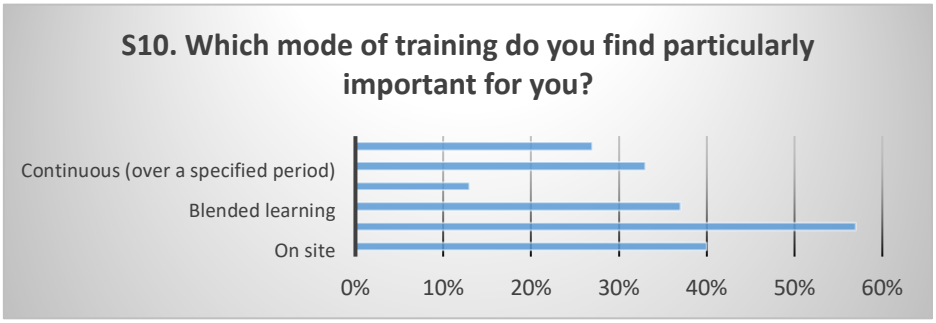

Fig.3.26. Question S10

The respondents have been interested in all types of training modes; however, the greatest interest has been related to online training and online training involving online components.

- **Question S20**

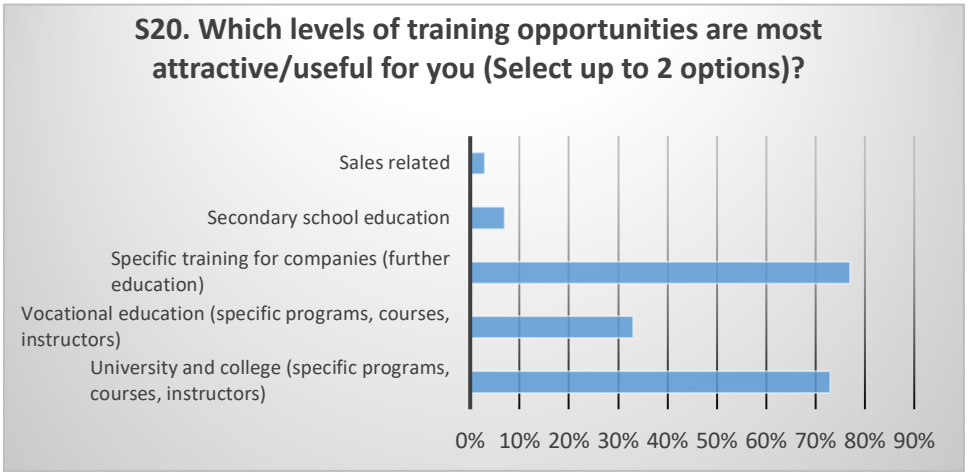

Fig.3.27. Question S20

The greatest interest has been linked to the training provided by higher and further education programs. Some limited interest has been expressed for vocational training.

– **Question S30**

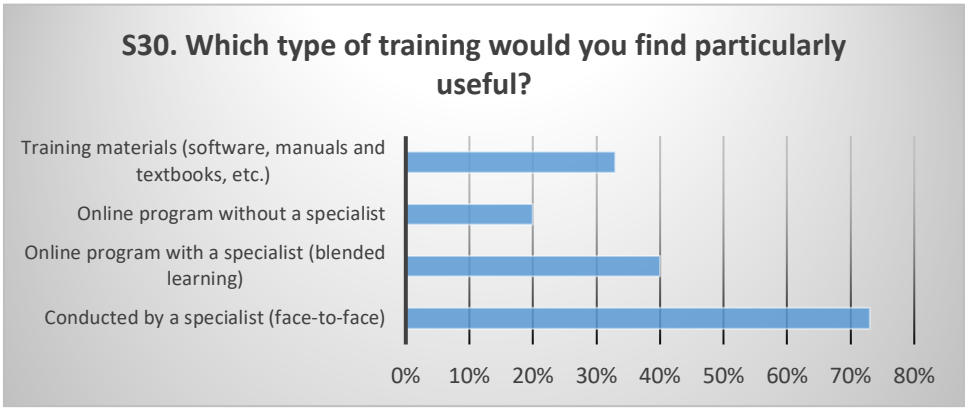

Fig.3.28. Question S30

The respondents have indicated the highest level of trust to training provided by professionals face-to-face, followed by blended learning involving a professional conducting teaching. Fewer respondents have been interested in training materials, which perhaps could be attributed to availability of various open-source materials. A fifth of the respondents indicated the interest in online training programs without live interaction with an individual.

Sub-block 4: Recruitment

– **Question S50**

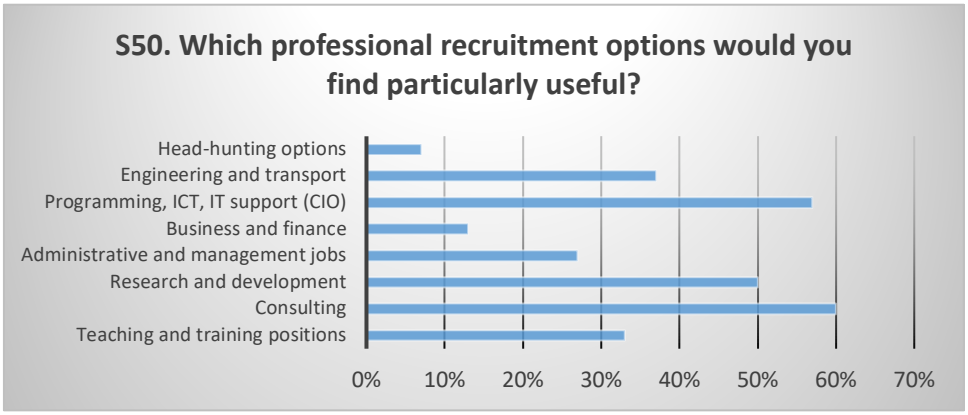

Fig.3.29. Question S50

Since employers tend to be interested in recruitment, some questions focused on the identification of recruitment options. The respondents have been found to be interested in various areas of employment, especially for consulting, IT, engineering, transport and research. Such interests are likely to be related to the companies' specialization and work experience of the respondents (see questions G2, G4).

– **Question S70**

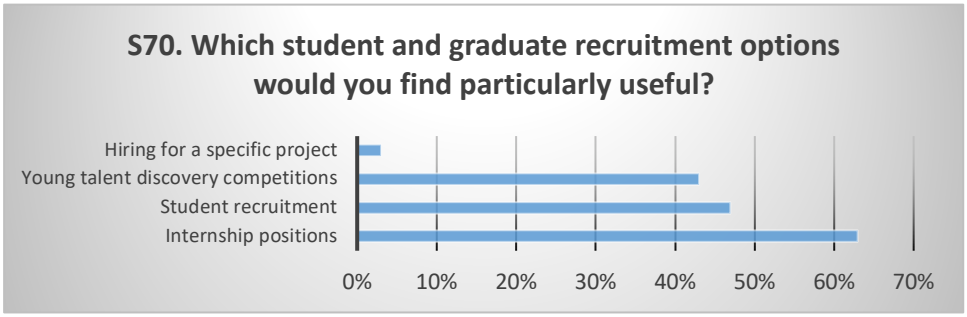

Fig.3.30. Question S70

The answers to this question indicate that employers are interested in the recruitment of young people, including internships and young talent discovery. Overall, such interest could be averaged at 50%.

Sub-block 5: Connecting Science to Businesses

– **Question S60**

Fig.3.31. Question S60

The greatest interest has been expressed in relation to project planning and management as well as grant acquisition.

Sub-block 6: Scope of the Platform's Options

- **Question S80**

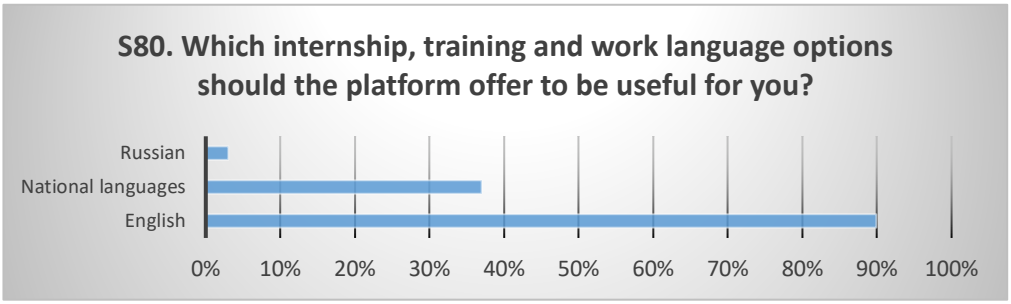

Fig.3.32. Question S80

The answer to this question indicates the need to connect to training on the international scope, which is why English has been chosen by the overwhelming majority of the respondents (some 90%). At the same time, more than a third of the respondents have selected national languages, which indicates their interest in the national market.

- **Question S90**

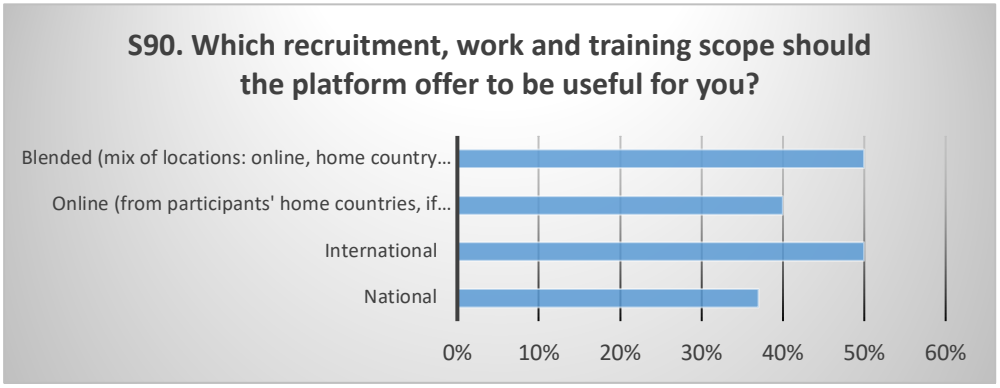

Fig.3.33. Question S90

The answers to this question are consistent with the previous answers to questions S10, S30 and S80 and confirm the respondents are more interested in international training and work options than in national ones. Online options have also been selected. The flexibility of options is supported by the choice of blended work and training options identified in 50% of cases.

Sub-block 7: Elicited Views on the Offers of the Platform

– **Question S100**

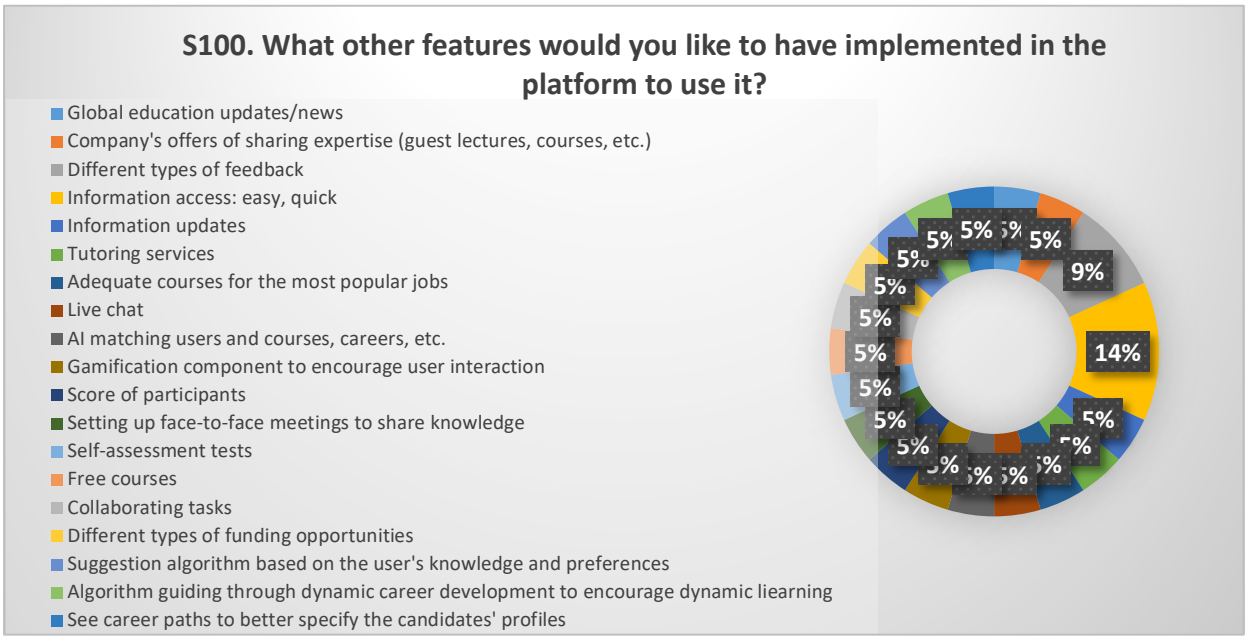

Fig.3.34. Question S100

The answers to this question have provided additional information on features that should be implemented. Not a single feature was found substantially dominating responses. The responses could be grouped into the following categories: information access and updates, portal interface (e.g. gaming, AI conducting matching operations), offers' diversity (tutoring, courses, tasks, etc.), global education markets.

– **Question S110**

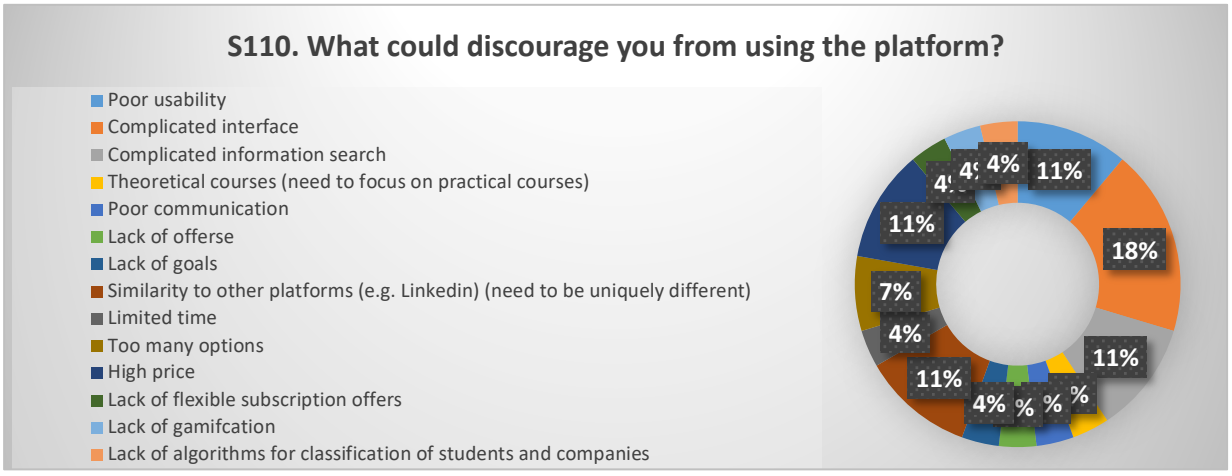

Fig.3.35. Question S110

The features that would be particularly discouraging covered poor interface (poor interface, poor usability, poor information search mechanisms). Other features would include high price and the lack of uniqueness of the portal and services offered by it.

3.3.2 Conclusion

This section combined the outcomes of the Surveys of Employers conducted in the countries of the project. These outcomes suggest the following features for the demo portal: (1) uniqueness of the portal, which might be linked to the match of search options to competences and both international and national scope of offers; (2) content filters: competences, courses, institutions; (3) organizational filters: mode, type and level of training; (4) technical specifications of the platform: user-friendly interface, fast access to information, etc.; and (5) affordable solutions. Clearly, these outcomes are in line with the outcomes obtained for educational institutions.

3.4 Survey of Students

3.4.1 Combined Results

In what follows, the results of the combined surveys are provided.

Block 1: Participants' Background

Sub-block 1: Educational Context

- **Question G1**

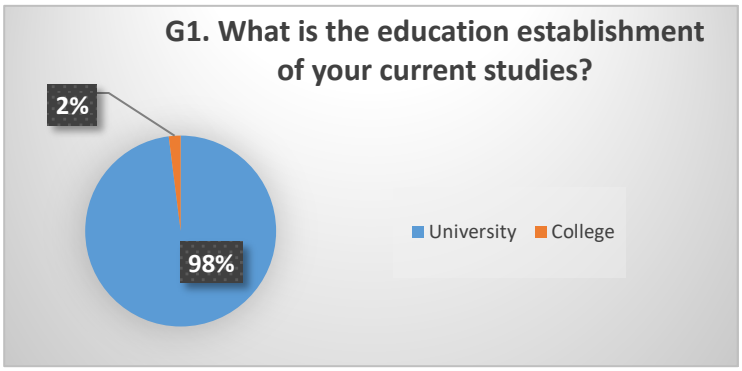

Fig.3.36. Question G1

Almost all participants have been university students.

- **Question G2**

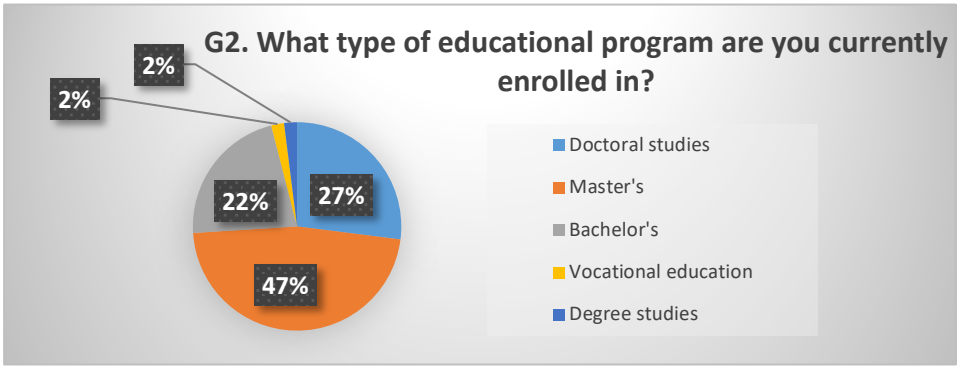

Fig.3.37. Question G2

Almost half of the respondents have been Master's students, whereas another half have been Bachelor's and doctoral students.

– **Question G3**

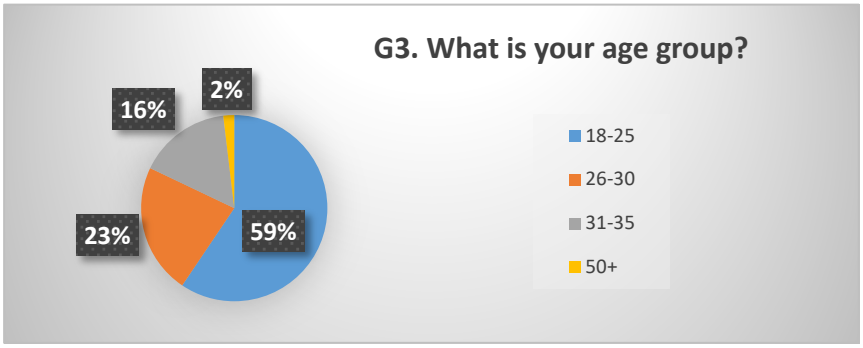

Fig.3.38. Question G3

Almost 60% of the respondents are youth in the age group of 18-25 years. The other two major groups are formed by the ages of 26-30 and 31-35 years. Therefore, it can be concluded that most students belong to the youth group.

Sub-block 2: Work Experience

– **Question G4**

Fig.3.39. Question G4

Almost 60% of students have been combining studies with work-related activities. Crucially, 90% of the respondents have had some work history and experience job hunting.

Sub-block 3: Educational Experience

- **Question G5**

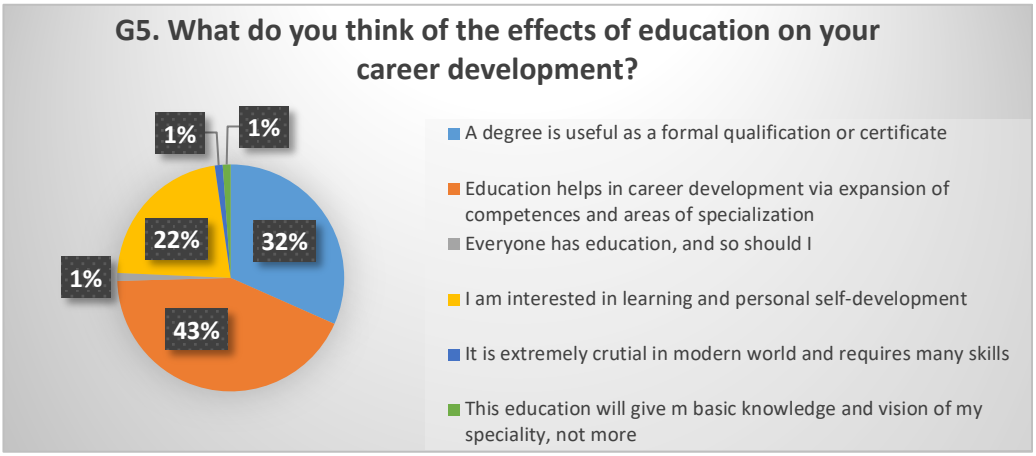

Fig.3.40. Question G5

No responses have indicated that education is useless. Sixty-six percent of the respondents consider education as a useful source of knowledge and competence development. Thirty-three percent share the view that education is important as an obtained qualification.

- **Question G6**

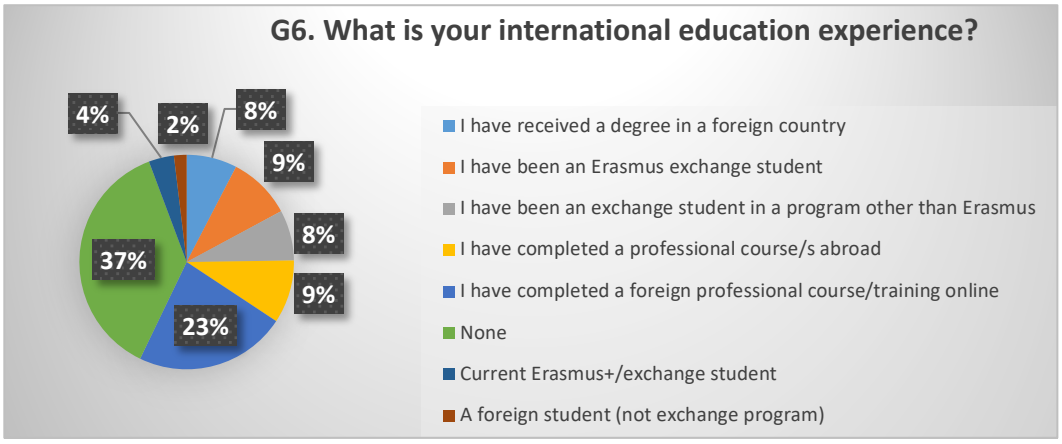

Fig.3.41. Question G6

Sixty-three percent of the respondents have had some international education experience; however, the majority of that experience has been relatively short as it has been limited to exchange programs and completion of some training, not a degree program. Thirty-seven percent of the respondents have not had foreign educational experience.

– **Question G7**

Fig.3.42. Question G7

Sixty-three percent consider international education important for the career development. According to twenty-seven percent of the respondents, international education is important under specified conditions, such as the area of specialization, country and the quality of education in the home country.

Overall, the students of the survey have been enrolled in undergraduate and graduate programs at universities. All of them consider education important, though for different purposes. A substantial majority of them have had work and international educational experience and consider international educational experience contributing to career development.

Block 2: Participants' Interest in the Demo Platform

Sub-block 1: Online Services

– **Question S1**

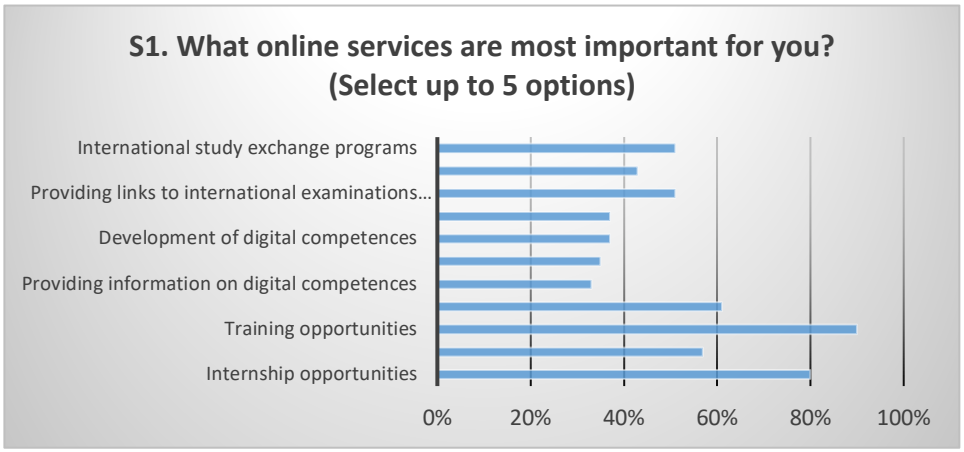

Fig.3.43. Question S1

The most important online services for students are training and internship opportunities (85% on average). Between 40% and 60% of answers included the following options: (1) matching training opportunities to competences; (2) providing links and access to training databases and examinations; (3) international study exchange programs, and (4) part-time student employment. About 30% of options focused on services including competences, such as providing information and access to digital competences and competence frameworks.

Sub-block 2: Training Components

– **Question S10**

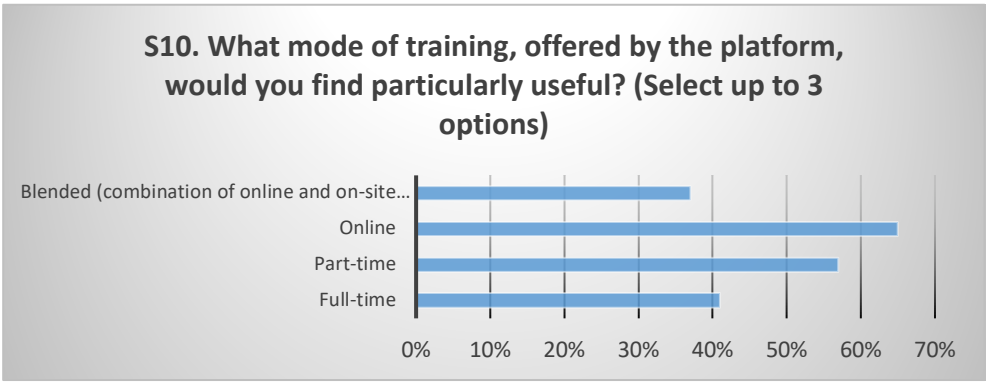

Fig.3.44. Question S10

The training mode most in demand has been online (65%), following by the part-time option (57%). Other options – blended and full-time learning – have been selected by approximately 38% each.

– **Question S20**

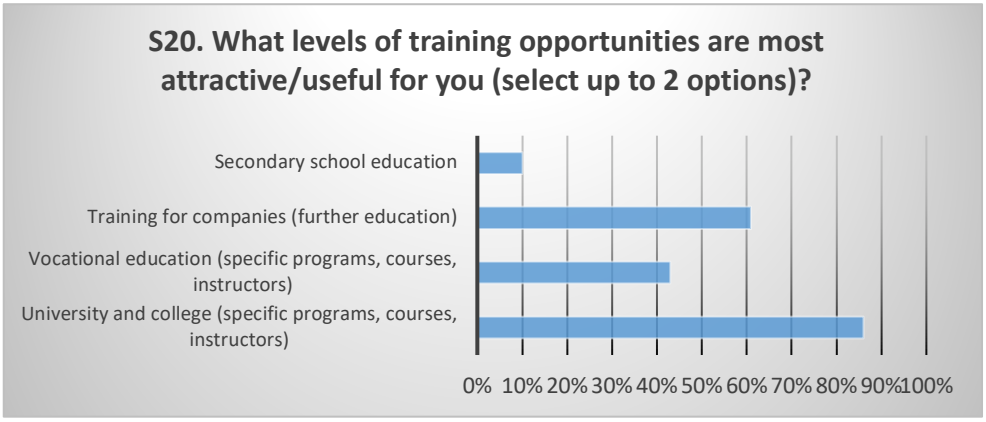

Fig.3.45. Question S20

As for the level of training, more than 85% of responses have included the tertiary level. The second most popular option has been training for companies (further education) and vocational education.

- **Question S30**

Fig.3.46. Question S30

The types of training that have been particularly in demand include professional and academic (about 70% on average). The second tier of the type of training includes research with more than 50% of cases, followed by digital and soft skills with some 32% each.

- **Question S40**

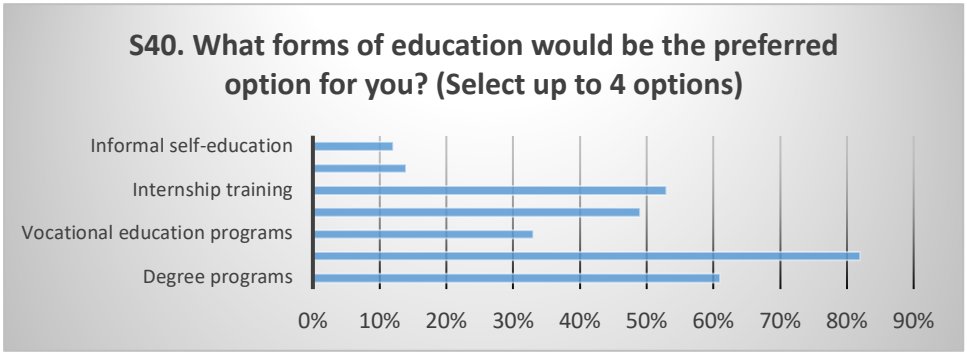

Fig.3.47. Question S40

More than 80% of cases have focused on certification and qualification programs. The percentage range of approximately 50% and 60% has included the offers of internships, specific courses and degree programs. Vocational education programs have been indicated in more than 30% of cases. Other options have been indicated in fewer than 15% of cases.

Sub-block 3: Scope Offers

- **Question S50**

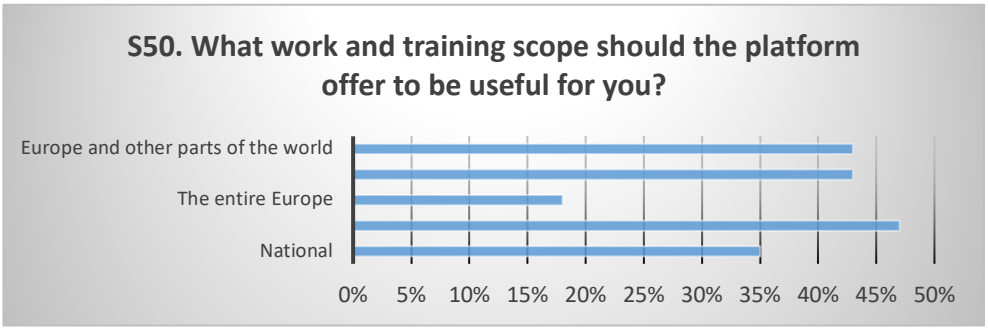

Fig.3.48. Question S50

The work and training scope of the platform should include both international and domestic options. The international options should primarily focus on the European Union.

Sub-block 4: Elicited Views on the Offers of the Platform

- **Question S60**

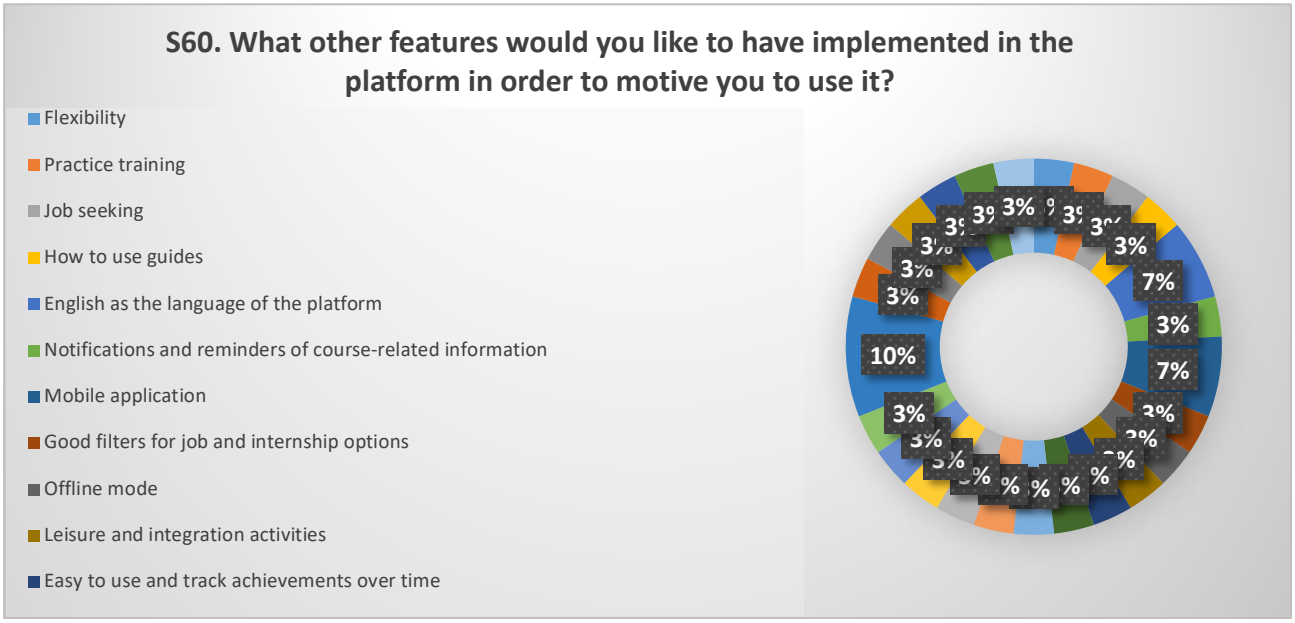

Fig.3.49. Question S60

The answers to this question have been diverse and could hardly be grouped into distinctive categories based on percentage. In terms of areas of features, they have included technical options (e.g. user-friendly interface, good filters, mobile application), variety of education and job

options, English as the language of the platform, self-education options (e.g. self-assessment tests), availability of free options (platform use, training), etc.

– **Question S70**

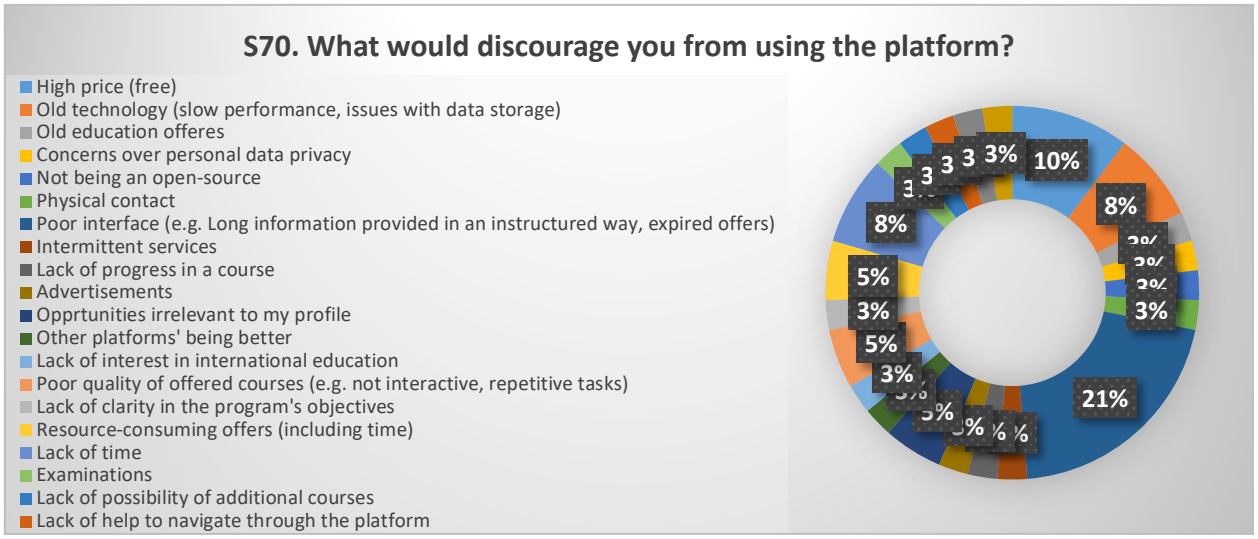

Fig.3.50. Question S70

As for the features that might discourage users from accessing the platform's services, they can be grouped into the following categories: (1) poor technical aspects of the platform (e.g. poor interface, slow performance, lack of proper data security); (2) poor quality of offers; (3) lack of uniqueness of the platform; (4) high price, and (5) personal reasons, such as time constraints.

3.4.2 Conclusion

This section combined the outcomes of the Surveys of Students administered in the countries of the project. These outcomes suggest the following features for the demo portal be implemented: (1) uniqueness of the portal and good quality of offers; (2) matching training to competences; (3) information on digital competences and competence frameworks; (4) self-assessment options; (5) offers of both the EU and national scope; (6) English as the key language of the platform; (7) filters to include mode, type and level of training; (8) good technical specifications of the platform (user-friendly interface, fast information access, etc.); (9) free options, e.g. training options; and (10) low costs or free platform's services. Such outcomes are consistent with the results obtained for the two other surveys of the project.

3.5 General Conclusions

The respondents of all surveys have represented diverse groups based on their profiles, education and work experience, which is why their responses can be considered to tap into the interests of various groups of educational institutions, employers and students. Other key responses are summarized in Table 3.4.

Table 3.4. Filters of the platform

Opportunities	Filters matching opportunities to:			
	Educational components	Scope of offers	Organizational components of training	Level of education
Training Internship Job hunting Recruitment	Competences Courses Programs Instructors	European Union National	Online Blending learning Part-time Full-time	Higher education Further education for companies Vocational education

The technical aspects of the platform should include the following components: (1) user-friendliness (easy to navigate); (2) quick information access; (3) database with courses, programs, competences; (4) access to competence frameworks, examinations; (5) storage space for users; (6) gaming or other interactive aspects; and (7) proper personal data protection. Other aspects of the platform should include affordable solutions, free use of the platform, emphasis on professional (practical) training. The platform should be different from other platforms, for example, by having competences connected to the search options of training, internship, job hunting and recruitment and having offers published for the EU and national scopes.

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4. A1.4 State-of-the-art analysis of digital capabilities in learning design, learning processes with emerging skill sets (UL)

4.1 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/learning-through-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 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.

4.2 Theoretical Aspects

Information and Communication Technologies (ICTs) as Digital Teaching Tools in Education. Typology and Specific Features

4.2.1 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 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'.

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.

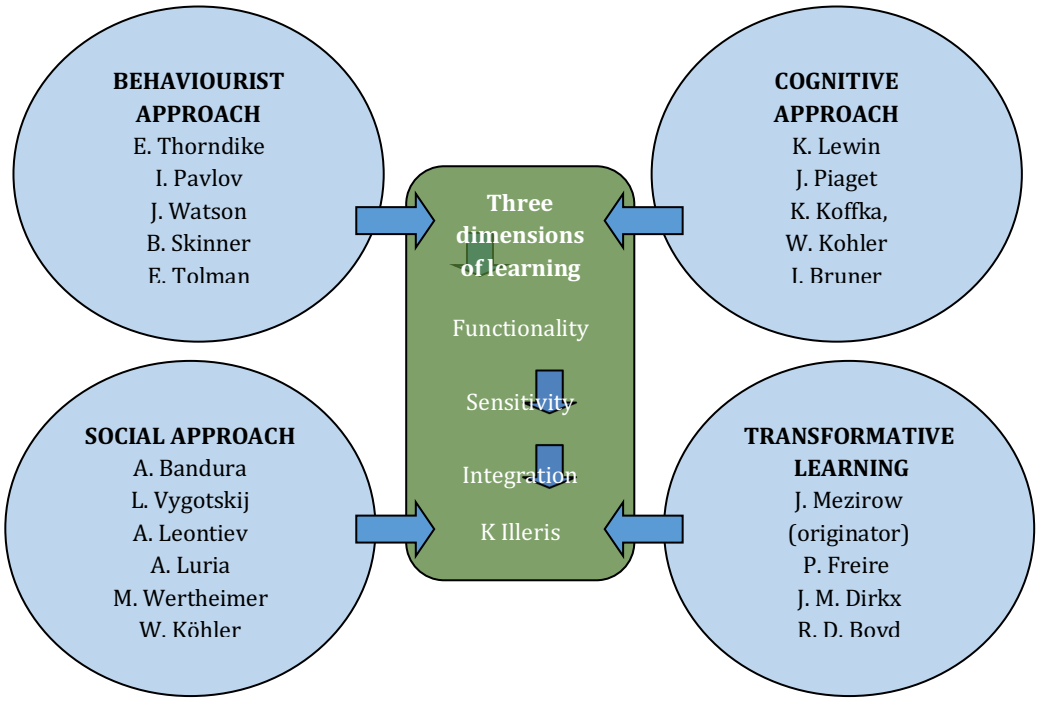

Fig. 4.1. Main theoretical perspectives of learning

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.

However, 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 interactive computer systems that enable 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.

4.2.2 ICTs in Education and Lifelong Learning

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[1] (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

[1] Movies created in virtual worlds.

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 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.

1. 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.

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.

2. Authoring Tools

Rapid authoring tools require at least minimal knowledge of using a computer and allow the creation of e-learning 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.

3. 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 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.

4. 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[2]) 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

[2] LMS is a system that allows for the analysis of users' progress (in tests, surveys, or reports).

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[3]). 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).

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.

5. 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).

6. 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:

[3] 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

- Access to teaching materials,
- Interactivity,
- Integration of various tools,
- Feedback and evaluation,
- An attractive form of presentation (content),
- The possibility of repeating the task,
- Collaboration on content on the web,
- Painless learning from mistakes,
- Sensory simulation,
- Learning through play,
- 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) open-source) 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.
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.

4.2.3 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 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.

4.3 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[4].

All the answers are available at:
https://docs.google.com/forms/d/115_yhfBDREvJQXFliYDaDpNneEY-6jPQ8fV5pM9Qfj4/edit#responses

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

Number of participants

- Others – 2
- Students – 140
- Teachers – 5

The detailed information about the participants is provided below.

[4] The list of stop words included for instance: *a, able, about, above, acquire, acquired, acquiring, after, again, against, all.*

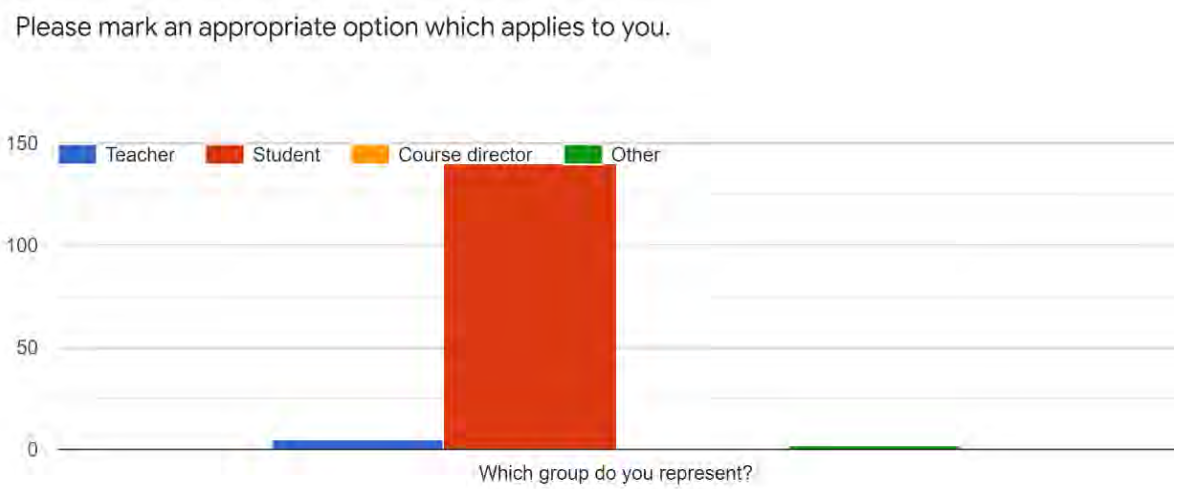

Fig. 4.2. Participants' status

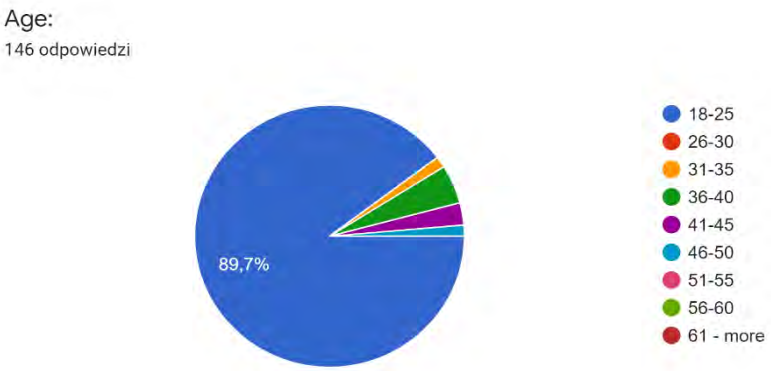

Fig. 4.3. Participants' age

1. 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) (see Table 4.1; Fig. 4.1).

Table 4.1. 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
Studies	7	3	0,83
Study	5	3	0,83
Training	8	3	0,83
Useful	6	3	0,83
Ability	7	2	0,55
Competence	10	2	0,55
Easier	6	2	0,55
Everyday	8	2	0,55
Expand	6	2	0,55
Field	5	2	0,55
Information	11	2	0,55

Fig. 4.1. NVivo word cloud generated from research results (competence)

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 the pedagogical content that you would expect to see in the portal (e.g. what kind of didactic activities would you like to participate in; you may think of games, quizzes, case studies, watching short videos, etc.) (see Table 4.2; Fig. 4.2).

Table 4.2. The display of 25 most frequent items (pedagogy)

Word	Length	Count	Weighted Percentage (%)
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

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

Fig. 4.2. 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.

3. 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) (see Table 4.3; Fig. 4.3).

Table 4.3. The display of 25 most frequent items (organisation)

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
Adjust	6	5	1,59
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

Fig. 4.3. NVivo word cloud generated from research results (Organisation)

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

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?) (see Table 4.4; Fig. 4.4).

Table 4.4. The display of 25 most frequent items (technology)

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

Fig. 4.4. NVivo word cloud generated from research results (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? (see Table 4.5; Fig. 4.5)

Table 4.5. The display of 25 most frequent items (motivation)

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
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

Fig. 4.5. 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? (see Table 4.6; Fig. 4.6)

Table 4.6. 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
Errors	6	2	0,91
Functions	9	2	0,91
Hard	4	2	0,91
Hours	5	2	0,91
Interface	9	2	0,91

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
Unclear	7	2	0,91

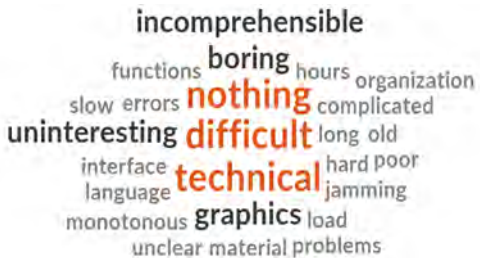

Fig. 4.6. NVivo word cloud generated from research results (discouragement from using the portal)

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.

4.4 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.

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5. A1.5 State-of-the-art Analysis of Digital Capabilities in Learning Management Systems (TTI)

5.1 Introduction

A learning management system (LMS) systems are known by various names, including course management system (CMS), learning content management system (LCMS), virtual learning environment (VLE), virtual learning system (VLS), learning portal, or e-learning platform. Each term might have a slightly different meaning, depending on your interpretation. Perhaps it should be called an instructional management system, as the system's parameters are usually set by instructors rather than by students. An LMS is comprehensive, integrated software that supports the development, delivery, assessment, and administration of courses in traditional face-to-face, blended, or online learning environments.

The powerhouse of a complete learning technology solution, an LMS operates best when it's scalable and flexible to the various needs of your learners. It's also a fundamental component of an effective learning strategy.

Learning management systems are used to deploy a variety of learning strategies across different formats, including (but not limited to) formal, experiential, and social learning, to manage functions such as compliance training, certification management, and sales enablement.

5.2 Common Capabilities of Learning Management Software

The main role of the best learning management system is to provide remote learners with easy access to training materials. The software helps organize important training programs while improving learner's engagement. It is designed to help companies and educational institutions achieve organizational objectives.

Fig.5.1. Key Features of LMS [1]

The main functionality of LMS includes the following components [1]:

1. Data Tracking. The learning management system isn't only used to upload the training materials. In fact, it gives the management team an opportunity to track the performance of the learners and evaluate if the courses are helping them improve their academic performances. The data tracking feature allows the trainers to monitor the learners and ascertain their strengths and weaknesses. You get a clear picture of the learners' performances and abilities. You could also use the software solution to highlight the students' weak points.
2. Reports and Analytics. The LMS comes packed with the reporting and analytics module that allows you to monitor the efficiency of your training materials. These reports can be aligned with the organizational objectives. By using these reports, you can get a clear picture of the student's preferences and requirements. Based on these insights, the management team can design effective and quality training programs. The integrated reporting system in the LMS application allows you to gather insights into the reliability of the new learning method. These reports and analytics tell you the average time your students take to complete the particular course. Some software systems deliver the reports right to your inbox.
3. Course Creation. The learning management systems are designed to support course creation. Make sure that some LMS applications are not compatible with the course creation systems. If that's the case, you are going to need to develop the courses in a separate system and import them into the LMS application. Find a system that enables you to develop courses within the software seamlessly.

4. Skills Testing. Training your employees or students does not seem as challenging as tracking their performance. It is important to monitor your students' performance and evaluate the changes in their learning skills. The management team is supposed to track the project and assignment completion. It is absolutely important for the company to know how well their employees are adapting to the new technology and the innovative learning method.

5. Gamification. There isn't a better way to build students' or employee engagement than the Gamification system. It enables the trainers to implement a reward program that offers certain benefits to the learners who excel in a particular course or achieve their desired goal. In other words, Gamification refers to the process that converts boring courses into exciting competition. Even though it doesn't make a subject more interesting or easier, Gamification has proven to be a perfect solution to the lack of students' engagement and interest in the courses. This learning approach boosts their confidence and encourages them to perform better and achieve some exciting rewards. The good news is the learning management system comes loaded with the Gamification features. You can use the LMS to organize a competition between the students pursuing a specific course.

6. Video Conferencing. Usually, email and SMS conversations cater to all your communication requirements. It facilitates smooth interaction between the learners and trainers. However, the learner might require a one-on-one conversation with the trainer. That's when the video conferencing feature of the learning management solution steps in. These advanced communication features allow users to communicate with their trainers through video conferencing. You don't have to type those long messages and wait for hours to get answers. Students can mark all the questions they can't solve and mention them to the trainer on a video call. Face-to-face communication is especially important when trainers conduct assessments or quizzes. You may want to see how your students are performing in their academics and what they have learned so far.

7. Social Boards and Forums. You must have seen the online forums and social messaging boards where students from different institutions upload questions. The learning management system software features a social board that allows students to discuss difficult topics and learn the important subjects in a group setting. Not only does it reduce the workload of the trainers, but it makes it easier for students to clear their doubts by discussing them with their friends. Basically, the built-in social boards in the learning management software allow students to discuss topics in a forum setting. They can ask questions, post answers, and help each other understand complex topics. It is a great way to allow your students to help and support each other. Using the social boards and forums, you can provide the students with an opportunity to connect with their peers and share their learning experiences.

8. Onboarding and Compliance. You cannot spend weeks training your employees and getting them familiar with the new working environment. Most modern companies expect their new employees to adapt to the workspace as soon as possible. Employees' onboarding is a time-consuming process. You might also need to hire an experienced trainer to train your new hires. The online learning management system simplifies the job by training new hires.

5.3 Brief History of LMS

There are several historical phases of distance education that preceded the development of LMS [2, 3]:

1. Correspondence teaching. The first known document of correspondence teaching dates back to 1723, through the advertisement in the Boston Gazette of Caleb Phillips, professor of shorthand, offering teaching materials and tutorials [4]. The first testimony of a bi-directional communication organized correspondence course comes from England, in 1840, when Isaac Pitman initiated a shorthand course, wherein he sent a passage of the Bible to students, who would send it back in full transcription. The success of the course resulted in the foundation of the phonographic correspondence society in 1843. The pioneering milestone in distance language teaching was in 1856 by Charles Toussaint and Gustav Langenscheidt, who began the first European institution of distance learning. This is the first known instance of the use of materials for independent language study [5].
2. Multimedia teaching: The emergence and development of the distance learning idea. The concept of e-learning began developing in the early 20th century, marked by the appearance of audio-video communication systems used for remote teaching [6]. In 1909, E.M. Forster published his story 'The Machine Stops' and explained the benefits of using audio communication to deliver lectures to remote audiences [7]. In 1924, Sidney L. Pressey developed the first teaching machine which offered multiple types of practical exercises and question formats. Nine years later, University of Alberta's Professor M.E. Zerte transformed this machine into a problem cylinder able to compare problems and solutions [8]. This, in a sense, was "multimedia", because it made use of several media formats to reach students and provide instruction. Later, printed materials would be joined by telephone, radio broadcasts, TV broadcasts, audio, and videotapes [9]. The earliest networked learning system was the Plato Learning Management system (PLM) developed in the 1970s by Control Data Corporation.
3. Telematic teaching. In the 1980s, modern telecommunications started to be used in education. Computers became prominent in the daily use of higher education institutions, as well as instruments to student learning. Computer aided teaching aimed to integrate technical and educational means. The trend then shifted to video communication, as a

result of which Houston University decided to hold telecast classes to their students for approximately 13–15 hours a week. The classes took place in 1953, while in 1956, Robin McKinnon Wood and Gordon Pask released the first adaptive teaching system for corporate environments SAKI [10]. The idea of automating teaching operations also inspired the University of Illinois experts to develop their Programmed Logic for Automated Teaching Operations (PLATO) which enabled users to exchange content regardless of their location [10]. In the period between 1970 and 1980, educational venues were rapidly considering the idea of computerizing courses, including the Western Behavioral Sciences Institute from California that introduced the first accredited online-taught degree.

4. Teaching through the internet: The appearance of the first LMS. The history of the application of computers to education is filled with broadly descriptive terms such as computer-managed instruction (CMI), and integrated learning systems (ILS), computer-based instruction (CBI), computer-assisted instruction (CAI), and computer-assisted learning (CAL). These terms describe drill-and-practice programs, more sophisticated tutorials, and more individualized instruction, respectively [11]. The term is currently used to describe a number of different educational computer applications [12]. FirstClass by SoftArc, used by the United Kingdom's Open University in the 1990s and 2000s to deliver online learning across Europe, was one of the earliest internet-based LMSs [13, 14].

5.4 Comparison of LMS Types

Usually, people assess the LMS based on its features, flexibility, cost, and other important LMS functions. One way to start this process is by analyzing the main types of LMS before deciding the type that will meet your needs. For example, when selecting a proprietary LMS, customers might select this option because this type of LMS usually provides high support; however, the cost associated with this option might be a downside. A better comparison and contrast of each option can be found in the table below [15].

Table 5.1. Main Options of LMS

Category	Proprietary	Open-source	Cloud-based	Sources
Service/ Support	Usually provides: • Software Training • Templates • Technical support • Maintenance • Warranty service	Has limited support: • In-house technical support is needed • Lack of security and privacy settings • No accountability for technical issues	Usually has: • No set privacy and security measures	[18, 19]
Cost	Usually expensive: • Enrollment-based • Annual license fees • All-the-time service payment	Usually free or free for basic packages. Advanced features will have extra cost such as: • Hosting • Maintenance • Back-ups • Extra storage space • Upgrades • Tech support	Cost-negligible or low: • Transparency of future expenses • Advertisements may be included to help the software remain free	[16, 19]
Reliability	Usually a reliable source: • Built by professionals who provide further training • Research supported and current technology • LMS or features/tools adopted by the company may be discontinued	Reliability is limited as code quality, accuracy, and update may not be maintained.	Reliability is on internet connection. It also offers scalability, as the software will work the same independent of the number of learners or instructors.	[16, 19]
User-Friendly	Customization is limited: • Few possibilities to try new features or tools • Customization delivery and appearance are challenging	Usually has high customization: • Source codes can be customizable • User can change and add new features or tools • Broader range of themes for delivery and appearance	Customization is moderate and it needs familiarity with the tools. • Activity focused, as tools are designed to engage and promote learner-centered activity. • Easy to store and arrange documents and date into an excel or PDF report • Lack of authentication- limited methods of determining enrollment, assessment or grades	[16 -19]

Category	Proprietary	Open-source	Cloud-based	Sources
Data Sharing	It usually links to other enterprise software systems, but data can be lost if the course leaves the hosted LMS.	Software updates are available; however, there is a possibility of stagnancy if community members are no longer developing.	Learners can access material anywhere and at anytime and can easily collaborate or share information	[18 - 19]
Flexibility	Usually limited - inability to adjust the software, add features, or address issues immediately by users and their organization	High flexibility – allows for adjustment of the software, adding features as well as collaboration because of the software and source code being accessible to anyone.	High to moderate flexibility - variety of tools and features available.	[16, 18, 19]
Software	Constrained- it can be restrictive and difficult to use or add new features. Software may not be maintained for current treads/uses.	Open – allows for suggestions and new ideas because of collaborative community development. Software may not be maintained for current treads/uses.		[16, 19]
Device Installation/Use	Software might need to be installed on a server instead of personal devices	May need integration with existing administrative systems or the need to establish an administrative system. Software can also be installed on personal devices	No need to install software. There is no need for a server or IT expertise. Easy distribution of course, mobile device friendly and real time reporting/ access to documents.	[16, 17, 19]
License Agreements	License agreement may be restrictive in how the software is implemented, distributed, and administered			[16, 19]

5.5 State of Higher Education LMS Market

Elearning used to be a part of the informal education system, but the pandemic ðipped that. Today, learning management systems (LMS) and elearning software statistics show that both have become the mainstream in learning delivery, with at least a billion online views of learning content per day [20].

These numbers only show the widespread acceptance of online learning that may well continue post-pandemic. As a result, the LMS and elearning market is expected to reach $1 trillion by 2027 [21].

In the article [22] these changes in the industry in 2022 and beyond are analysed. The following statistics (Fig.2) provide crucial data points on how the LMS and elearning industry is accelerating. The data show that education technology and LMS software have yet to satiate the desire of instructors and learners. The accessibility of bite-sized learning, as well as instant customization, will continue to transform the online learning landscape.

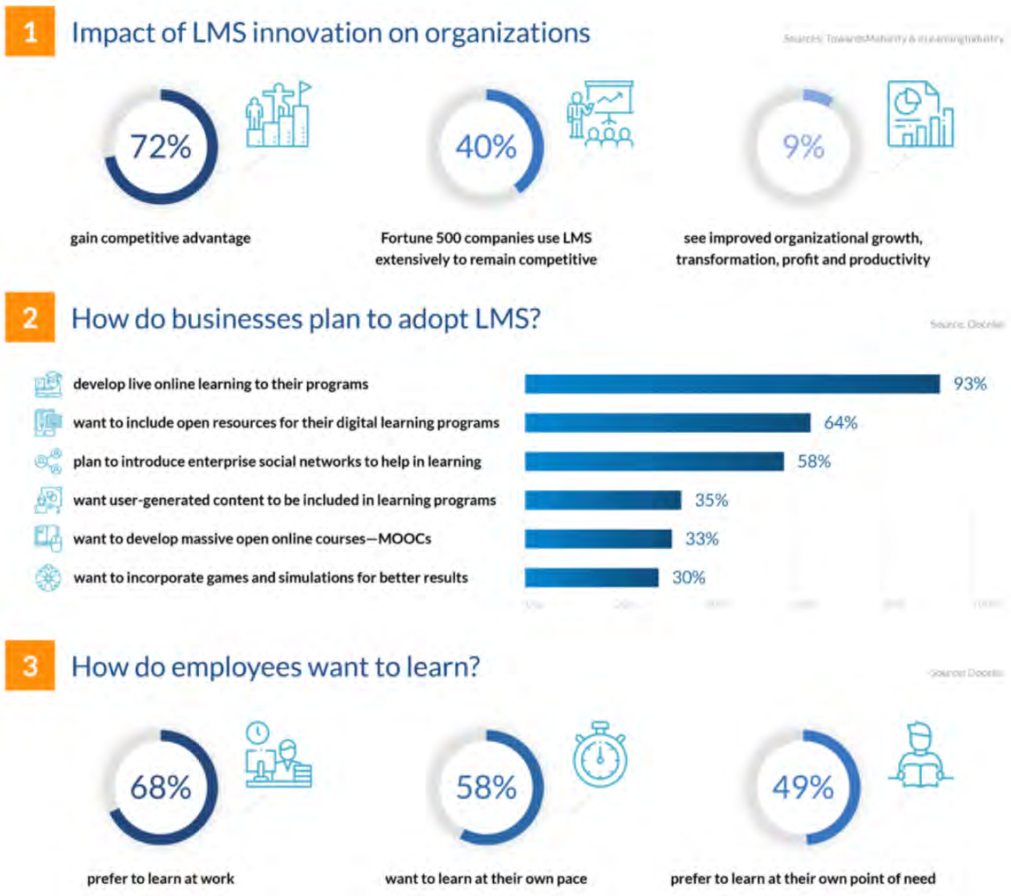

Fig.5.2. Three Key LMS and E-learning Statistics [22]

The telecommunications revolution, including the development of multimedia platforms, has played a key role in putting elearning and LMS software at the center of education. As technology has become indispensable in teaching and learning, the learner is poised to benefit from all the advancements.

In the same manner, the rising adoption and proliferation of elearning keep technology solutions and service providers expectant of unprecedented growth. The following market information

mirror a fast-growing industry driven by a remarkable shift in workplace training and classroom learning:

1. The millennial population, which comprised 35% of the global workforce in 2020, is one of the main drivers of the remarkable increase in the use of elearning tools [23].
2. The global market for elearning is projected to reach $305.3 billion by 2025 [24].
3. The global corporate elearning market is expected to grow by $ 37.8 billion during 2021-2025, progressing at a CAGR of 13.14% [25].
4. Meanwhile, the cloud-based LMS is predicted to grow at a CAGR of 24.59% from 2021-2029 [26].
5. The growing spending on PaaS and SaaS portion of cloud hardware and infrastructure software is projected to reach $32 billion by 2020 from $8 billion in 2015—this is set to boost the growth of the global cloud-based learning system [26].
6. From 2021 to 2029, the higher education market segment is expected to grow at a CAGR of 25.9% [27].
7. The gamification market global value in 2020 reached $9.1 billion [28].
8. The global gamification market is expected to reach $37 billion by 2027 [29].
9. From November 2019 to June 2020, Zoom stocks climbed from $69.64 to $252.81 [24].
10. 63% of university leaders predict full university learning courses by 2030 [30].
11. Microlearning improves focus and supports long-term retention by up to 80% [31].
12. Among L&D professionals, 94% prefer microlearning compared to other elearning tools [32].

There are currently over 800 LMS in the world[33]. On special sites it is possible to compare these systems according to various criteria. Traditionally, the popularity of LMS differs in the markets of America and Europe. Fig. 5.3 and Fig. 5.4. show the market share of LMS on the US and Canadian higher education markets [34].

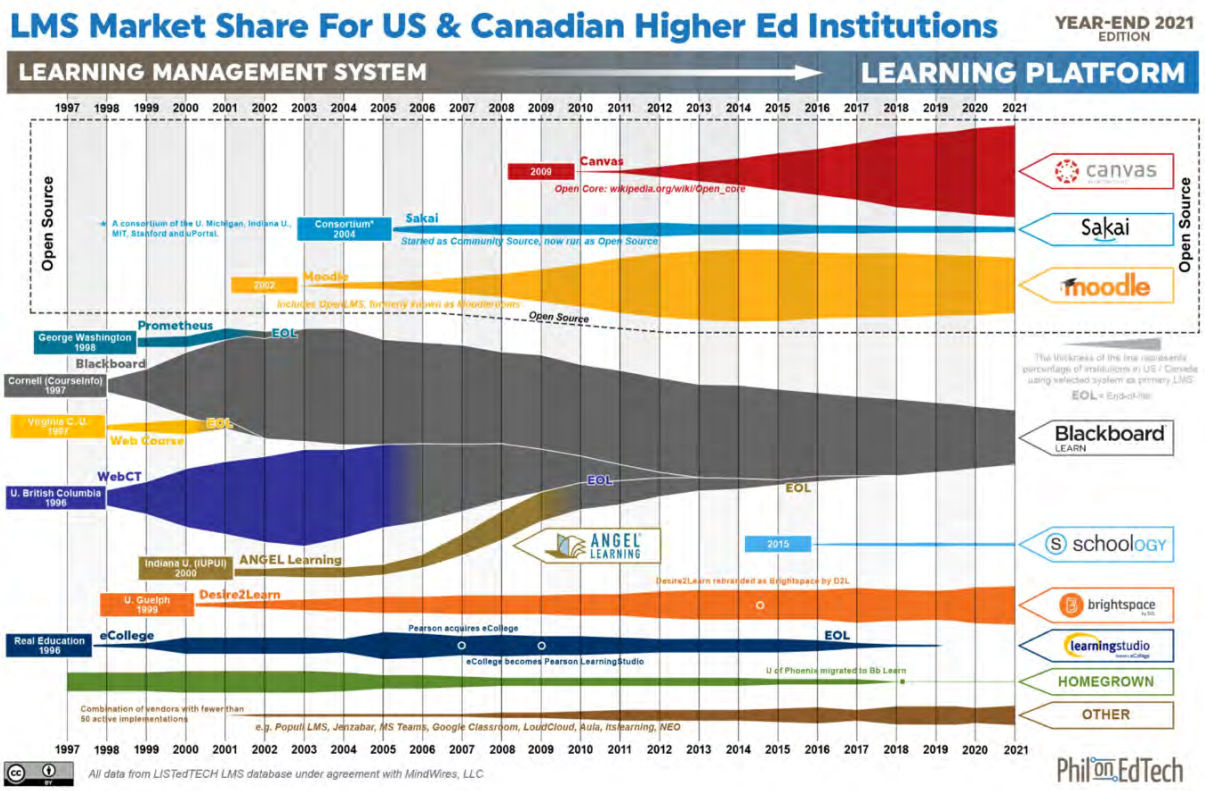

Fig.5.3. LMS Market Share on in US and Canadian Higher Education

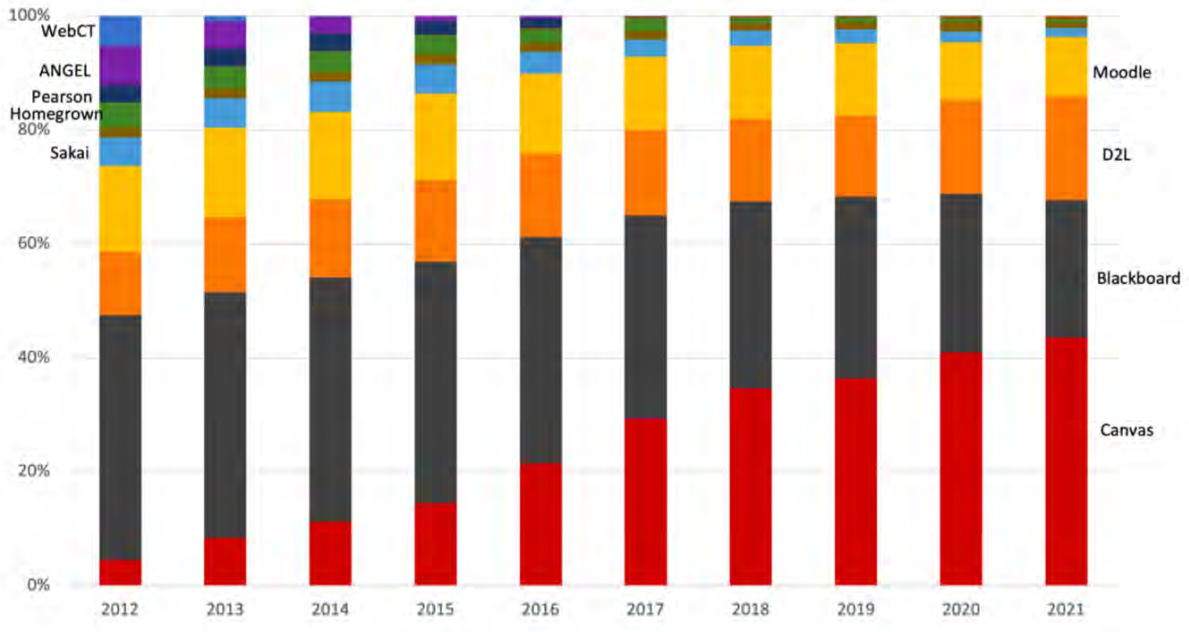

Fig.5.4. Historical LMS Market Share for North America

However, the market distribution for higher education institutions in Europe is somewhat different. Fig.5.5 shows the distribution of LMS by country, whereas Fig. 6 -by types of LMS in Europe [35].

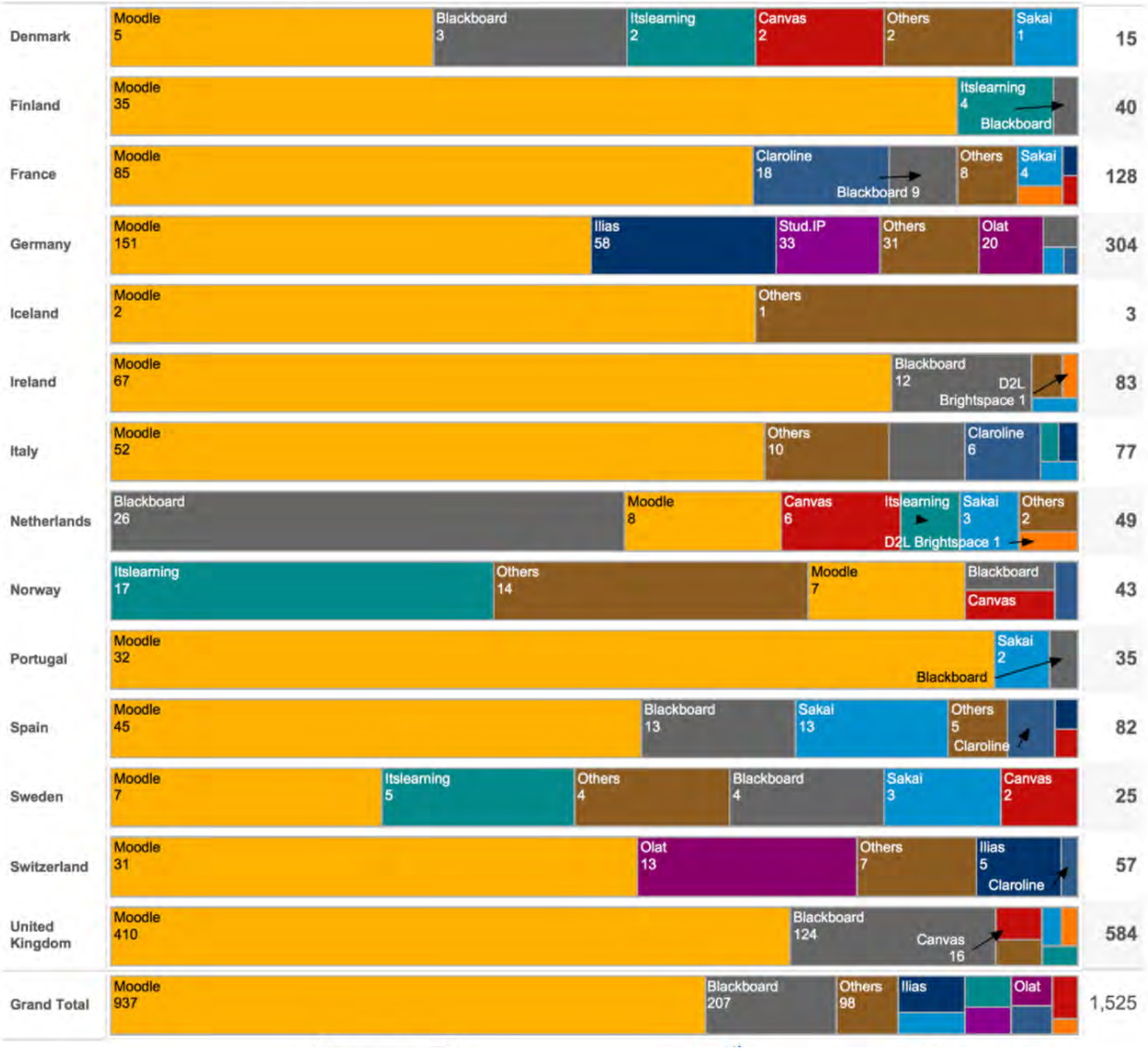

Fig.5. LMS Market Share for Europe by Country

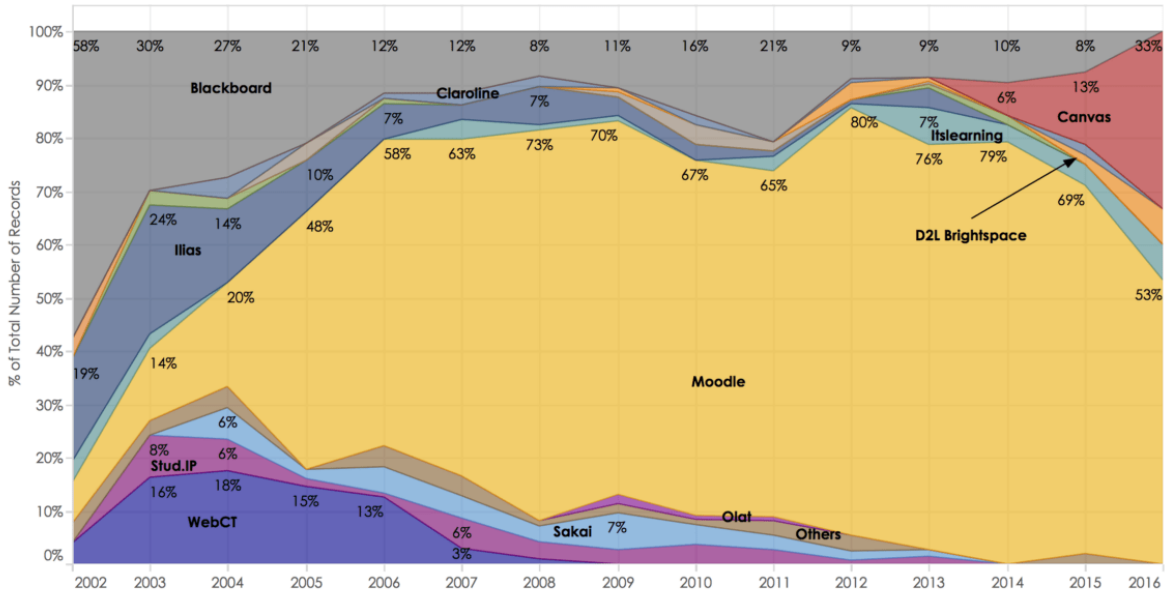

Fig.5.6. European Market Share by LMS Type

5.6 Trends of LMS development

An analysis of the trends in the development of LMS shows that several directions can be distinguished.

In the field of development of specific types of LMS, the following trends can be distinguished [36]:

1. Average age of LMS. Canvas and D2L show a young age, signalling early adoption that lowers their average, but also a risky standing. GUNET eClass and Homegrown boast 15.9 and 9.8 years per installation, and no market share to speak of. Industry average is 7.3 years.
2. Cloud I: vendor hosting. Growth of cloud-based services follows the world's trend, except when Open Source. With Moodle there should be a disclaimer: the Partners, some of which offer all-encompassing solutions. 7 out of 8 LMS implementations take place in the cloud. Denmark and Norway are the exceptions where self-hosting is the rule, a situation not expected to last.
3. Cloud II: datacenter law. Europe requires cloud providers to have servers within its geography. This affects US and Australian LMS the most. Blackboard does maintain some infrastructure in Europe; compliance with regulation, however, is all but unclear.
4. The rise of the consortia. To lower bureaucratic burdens, leagues of institutions who procure LMS in bulk have been a tradition in Europe, which is starting to spread.

In pertinence to the development of LMS functionality, the following trends can be distinguished [37-39]:

1. Connectivity with Other Systems

Perhaps the biggest current trend in L&D is that understanding is so much more than just "courses." Organizations are taking a more holistic view of learning to include performance development, career maps, skills journeys, social learning, and more. This broader view demands current technology that can do more than simply house online courses and perform basic reporting on completions and pass rates. Imagine an integrated system where managers and employees alike can distill information from multiple sources, including performance metrics, development plans, and of course, online learning and professional development resources. This system is a talent experience platform . Harness the power of all of the data pertaining to performance, and don't isolate learning into siloed experiences that feel disconnected from other experiences on the job.

2. Personalization

If you've done your homework and conducted a needs analysis prior to creating any content for your audience of learners, you probably made the observation that your audience isn't a homogenous cohort, but rather a diverse group of individuals with unique needs and preferences. Respect their individuality by giving them the opportunity to have personal experiences tailored to their needs. Organize the multimedia content in your LMS into playlists, such as all content pertaining to a specific topic or certain role. Share information with learners through dashboards that present recommended content that appeals to their interests and to their completion history. Customizing your system's look and feel to appeal to each individual is a great method for increasing learner engagement.

3. Content Curation

Content curation in learning solutions is the act of including external content in your programs, such as TED talks, Coursera courses, industry articles, podcasts, and more. By curating content, you expand your learners' access to information beyond what's contained within the four walls of your organization. Using curated content also saves valuable time and development resources (no need to build from scratch!). Content curation pairs nicely with learning playlists and dashboards; consider creating playlists that include both internal and external content on a particular theme or topic to present your learners with diverse perspectives throughout their learning journey.

4. Social Learning

One of the hottest LMS trends in corporate eLearning is the integration of social activities. Formal learning is merely the start of the learning process, not the end when you incorporate social activities such as chat forums, reflection activities, collaborative learning experiences, and

platforms where alumni learners can share their expertise and harness their natural tendencies to connect with one another. This hand-off from seasoned employees to novices forms meaningful communities of practice, and over time the collective wisdom in the community will grow as employees continue to share their real-world experiences and come together to solve problems. The use of social learning can be especially powerful in remote environments by helping employees form meaningful bonds with one another even while separated by physical distance. Achieve top LMS learner engagement by providing your learners with a platform built with their social needs in mind.

5. Interactivity

One of the most powerful demonstrations of how an LMS can help companies is by pairing best-in-class features, such as grouping learners into audiences then polling them or using polls as self-assessments where learners can assess their abilities before and after training to identify potential areas for development. Polls can also be used to collect feedback from others, including coaches, managers. Poll data can be especially helpful in providing insight into areas that are more qualitative in nature than quantitative. No two learners are alike, and by implementing interactive features no two learning experiences will be alike either.

6. Badges and Gamification

One surefire method to achieve LMS learner engagement is through the use of digital badges and highly rewarding game-like learning experiences. Your learner's high engagement levels will correspond to high attention during training and high retention of the information after completion. Badges function as awards of completion and recognition, and can even be displayed externally, such as in email signatures or on social media profiles. Whether learners enjoy the pursuit of collecting the badges, the act of displaying them, or both, badges often appeal to learners' intrinsic and extrinsic motivation. Game elements that can be incorporated into learning experiences can include unlockable content that learners gain access to for successful performances or the completion of tasks, praise for their progress as they advance through “levels” of content, and leaderboards celebrating learners’ high performances. These elements are fully customizable and can be designed to meet the needs of your learners and your organization.

7. Continuing Monumental Adoption of Virtual Training

No real surprise here, but the numbers are still shocking. In 2017, 77% of companies incorporated some form of virtual training. By 2020, that number jumped to 98%.

This jump was made out of necessity in 2020's shift to a larger remote workforce but has other side benefits. Those companies with comprehensive training programs (read: well-developed and expertly rolled out) had 218% higher revenues per employee. They also experienced 24% higher profit margins.

8. Greater Need for "Training for Trainers"

Traditional trainers working in classrooms or delivering lectures aren't always equipped for success in an online or virtual environment. Delivering training through a screen is a much different experience and it requires a specific skillset. Due to the push for virtual training options, there has been exponential growth in the need for training that helps in-person instructors upskill to virtual environments.

Another set of skills needed? Developing the training itself. It takes a particular touch to design engaging training to be delivered virtually across different platforms. Some companies are finding that their designers need to "go back to school" too.

9. Content Curation and Creation Tools Take Center Stage

The pace of change across 2020 could be described as "warp speed." With so much on-the-fly development and quick changes to safety protocols, training requirements, and work processes, a major corporate learning trend in 2021 will find businesses turning to pre-made training materials.

10. Performance Support Blurs the Lines of Training

Performance support will change in 2022 as many people stay remote. This means that microlearning in the flow of work begins to blur the line of sitting down to a traditional training or utilizing training aids to support job performance throughout the day.

Not only does performance support give employees the tools they need to do their job, but it also allows them to share their expertise during their days. Training becomes better than the one-way street it might have been in the past. It focuses on collaboration toward a common goal between different employees, teams, or departments.

Better still, training is fully integrated. It's not a separate, seemingly unrelated add-on that becomes another thing on the growing to-do list. When used as a support tool, it's vital and valuable.

11. Mobile-First Training, Not Only Mobile-Ready

Previously, a minimum standard was that eLearning be "mobile-ready." Most trainings were built with the desktop user in mind and then modified as needed for mobile devices.

In one of the biggest eLearning trends, 2022 sees a reverse of the traditional process of building content for desktop users and then adapting it to mobile. Many courses or programs are building for the mobile experience first and then transitioning to a desktop user experience instead. This upends how we used to think about designing eLearning.

A quality mobile experience is crucial, especially as many workers are still outside the office and taking training at home. This makes it easier for businesses to deliver tools to employees when and where they need them.

12. Greater, Richer Data Sets Drive Decisions

You know the expression, "When you know better, you do better"? Better data leads to better decisions, and many companies are turning to deeper, richer data sets to gain insights into their remote workforces and tracking different metrics to determine productivity and development.

In one related tool, xAPI can replace the traditional Learning Management System with a learning record store (LRS). The LRS doesn't just indicate that an employee has finished a training, it can also track exactly what employees did with what they learned. With this tool, managers and leaders can gain insight into what's working, what needs to be developed further, and which direction to head next.

13. Workplace Demands More Flexible Training

Another big lesson from 2020 that affects eLearning in 2022 is that many people who begrudgingly started working remotely have found that they actually like it and want to continue.

Surveys of workers have found that fully 90% of employees want to continue working from home in at least some capacity. Almost 50% of workers in these same surveys indicated that they want to continue to work remotely for most or all of their time.

The changing workplace means that the future of corporate learning must necessarily become more flexible so employees can take training when they need it.

14. Microlearning

As noted above, microlearning tools make it even easier for employees to quickly reference skills and knowledge they need for their job. You can learn more about the different types of microlearning here.

15. Video Training

Video training, whether synchronous and virtual instructor-led (VILT) or asynchronous and accessed when an employee needs it, is also seeing a resurgence. Synchronous VILT allows employees to work together and problem-solve too. This builds connections and community that can increase productivity even when working apart.

16. Virtual, Augmented, And Mixed-Reality Training

What used to seem futuristic and only for video gaming is now becoming one of the eLearning trends and predictions that was forecast years ago and is still building up real-world opportunities. Working at home means that in-person, on-the-job training isn't widely possible. VR, Augmented Reality (AR), and MR tools allow employees to work through complex simulations or scenarios wherever they are.

17. Virtual Classroom Training

Before the pandemic, many companies were wary about using virtual classrooms for their training procedures. They worried that it wouldn't be effective, but when the pandemic pushed companies to take their training online, they saw that it was highly successful.

There are still challenges when it comes to virtual training. Many employees don't have a strong internet connection, and some may not wish to use their webcams. Training content also has to be reworked to make it fit an eLearning platform.

Still, most employers are beginning to feel that the benefits are outweighing the risks, and virtual training may eventually become the norm.

18. Customer Education is the Next Business Must-Have

Companies have long known the importance of customer education. Well-informed customers who know how to use a service or product will have a better experience and have a better chance of being repeat customers. While customer training has traditionally been an in-person course, the pandemic has forced it online.

Many businesses are now budgeting to create customer tutorials and other forms of education through learning management systems. These programs are growing in popularity and will likely be the way companies educate their customers going forward. The eLearning business is a hot commodity right now.

19. Artificial Intelligence Continues to Advance

While businesses don't use artificial intelligence (AI) and machine learning through their learning management systems, these technologies can help make LMS easier to use and much more effective.

AI and machine learning are advancing by leaps and bounds. They present a range of capabilities to help make learning and managing learning easier for all parties. A few of the features include data analytics, chat bots and assigning tasks.

20. Mobile-First Training, Not Only Mobile-Ready

In the past, a learning content management system would create programs made for desktops, with mobile use as an afterthought that would come in the future. The program would be adjusted for mobile on an as-needed basis.

Now it's clear that a lot of learning takes place on mobile devices, one trend for 2022 is a design reversal. Programs will now be made for mobile, and adjusted as needed for desktop use. This process allows users to learn from anywhere.

21. Analytics Tools Dig Deeper

Companies have a long tradition of using data to track the effects of their training programs. They wanted to know how effective their programs were with employees, and if they educated customers, they wanted to see if it helped with customer retention.

Now LMS companies are getting in on the action as well, and this trend will continue in 2022 as the ability to track data grows. An enterprise learning management system can now integrate data analytics through its own system to help their customers even more.

This data can be exported to analysis tools, can be completely embodied in the custom LMS, or integrate an outside data analytics tool into the LMS interface.

5.7 Conclusion

LMS trends are constantly evolving, which benefits both learners and organizations alike. Modern systems enthrall and engage learners, making on-the-job learning actionable, relevant, and impactful. By crafting experiences that empower learners to be active participants in the process and access learning that fits their unique needs, today's LMSs offer so much more than just automation of instruction and the mundane record-keeping of the past. Engagement is a critical component in the learning experience and is not just a trend or passing fad.

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6. A1.6 Development of Model for Competence-Based Customization of Programs (UM)

6.1 Sources of Competences, Competence Standards and Models

Competences have been defined in the literature as a term that is widely used to refer to a variety of qualities and capabilities that are becoming increasingly important in education, such as critical thinking skills, effective communication skills, teamwork, imagination, creativity, and intellectual rigor [1]. They can be divided into four categories:

1. Basic competences. These are the ones that have to do with fundamental knowledge and how to understand and solve difficulties in everyday life. This set of skills could include the capacity to read and write, as well as the ability to communicate in a specific language.
2. Generic competences. These are capacities, qualities, and activities that are applicable to a wide range of professional fields. A generic competence, for example, would include the ability to work in a team and leadership.
3. Specific, technical, or specialized competences. These are technical characteristics directly related to the professional occupation. These skills are difficult to transfer to other professional or academic settings. Some specific talents, for example, may be linked to the ability to code in a specific programming language or to the study of a communications protocol.
4. Meta-competences. These are broad and high-level. They benefit other ones. Competences such as self-awareness, problem-solving, and creativity are some examples.

Education is predicated on the student's acquisition of a set of competences, which translates to giving them a collection of formal training along with abilities, and attitudes that enable them to do the tasks required in a job position. The growth of these skills is inextricably tied to the growth of the individual. As a result, distinct levels of compliance on the side of the students must be defined. The modeling of a competence takes into account characteristics like the one aforementioned [2]. The notion of a competence in the field of e-learning, and particularly computer-based education, is also linked to its storage in electronic media. Therefore, a competence's definition must adhere to a standardized format, allowing all competences to conform to a definition model and be interoperable across various information systems.

The concept of e-learning is very broad. As an example, Computer-Based Education is included within the area of e-learning but it is more focused on the use of computer media. In the A1.6 section, both concepts will be treated interchangeably. The standards cover the definition of e-

learning from different perspectives, structuring the information from different areas of standardization [3]. The main areas of e-learning addressed in the standards are the following.

1. Metadata for the Definition of Educational Resources

A set of metadata defines a learning object. From the metadata, a set of descriptions, properties and information about the learning resources can be obtained. This simplifies their use and management. Among the most important international standards in the field of metadata are the following: IEEE Learning Object-Metadata (LOM), IMS Metadata and Dublin Core Initiative Metadata (DCMI). For example, in IEEE LOM, learning objects are defined in XML format. Therefore, the standard relies on the creation of a specific XML Schema of metadata to define learning objects. A learning object is a collection of contents, exercises, assessments, links of interest, tips, good practices... All these ingredients properly combined allow the acquisition of new competences. Learning objects cover a very broad concept, ranging from sillabi, transparency for the explanation of basic concepts, or even web pages http://www.mkyong.com, where tutorials for learning Java EE are offered.

2. Organization of Educational Resources and their Packaging

In this area, the aim is to define the exchange of learning objects between different software platforms. For this purpose, data exchange protocols are defined, as well as data packaging formats for their transport on the network. The following international standards stand out: IMS Content Packaging Specification and SCORM Content Aggregation Model. The definition of standards of these characteristics allows learning objects to be stored in each of the systems used for teaching, regardless of their delivery through communication networks.

3. Educational Modeling Languages

The previous international standards listed and in general, most of the international e-learning standards, are born with the assumption that e-learning is an individual task, performed by a single person in an autonomous way, who learns from the achievement of a set of sequential tasks that each time make the learner progress in his knowledge. In this vein, e-learning is born under the premise of collaborative learning. Keeping this idea in mind, processes are defined in which it is necessary that several authors participate in the progress of knowledge on the part of the students. The main standard is the IMS Learning Design (IMS LD). This standard provides a modeling language, called OUNL EML, which makes it possible to define educational processes as a set of activities, involving both students and teachers. In short, it allows defining a workflow to specify a learning object as if it were a business process.

4. Learner Management

This area deals with the management of student information in e-learning web applications. It is determined with managing the information coming from the students such as their personal data, their application configuration preferences and their academic information. The main standards

are: IMS Enterprise, IMS Learner Information Package, IMS Learner Information Services, IEEE-LTSC Public and Private Information for Learner and the European Diploma Supplement (EDC) standard.

5. Execution Environments

There must be a separation between the contents taught in the e-learning modality and the execution environment. There is a set of basic tasks corresponding to the execution environment that must be correctly implemented, such as the delivery of the educational content to the learner, the support for the correct understanding of the delivered content by the learner, planning of the new content delivery, etc. In order to enhance the reusability of the tasks carried out in the execution environments, it is necessary to separate each task into different software modules. In this area it is important to highlight the SCORM Runtime Environment standard.

6. Digital Repositories

Digital repositories allow the management of educational resources on the network. The main idea of these standards is that educational resources can be stored centrally by an application, so that they can later be reused by other applications. In this area, communication mechanisms between different digital repositories are proposed. The following standards stand out: IMS Digital Repositories Interoperability and Simple Query Interface defined by CEN/WS/LT.

7. Architectures

The standards in this area provide a common framework for developing e-learning systems as a set of interconnected components. The Learning Technologies Systems Architecture (LTSA) standard, specified by IEEE LTSC, is one of the first technological convergence frameworks in this field. The standard describes five successive layers of refinement for interoperability between different e-learning components. Each layer deals with educational processes at a different level of abstraction, simplifying interoperability between layers through APIs.

8. Glossaries and Ontologies

This area focuses on the definition of vocabularies, glossaries and ontologies for the full specification of knowledge in e-learning systems. A standard in this area is IEEE LTSC P1484.3, which establishes a glossary of terms related to e-learning technologies.

9. Definition of Competences

In order to have a clear understanding of the competences to be acquired by learners, it is necessary to define competence definition models. These serve as a starting point for the specification of competences. In this area it is possible to use models/standards that will allow to compare the acquired competences between the learners. In addition, clear processes for the acquisition of competences can be established. However, there is no agreement among standardization bodies on the definition of competences, nor is there a model that imposes itself

on the rest for the definition of competences. Within this field, the IEEE LTSC P1484.20.1 and InLOC: Integrating Learning Outcomes and Competences, developed by CEN Workshop Learning Technologies, stand out. Both define competence models and are independent.

10. User Interfaces

This area focuses on the definition of graphical interfaces for the development of e-learning applications. Within this area, the aim is to establish a set of icons, graphic components, etc., that can be used in any information system developed, so as not to generate confusion for the user.

11. Multimedia Formats

There are a multitude of standards that define guidelines on the formats to be used in multimedia contents. These resources can offer advantages in some scenarios that may arise in the use of e-learning technologies. Therefore, the formats used for image, audio and video files in this type of platforms should be defined.

12. Localization

This area of e-learning deals with how to present the contents of an e-learning information system according to the geolocation of the user. It is important to define mechanisms that respond to issues related to language and cultural diversity. There are European institutions, such as CEN, that are working in this area.

13. Intellectual Property

The multimedia resources in information systems may be subject to a set of rules set by intellectual property laws. Therefore, in this area the definition of contracts between the owner of the intellectual rights of a resource and the user who makes use of this resource is standardized. The CEN addresses aspects related to intellectual property, while the IEEE-LTSC defines in the Rights Expression Language (REL) a syntax and grammar for the specification of rights on how to distribute and/or use resources.

14. Accessibility

People with disabilities can be excluded if the accessibility of e-learning systems is not properly addressed during development. In this area, there are accessibility standards such as the IMS AccessForAll Digital Resource Description and the IMS Guidelines for Developing Accessible Learning Applications.

15. Semantics and Consolidation of Change

In this area, mechanisms are proposed for the integration of semantic elements defined in other areas. The IEEE-LTSC 1484.14 standard deals with this area.

16. Hardware Systems

This area describes a set of guidelines and specifications on hardware systems, peripheral

devices and their interoperability for use in e-learning tools.

17. Quality

This domain defines metrics, guidelines, taxonomies or other evaluation artifacts for the development of information systems. The objective is to involve users so that they are able to define their specific needs in terms of learning quality. In this way, providers can specifically state their learning quality and foster the development of a global e-learning market.

Once the standards for e-learning systems had been analyzed, it was proposed to select those that covered the area of academic competences. As mentioned above, there are already several standards in this area that have been drafted by different organizations. It has been observed in the literature that there is an important need to harmonize standards even in the definition of competence frameworks [3]. In fact, the harmonization of this type of standards may generate a definition of a standard Curriculum Vitae model, in which a particular standard is used for the definition of competences acquired by the learner/job applicant.

In the domain of academic competence definition, it has been observed that only the following three international standards exist for the definition of a competence specification model [3].

1. IMS Reusable Definition of Competence or Educational Objective - Information Model (IMS RDCEO), defined by the IMS Global Learning Consortium [4]. This standard defines a model, considered incomplete by the IEEE 1484.20.1 standard, for the definition of competences.
2. IEEE-LTSC Std. 1484.20.1 Standard for Learning Technology - Data Model for Reusable Competence Definitions [5]. This standard is an extension of the previous one and has the same purpose, to define a model for the specification of competences.
3. InLOC - Integrating Learning Outcomes and Competences [2]. It is a standard developed by CEN. The aim of the standard is also the specification of a model for the definition of competences, which can be integrated into standard curriculum vitae models, such as Europass. This standard is not based on any of the above standards.

The IMS RDCEO standard was discarded for the attainment of academic competences, since the IEEE Std. 1484.20.1 standard is based on this standard. The IEEE Std. 1484.20.1 and InLOC standards were selected, as they are independent and serve as the basis for the definition of academic competences.

Competence sources and competence models were also considered to define competences. Several sources of digital competences can be found, such as the following:

1. European e-Competence Framework (e-CF). It provides a collection of competences that may be required and implemented in an IT professional work context. A common vocabulary for competences, skills, knowledge, and proficiency levels is used and

understood throughout Europe.

2. DigComp. Comprehensive framework for citizens' digital competence development in Europe The framework provides a complete explanation of all the skills required to be competent in digital environments, including knowledge, skills, and attitudes, as well as levels within each competence.
3. European Qualifications Framework (EQF). It is an eight-level framework based on learning outcomes for all types of qualifications that serves as a conversion tool between different national qualifications frameworks. This framework aids in improving the transparency, comparability, and transferability of people's qualifications by allowing them to be compared across countries and institutions.

Other sources of competences can be found in more specific domains that allow determining the academic competences of particular subjects.

4. In Software Engineering (SWEBOK). It is a document created by the Software Engineering Coordinating Committee, promoted by the IEEE Computer Society, which is defined as a guide to the knowledge present in the area of Software Engineering.
5. In Project Management (PMBOK). It is a book that presents standards, guidelines and norms for project management.

In addition, competence models focused on a particular domain, such as computer science, information technology or software engineering, were found. They are also a source of competences, and are as follows.

6. Computing Curricula 2020. It contains international guidelines for undergraduate degrees in computer science and is published by the ACM and the IEEE Computer Society.
7. Information Technology Curricula 2017. Also published by the ACM and the IEEE Computer Society, it defines the competences for degrees in Information Technology.
8. Software Engineering Competence Model. Defines competences required of software engineers who work on software-intensive systems' creation and modification.

6.2 Competence-Based Education and Models

Although Competence-based education (CBE) is gaining a growing interest nowadays, fostering educational programs through student competences tracking [6], the literature still struggles to define CBE in the context of higher education [7]. Given its lack of consistency, conformity around standards, and strong theoretical backing, the CBE has multiple definitions and different interpretations across programs in the literature [8].

Even though no given standard in the literature structures CBE, it is often confused with concepts such as problem-based learning, mastery-based learning, outcome-based learning, and performance-based learning, which do not capture the essence of CBE. The literature still agrees that CBE incorporate emphasis on outcomes, a strong pedagogy, the use of interdisciplinary resources, and assessment of a student attainment of competences across the curriculum.

In view of this, different models to structure the implementation of CBE in the context of higher education were proposed. Book [9] put forward two different models, one based on direct assessments and in which grades are non-existent and the formal evaluation is structured in a way to measure students mastery of the course competences allowing them to demonstrate their progress when ready. The second is credit hours based, in which the number of credits taken plays a major role in graduating, and grades are the sole formal evaluation and the only opportunity for students to demonstrate their mastery of competences. In contrast, Pace [10] proposed a model which combines both: (1) Comprehensive assessment system that allows students to have a customized learning experience and multiple opportunities to demonstrate their mastery of competencies at their own pace. (2) Grading system reflecting the degree of mastery of these competences, allowing students who may failed to earn the course full credits, to only relearn the competences that they were lacking rather than retaking the whole course, thereby shifting the focus from instructional delivery to student performance. **Ошибка! Источник ссылки не найден.** shows a comparison of discussed CBE models in an accordance with their common similarities and the distinguished characteristics of each.

Table 6.1. Comparison of CBE models

Models	Grades	Assessment	Flexibility	Customization
Direct Assessment Model [9]		x	x	
Credit Hour Model [9]	x	x		
Pace Model [10]	x	x	x	x

From a different perspective, and drawing from a study of the national postsecondary education cooperative working group on CBE initiatives [11], Voorhees [12] presented a rubric to evaluate CBE models when implemented. Gervais [8] however, with a focus on assessing whether or not exist the CBE criterion in academic institutions/programs/accreditation standards, suggested different rubric relying on the institutional/program considerations, the construction of learning, the mastery of learning, the assessment of learning, and the role of faculty. Although the finding suggests the availability of different models and rubrics tackling CBE, neither the availability nor the ease of access to CBE models and rubrics ensure successful implementation of the latter [12].

Against this background, the success factors of the CBE were investigated in the literature. On the one hand, Johnstone et al. [13] propose five key pillars for a successful CBE model which rely on: (1) The robustness and the validity of competences that a giving CBE program reflects. (2) The

students' ability to learn at a variable pace and in a supported manner within these programs. (3) The availability and reusability of effective learning resources. (4) The explicit presentation of the competences mapping process, the learning outcomes, and assessments. Finally, (5) the reliability and security of these programs' assessments. On the other hand, according to Newbold et al. [14], the roles which play the faculty implementing CBE within its programs have a major impact on ensuring the latter's success. Unlike the case in traditional learning, faculties should: (1) Stimulate students to explore topics and intrigue both their curiosity and creativity rather than lecturing them. (2) foster nonlinear holistic learning. (3) Encourage self-efficacy among students.

In the light of these findings, more research and awareness in higher education about CBE and the role it can play in professional programs are suggested. Therefore, our work aims to harmonize existing CBE models and CBE rubrics features in order to suggest a comprehensive CBE model for higher education that incorporates success factors.

6.3 Harmonisation

Establishing mechanisms for harmonization of standards is a complex task. It has been observed that as standards in Software Engineering develop, standards lose cohesion with each other, leading to heated debates in communities about the collaborative development process, interoperability and harmonisation with existing standards. It has been assessed in the literature that harmonization efforts can be aided by the results of recent research to create better quality standards [15]. In addition, the adoption of a uniform set of standards in a specific domain mitigated information frictions. A difference-in-differences design found that, following the adoption of a set of standards, the actions taken generated more information and at a faster speed [16].

6.3.1 Hframework

The HFramework technique shapes the purpose of the harmonisation protocol since it specifies a solution for harmonising multiple models and standards. Moreover, it provides a sufficiently precise methodology to address the complexity that may occur when harmonising varied sources [17]. HFramework establishes three distinct layers of frameworks (see Fig. 6.1).

1. Conceptual Framework

The Conceptual Framework proposes two ontologies to represent contextualized knowledge of the whole harmonisation. This context-adapted information allows harmonising sources of competence, competence standars and models as well. The ontologies are defined as follows:

a. H2mO Ontology. This ontology introduces the main concepts in the definition of a multi-model harmonisation project [18]. H2mO ontology will be used in the homogenisation of

the sources with the aim of meeting the following goals:

i. Recognition of terms, synonyms and homonyms, inconsistencies and conflicts between the different models.

ii. Integration of the main concepts in the harmonisation of multiple models.

b. PrMO Ontology. This ontology defines the key elements used to express process-based approaches. A common structure of process elements has been defined in HFramework. In addition, a homogenization method is applied in order to unify different models in the same process structure and facilitate their harmonization [19].

2. Methodological Framework

The Methodological Framework consists of a set of systematic guidelines that form a harmonisation strategy. The following components are defined:

a. Guidance for identifying harmonisation objectives.

b. Criteria for establishing the harmonisation strategy (HStrategy).

c. Harmonisation process (HProcess) to establish the tasks necessary to approach harmonisation in a systematic way. HProcess is the core of the HFramework methodology, as it integrates all components of the methodology.

d. Harmonisation methods (HMethods) that describe the tasks to achieve that two or more models are harmonised. The most important are the following:

i. Homogenization method (HoMethod) that describe a set of activities to establish harmony between the structural differences of multiple models. It uses the PrMO ontology to match the models in the same structure, allowing them to be easily compared.

ii. Mapping method (MaMethod) that allows to identify differences and similarities between multiple models to be harmonized [20].

iii. Integration method (IMethod) that allows to bring together several models by applying a set of combination criteria. One of the other methods must have been previously applied.

3. Tecnological Environment

HFramework provides with an online application (HProcessTOOL) that allows to monitor, control, and check the harmonisation process at any time.

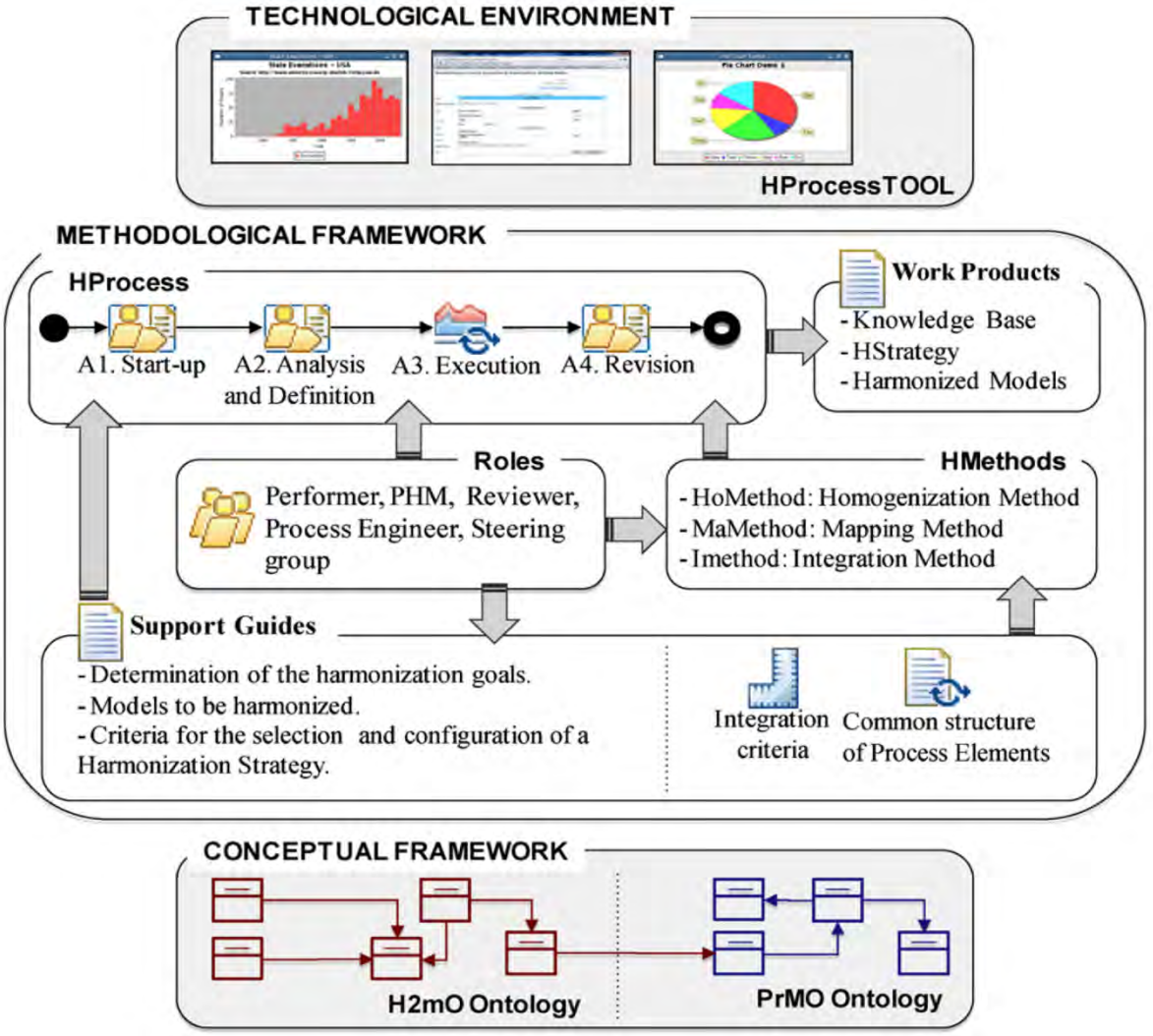

Fig. 6.1. Hframework

6.3.2 HProcess

HProcess generates the strategy to be followed during the harmonization process (HStrategy). For this purpose, it relies on the H2mO and PrMO ontologies, and on the aforementioned HMethods. It is worth noting that the strategy can be adapted depending on the organizational needs by defining the ontologies and HMethods to be used accordingly. HProcess seeks to reduce the complexity of harmonization. The whole HProcess can be observed in Fig. 6.2.

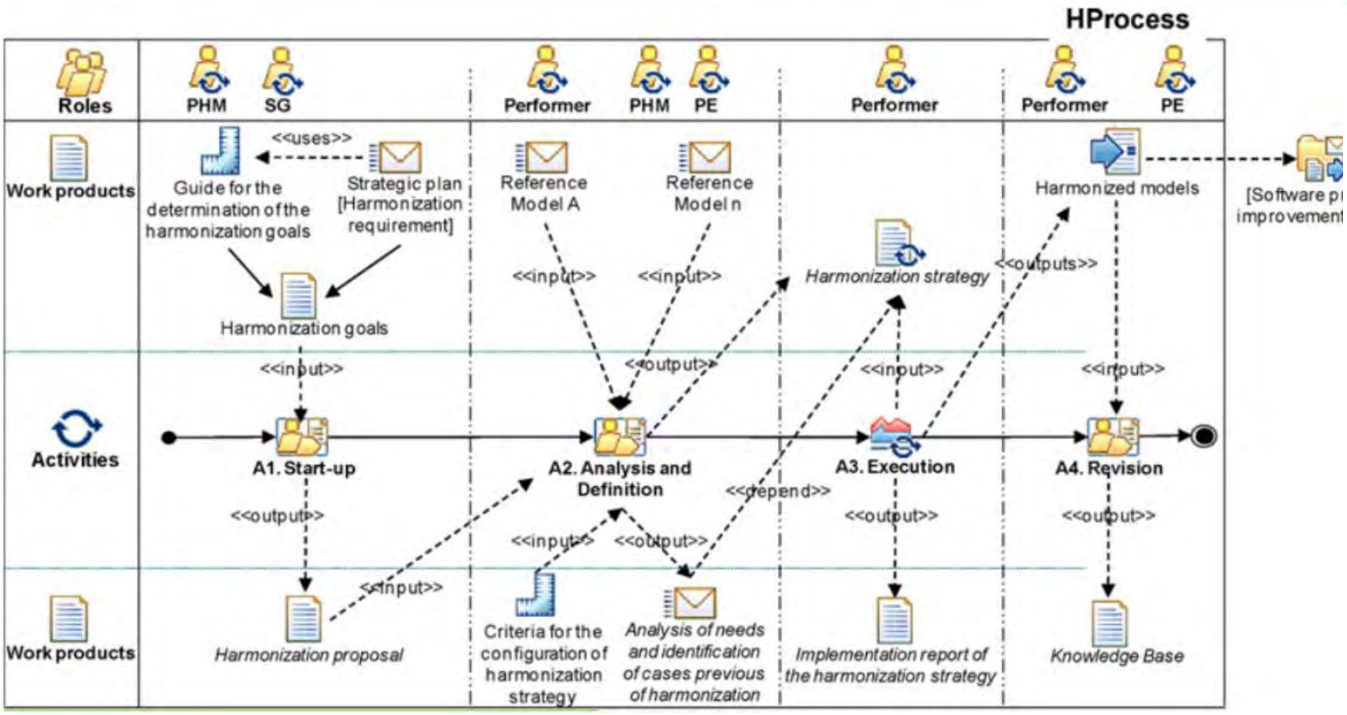

Fig. 6.2. HProcess

A total of four roles are defined in HProcess. These are the following: (1) P, performer, who evaluates the models and implements the harmonization methods. It must have capacity for abstraction and must be in charged of relate and compare models; (2) PE, process engineer. It is the person who performs the definition of the documents and guidelines for driving the strategy. This individual must have deep knowledge in the definition and modeling of processes; (3) PHM, process harmonisation manager. This person oversees the harmonization process' actions. She/he must have leadership and managerial skills, comprehend the organization's needs, set priorities, and get the necessary resources for the harmonisation; (4) SG, steering group, members of senior management make up this group of people. They must approve resource requests and/or organizational changes. This group includes the PHM, but it does not have a vote in decision-making.

HProcess is also made up of four core actions, which are as follows: (A1) Start-up, in which the harmonization requirements are recognized based on the organization's harmonization plan (HStrategy). Then a harmonization proposal is written, specifying the responsible personnel, objectives, work organization, timetable, and other items needed to guide those in charge of harmonization through each of the actions to be carried out; (A2) Analysis and definition, in this step, the identified needs are prioritized in order to carry out the harmonization. A previous search is conducted to find past instances in which harmonization procedures (allocations, comparisons, combinations, and so on) were used in the models engaged in the harmonization process. The results of the search will be used to update the harmonization strategy as well as the

harmonization requirements and goals. The HStrategy will be consolidated in this phase, which will include a prioritization of harmonization requirements and the directionality of harmonization across models. How the models are merged or compared is determined by the directionality (i.e., whether model "x" is combined or compared with model "y" or, model "y" with model "x"). Depending on the directionality and harmonization procedures used, the outcome of harmonization may differ. (A3) Execution, all activities, tasks, and methods defined in HStrategy are carried out during this phase. In this step, the homogenization, comparison, and integration of models are utilized. It is worth noting that the A2 and A3 phases take an iterative and incremental approach, resulting in increasingly refined harmonization with each iteration; (A4) Review, in which all procedures, methods, tasks, and activities carried out in phase A3 are documented. Future harmonizations will be built on the foundation of this documentation.

Work packages are created as a result of the HProcess activities and can be used throughout the harmonization process. They are classified as follows.

1. Harmonization proposal. It is used in phase A1 to describe the scope of the harmonization initiatives, as well as the organization's goals and needs that drive the harmonization of the selected models.
2. Analysis of needs and identification of cases prior to harmonization. It is employed in phase A2. This paper compiles a collection of previous harmonization project cases that can be used as a guide for completing the harmonization. It also includes a prioritization of the harmonization requirements, as well as the procedures, methodologies, activities, and tasks to be accomplished in phase A3, the harmonization's directionality, and the organization's objectives to be met once phase A3 is completed.
3. Harmonization strategy. This artifact is used in phases A1, A2, and A3. It is one of the most crucial documents for guiding harmonization implementation. The harmonization strategy includes a description of the harmonization processes and methodologies, as well as a risk management plan, a measurement plan, and a timeline for the iterations in the harmonization cycle.
4. Implementation report of the harmonization strategy. This is a report that summarizes the findings of phase A3. It includes information on the current state of the harmonization process, incidents, problems encountered, a comparison of the estimated amount of work to the actual effort required, decisions made, and suggestions... It is worth noting that this report can be completed at the end of each cycle in A3.
5. Knowledge base. At the conclusion of phase A4, this document is generated. It compiles all of the challenges and solutions used in each of the harmonization project's tasks, activities, or methodologies.

6.3.3 Protocol

According to the competence harmonisation, sources of competences, competence standards and models will allow to create a customized competence model. The purpose of harmonization is to meet the needs and specifications of multiple sources, standards and models of competence at the same time. As a result, the expected competence model will comply with the considered sources (see Fig. 6.3). A total of 4 stages have been defined in the harmonisation of sources.

1. Formalisation. The HFramework methodology has the PrMO ontology allowing to homogenize the specification of standards written in natural language based on a fundamental concept. The harmonization of sources focuses on the process concept [18].
2. Homogenisation. In this phase, the structural differences in the sources of competences to be harmonized are resolved. In general, in each competence document, the most appropriate structure is chosen. For example, it is possible to find structurally very different standards. In some cases, the standards have no structural differences and can therefore be taken as already homogenized standards and prepared directly for the comparison phase.
3. Comparison. A total of three possible scenarios may happen in the comparison process when working with standards: (1) both standards have a set of common elements, such as the competence identifier, title, and description; (2) both standards have a set of similar elements, which, while not identically defined, serve the same purpose; (3) both standards have a set of non-common elements, such as the definition and modeling of the metadata associated with the competence in question. These scenarios will define the actions to be taken in the next stage.
4. Integration. The integration procedure is the last step in the harmonization process. It mostly entails resolving the discrepancies that were discovered during the preceding comparison phase.

Within the harmonisation methodology, different sources of competences as described in Sections 6.1 and 6.2 will be used as a starting point to align with the need of CBE as described in Section 6.2. The four previous phases will be applied with the set of selected sources. A total of three artifacts will be produced after the competence harmonisation potocol is performed.

- A catalogue of reusable requirements. This catalogue will be used to develop systems compatible with the harmonized model.
- A harmonised competence model. This artifact will allow to organize and structure the information on competences, making this information homogeneous.
- A reusable competence repository. It will serve to simplify the competence selection process for training providers, for example, by facilitating the creation of new degree programmes when completing the sillabi. It will also serve as a starting point for

employers when searching for candidates. Students will be able to find the training they want from the competences offered by the courses.

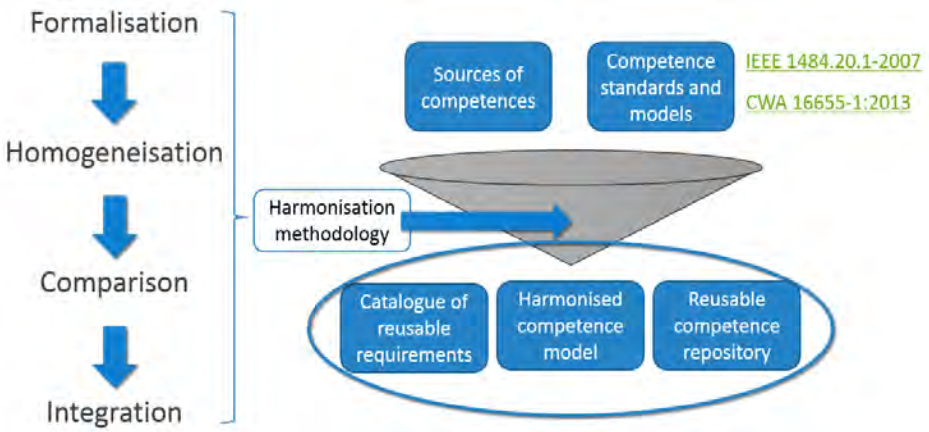

Fig. 6.3. Competence harmonisation protocol

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7. A1.7 State-of-the-Art Analysis of Technological Platforms and Digital Capabilities for Education Services (UoI)

7.1 Introduction

7.1.1 Information and Communication Technologies (ICT) in Education

Computer technology and other components of digital culture have altered how people live, work, play, and study, influencing the development and distribution of knowledge and power worldwide. In recent years, we witness an increasing need expressed by educational institutions to include Information and Communication Technologies (ICT) into the teaching-learning process. ICT have had a significant influence on society in recent decades. These new tools have become one of the most often used techniques by a variety of educational organisations in their chase of innovation and educational quality improvement. A wide range of research has proven that the proper use of these technologies improves education quality and links learning to society. Furthermore, it provides flexibility and accessibility for individual, group, and societal teaching and learning. As a result, incorporating ICT into education is critical for increasing access to information and maintaining the pace of societal progress. As a result, new educational techniques and strategies have evolved in recent years, with the goal of enhancing educational systems through the use of ICT, which has shown favourable effects in many studies [1]. In particular, in UNESCO's website it is stated that "*Information and communication technology can complement, enrich and transform education for the better.*" [2].

It is widely accepted that these approaches can lead to higher order thinking skills, provide creative and individualised options for students to express their understandings, and leave students better prepared to face ongoing technological change in society and the workplace when teachers are digitally literate and trained to use ICT [3]. Graduates unfamiliar with digital culture face a growing disadvantage in the national and global economy. As a result, digital literacy - the abilities of looking for, discerning, generating information, and the critical use of new media for full participation in society - has emerged as a significant concern for curriculum designs [4].

Digital literacy is being developed in several countries through the integration of information and communication technology (ICT) into schools. Among the most frequent educational ICT applications are the following ones [5]:

- One laptop per child
- Tablets
- Interactive White Boards or Smart Boards
- E-readers
- Flipped Classrooms

Especially nowadays, education deals with a variety of challenges concerning the restriction that the COVID-19 pandemic imposed to society. Online education has become a reality, while students, instructors, and everyone else is working hard to keep learning going. Numerous new online educational tools have been developed or tools that serve in some way the educational process. The three challenges that people face in using ICT tools are as follows[6]:

- Access
- Equity
- Quality

Now, schools are taking the benefits of ICT to deliver knowledge and information to children. ICT has become a core in the teaching-learning process.

The goals of using ICT in education can be described as follows [6]:

- Making education more accessible through the use of the internet.
- Improving the quality of education, particularly in rural regions.
- To make the educational system more transparent.
- To improve the school system's policies, rules, and laws.
- To examine and evaluate the efficacy of students' understanding and involvement.
- Analyse students' performance, placement, and knowledge application.

7.1.2 Advantages and disadvantages of ICT in Education

In short we can summarise the advantages of ICT in education as follows [6]:

- Individualization of learning
- Interactivity
- More economical
- Multiple teaching functions and diverse audiences
- Uniform quality
- Facilitates cooperative learning
- Act as a motivating tool
- Not prone to distance and climate factors

On the other hand, a variety of cons do exist regarding the use of ICT in education.

- High Infrastructure and start-up costs
- Accessibility issues (e.g, poverty, illiteracy)
- Difficulty in performance assessment
- Continuous training requirement

All in all, it is more than evident that ICT play crucial role in the field of education, and now is rather an integral part of it. They act as the means that assist teachers in their work and facilitate

the whole educational process and therefore the effective dissemination of knowledge to the students.

7.2 State-of-the-Art Analysis of Technological Platforms

7.2.1 Learning Management Systems

A learning management system (LMS) is a software program that offers a framework for managing all parts of the learning process — it's where you store, present, and track your training materials. While it is most commonly referred to as an LMS, it may also be referred to as a training management system, a learning activity management system, or even a learning experience platform (LXP) [7]. LMS reinforces the learning process through online classroom environments. An inclusive learning environment for academic achievement is supported by a standard LMS, which includes intervening structures that enable online collaborative-groupings, professional training, debates, and communication among LMS users.

The use of a LMS offers online students with continuous feedback on their progress and simultaneously it helps them to become more self-sufficient. Moreover, learner's engagement is maintained because online users utilise an LMS to track their progress [8]. Studies show that LMS acceptability among students in higher education varied by nation, with Arab institutions in the Middle East reporting a low level of e-learning acceptance while western countries reporting a high rate of e-learning system adoption [9]. An LMS is more than simply a collection of online training courses. It ıs a well-organised system for handling both eLearning and in-class training operations (such as user registrations and course assignments). A trainer can use the LMS to automate processes like tracking and reporting student actions, processing statistics, providing detailed reports, grading tests, and making and giving certificates, among other things.

Computer-based instruction (CBI), computer-assisted instruction (CAI), and computer-assisted learning (CAL) are all terminologies used by Watson and Watson [10] to explain computer adoption throughout history. Computer application programs, instruction, and design preparation are all covered by these concepts. An LMS is a web-based learning management system that acts as a framework for capturing several layers of progressive learning. An LMS serves as a platform for distributing and managing educational materials. Learners may enrol for classes, manage their grades, and check for changes and course announcements on an LMS platform, which fosters engagement and accomplishment [8].

7.2.2 History of LMS

The teaching machine, invented by Sidney L. Pressey in the 1920s, provided a variety of practical exercises and multiple-choice questions (MCQs). The teaching machine, which looked like a

typewriter, required students to drill in answers rather than typing them out, which were then recorded at the rear of the machine. The student could only go forward if their answer to the preceding question was correct—a characteristic that is still present in most modern LMSs.

The problem cylinder, invented by Milton Ezra LeZerte in 1929, was a gadget that offered instruction without the need for a teacher's interaction. One of the best aspects of the problem cylinder was that it not only used MCQs to test learners' knowledge, but it also examined their replies to see if they were correct or incorrect, saving the teacher time.

The University of Houston in the United States aired the first for-credit college course in 1953, allowing students to learn from the comfort of their own homes. Every evening, video lectures/lessons were broadcast so that everyone, including full-time workers, could benefit from the teachings, guaranteeing that learning was not hampered by job obligations.

In some ways, SAKI was the first computer to provide learning that seemed slightly personalised. Gordon Pask and McKinnon Wood invented SAKI, which stands for Self-Adaptive Keyboard Instructor, in 1956. Based on the learner's performance, it provided individualised practice questions. SAKI would 'learn' and raise the complexity of following questions as their performance improved.

Dr. Donald Bitzer's creation of PLATO (Programmed Logic for Automatic Teaching Operation) in 1960 was the next big thing. PLATO was a computer-based training platform that allowed learners to track their own progress and study at their own speed. PLATO, on the other hand, stood out since it was the first time the learning community had experienced social/collaborative learning. Learners may engage with other learners utilising instant chat/messaging, email, and chat rooms thanks to the site's numerous networks.

In 1983, MIT's Project Athena, which was almost a predecessor of the LMS, aimed to expand the use of computer equipment outside the domains of general science and engineering. At its foundation, Project Athena set up workstations to establish a distributed computing environment. To put it another way, Project Athena allowed students and teachers to view their files from any workstation or desktop computer on the MIT campus.

Moodle, short for Modular Object-Oriented Dynamic Learning Environment, was the first open-source LMS released to the world in 2000. Learners may begin studying with Moodle as soon as they install the application on their desktop PCs. Learners were able to choose the content they wanted to save or export, allowing for personalised learning. Because of Moodle's plug-and-play capabilities, training content may be given to learners more quickly and at a lesser cost.

In 2004, SCORM (Sharable Content Object Reference Model) was released as a communications standard that defined specifications for content packaging and metadata, which is now a common part of most LMSs.

Experience API, sometimes known as xAPI, is an eLearning specification that was created in 2010 as a replacement for SCORM. "Learning content and learning systems can talk to one another in a way that records and monitors all forms of learning experiences," according to the xAPI [11].

In the following we summarise some limitations that arose from the use of these past LMS versions through time [11]:

- They were not compatible with mobile devices.
- They were not easily customizable.
- They were characterised by limited user-friendliness.
- They held very few administration features (e.g., create customised course certificates for users, exchange information with instructors or other LMS admins, etc.).
- They were less reliable and open to data and security attacks.
- They had limited reporting and analytics capabilities.
- They were either slow or no upgrades were offered.

7.2.3 State-of-the-Art

However, as technology evolved, such a fact directly affected the progress of LMS and most of these issues have been addressed successfully rendering LMS an extremely useful tool for educational and training purposes. The current LMS are built to satisfy the needs of today's learners and to support the training requirements of a global workforce. For example, unlike old LMSs, current LMSs embrace new characteristics and can do the following functions [11]:

- Deliver a diverse range of training materials in a number of forms, providing learners total control over what and how they study.
- Gamify the LMS using badges, points, and leaderboards to increase learner motivation.
- Make current LMSs more sociable by hosting chat rooms and message forums for learners to collaborate and learn from one another.
- Facilitate learning on-the-go in informal settings by providing instant access to the relevant knowledge.
- Reporting and tracking that provide insight into how learners are performing, what impact the training is having, and how to improve learner management.
- Utilise monitoring data to give learners with customised learning routes depending on their work positions and prior knowledge.

The **key LMS features** that a modern LMS should incorporate are [12]:

- Artificial Intelligence (AI) that helps in personalising the learning experience.
- Accessibility: developing learning content that creates the best learning environment for everyone.

- Automated admin tasks: Features that allow administrators to automate recurring/tedious tasks.
- Platform consolidation: bringing all of the designed use cases into one single LMS, saving time, money, and unnecessary hassle.
- Personalised learning paths.
- Intuitive user interface.
- Certifications and retraining.
- Course and catalogue management.
- Content integration and interoperability: support learning content packaged according to interoperable standards such as SCORM, AICC, and xAPI.
- Gamification: Boost students' motivation by allowing them to earn points, badges, certificates, and other rewards for completing all learning tasks.
- Integrations: allowing third-party integrations and plugins with other platforms, e.g., video conferencing tools, etc.
- Mobile learning: content should be accessible from mobile devices.
- Microlearning: relatively small learning units and short-term learning activities.

The different types of LMS [13] that you can address can be categorised as follows.

1. Installed LMS vs web-based LMS

Installed LMS is the traditional method of installing software on computers. It is placed on the premises on a server an institution/company possesses. The setup costs are substantial, and the IT infrastructure must be managed in-house. Overall, it is a costly prospect.

2. Hosted LMS vs Software As A Service (SaaS) LMS

Both are hosted in the cloud. The infrastructure maintenance is the difference between a hosted LMS and a SaaS LMS. When using a hosted LMS system, you will be responsible for hosting the LMS yourself. That implies you have command over the server's uptime and security, while you are responsible for managing technical updates and upgrades. On the other hand, the LMS provider is responsible for the entire application service. He is responsible tol keep the software up to date, perform any necessary upgrades, and own and manage the infrastructure. The customer just pays (monthly or annually) for the user.

3. Open-source LMS vs Closed source LMS

Over the last few years, open-source LMS have grown in popularity. The fact that Open Source is free to use is its most appreciated attribute. Some open-source LMS systems charge a little cost; the fundamental LMS open source code is free, but you must pay for more features and updates. In contrast, closed-source LMS are offered in charge, while all customisation is limited to the LMS owner and may be provided as a cloud-based SaaS service.

4. Integration capable LMS vs Non-integrated LMS

LMS may be connected with various apps. Calendars, social networks like Facebook and Google Apps, and a variety of other options are available. The opposite of an above-described LMS is one that has all of its primary features built-in and does not have many third-party connectors. The purpose of this type of LMS is to provide clients with a one-stop-shop solution where they can access all of their key tools in one spot. This technique may work if the LMS's built-in features are all you want.

7.2.4 Modern and Popular LMS

A variety of LMS has been developed to meet the requirements of modern educational institutions and companies, as well. We provide some examples of widely used LMS and LMS that come with great potential in the time being (2022) and present diverse features [14].

1. Mindflash (Cloud-hosted)

It is ideal for establishing new programs, worldwide and blended training, specific content requirements, and as a full solution for large programs. Employee training, onboarding, virtual classroom, and compliance training are all good uses for Mindflash. It has Perfect Material Conversion Features that allow you to develop new course content or import old course content. It is a solution that may be utilised by businesses in any industry. Quizzes, reports & dashboards, SCORM & API, and more features are available.

2. SkyPrep (Open API and Cloud-hosted)

It is ideal for small to big businesses searching for a simple way to teach their workers, customers, and/or partners. SkyPrep is an award-winning LMS that is known for its ease of use and excellent customer service. You can easily deliver, monitor, and track your training using the cloud-based service. SkyPrep's user-friendly platform allows you to rapidly and easily develop online learning programs. With only a few mouse clicks, you can create courses and reports to measure student progress. Using game-based learning to make training more pleasant and engaging for your team will improve the learning experience.

3. ProProfs (Cloud-hosted)

ProProfs LMS is the world's most user-friendly cloud LMS for deploying corporate training programs. The platform is lightweight, clean, and easy, and it can help you set up online staff training in minutes. It may be used by persons of all levels of expertise for both pre-training and post-training assistance. A quiz-making tool, surveys, collaborative capabilities, and advanced reporting are all part of its software suite for workplace training.

4. **iSpring (Cloud-hosted)**

iSpring provides a systematic learning path for each individual, as well as the ability to adapt the path structure to meet the demands of the learner. It supports SCORM, has a wide range of supported formats, and has an infinite storage capacity. It enables you to organise learners and assign different user roles in the LMS. It also gives users detailed reports on their progress. Administrators may quickly schedule activities using iSpring Learn's Event Calendar, which includes live training, seminars, and webinars all in one spot. It is connected with Zoom and Microsoft Teams, allowing users to use the services for virtual meetings that can be scheduled and held directly from the training portal.

5. **Docebo (Cloud-hosted, Open API)**

It supports numerous environments without causing any integration concerns, allowing you to save a significant amount of time. APIs, gamification, language and translation, white labelling, and good customization are all supported. It automatically performs administrative processes, provides scalability, certification, and re-training, and allows clients to move around with ease. It contains a lot of pages, coach and share features, quick notifications, and a content markup area so that customers can simply import and develop courses. It also features Intelligent Tutoring Systems (ITL) classrooms, good extensions, great performance, and a sophisticated reporting framework for the benefit of the customer. It also presents a powerful user and UI experience, a strong integration mechanism, and a robust integration mechanism.

6. Moodle (Cloud-hosted, Open API)

Because it is open-source and backed by a worldwide community of developers, it is simple to localise and extremely adaptable. Moodle is a prominent LMS that was created to give instructors, administrators, and clients a single powerful, secure, and integrated platform for creating customised learning platforms for its consumers. It provides a variety of dynamic learning packages that may be accessed at any time. It provides a single learning platform, numerous course design, quick backup, and easy data administration. It features collaboration tools and plans, extensive reporting and logs, quick notice and alarms, and security upgrades on a regular basis. It features a custom site design and layout, and allows users to incorporate other resources, and manages their roles and rights. Multilingual support, multimedia integration, different progress monitoring features, and outcomes and rubrics are all included. It offers a customizable dashboard, peer and self-assessment, a secure authentication mechanism, and bulk enrollments with open standards compatibility.

7. Canvas (Cloud-hosted)

Canvas is ideally suited for education since it makes learning simple and straightforward, allowing users to be more productive. Canvas is a well-known LMS that allows learners and instructors to showcase their abilities whenever they desire. It's incredibly straightforward and easy to use. Its benefits include open source, customization, excellent support, fast speed,

security, scalability, and little risk due to its cloud-based nature. Canvas was created to get out of the way of customers and allow them to just do their jobs.

8. Edmodo (Cloud-Hosted, Open API)

Edmodo provides the greatest collaborative learning for people, allowing students to interact more freely. Edmodo is a group of people devoted to helping students, instructors, parents, and administrators improve their learning skills. It enables learners to connect with people and customers in order to realise their greatest potential. It is also the world's biggest learning network for K-12 students, instructors, and administrators. It has the ability to keep clients engaged throughout the learning process.

9. Blackboard (Cloud-Hosted, Open API)

Testing and evaluation, group conversations, and a dedicated profile for user learning are the best features. Blackboard is a well-known LMS for K-12 students. It provides powerful, individualised, and competent learning. It enables sophisticated inventive studying technology to bring teaching and learning to life, allowing tutors to adapt to new standards, update learning, and provide students with a powerful and accurate digital learning experience. It encourages pupils to reach their best potential.

10. Schoology (Cloud-hosted, Open API)

It includes a large number of quizzes and evaluations that help users gain a better understanding of a particular learning program. It has educational tools that enable educators to easily create assignments. Highlighting and annotating are among the tools provided. It includes data, analytics, and tailored learning, as well as robust communication and teamwork. It features significant interoperability and assessment management capabilities, as well as asynchronous learning.

7.2.5 Intelligent Tutoring Systems (ITS)

Computer learning has become more integrated with artificial intelligence (AI) approaches as technology has advanced, allowing for the development of more individualised educational systems. These systems are called Intelligent Tutoring Systems (ITSs). They are computer systems that aim to offer learners with quick and tailored education or feedback, frequently without the need for human involvement. Jaime R. Carbonell invented the SCHOLAR tutor system in 1970, which was the first ITS. This software system was created to help students review their understanding of South American geography [15].

AI approaches, particularly machine learning, have been increasingly popular in educational systems during the previous few decades. ITS are adaptive teaching systems that combine AI and pedagogical methodologies. The capacity to modify educational activities and tactics depending on the learner's traits and requirements is a key aspect of these systems [16].

In today's ITSs, the goal is to mimic the role of a teacher or teaching assistant, and to automate pedagogical responsibilities including issue production, problem selection, and feedback generation. Recent work on ITSs has been focused on ways these systems might successfully harness the complementing benefits of human-led education from a teacher or peer when employed in co-located classrooms or other social environments, given the current move towards blended learning paradigms. These technologies, particularly in digital contexts, can have a direct influence on student learning. While large-scale adoption of ITSs in schools has yet to occur, digital applications have demonstrated that deep-learning algorithms may give students individualised learning experiences. Machine learning algorithms are used to replicate how children learn, with the ultimate objective of allowing teachers to create computerised classes without the assistance of an AI programmer. If this is done, ITSs will be on their way to becoming widely used in the education sector, both online and in classrooms. Teachers would be able to shape the technology to fit their own particular teaching styles and methods, emphasising the customization component of technology that makes it so important, from teacher to student [17].

ITS have the potential to play a significant role in the future of education by addressing many of the issues that are now plaguing the industry. One of the most significant issues facing young people's education, and one that applies to anybody of any age, is that humans are complex creatures that require tailored learning approaches to succeed. This goes against the grain of many of our present educational institutions, which are built on standardised testing and a one-size-fits-all approach. Individuals have been left behind as a result of the existing approach, which fails to emphasise distinct skill sets within learners. AI and systems like ITSs take on this obstacle front on, providing a learning environment centred on individualised curriculum and showcasing individual abilities and interests. Many experts believe that this is the most successful technique of teaching, and many countries are adopting it. Learning settings, whether in a classroom or online, will likely include disruptive new tools based on AI technology, such as ITSs, in the near future [17].

The ITS present a common architecture with four modules. The **expert module** is the first portion. This section contains the information that the learner want to learn (domain knowledge). In addition, this module employs problem-solving and analysis strategies similar to those employed by human specialists in the learning process. The student diagnostic module, also known as the **student model**, comprises characteristics such as the learner's level of knowledge, actions, responses, behaviours, learning styles, knowledge deficiencies, and other information about the learner obtained and updated during the system's learning process. The **instruction, tutor, or pedagogical module** is the third section. It identifies students' knowledge gaps and focuses on teaching tactics and approaches to compensate for the discovered knowledge gap in a certain topic. The basis of this module is adaptive feedback, hinting, and suggestion generation, learning path navigation, and displaying adaptive instructional content. The **user interface model** is the last module, which is a communication component of ITS that controls the interaction between the user and the system [15].

7.3 Digital Capabilities for Education Services

7.3.1 Distance Learning

Distance education is a type of education in which students are not required to be physically present at their institution. In other words, you may learn, study, and obtain certification in your chosen field entirely online without ever having to visit an exam centre, a college building, or a university campus. Today, most distance learning is conducted over the Internet, which a large majority of students may access from their homes or from facilities such as local libraries. These technological tools are utilised to disseminate educational materials, keep students in contact with teachers, and facilitate student communication. Of course, remote education can also be conducted via other technical mediums, such as television, DVDs, teleconferencing, and printed materials. Nonetheless, the immediacy and practicality of online-based education have made it the preferred method of instruction for many distance learners. Online programs frequently leverage various modern technologies to make staying connected and successfully expressing ideas easier and more efficient than before. Students may find themselves completing classes through the use of interactive videos, email, and discussion forums.

7.3.2 Theories of Distance Learning

As with instruction in general, no single learning theory has arisen for online education. Numerous theories have emerged, most of which are derivations of prior key learning theories. Terry Anderson [18] studied the prospect of developing a theory of online education, assuming that it would be a challenging, if not impossible, endeavour. He viewed this endeavour through the lens of remote education, having spent the most of his career at Athabasca University, Canada's largest supplier of distance education. While he acknowledged that many theorists and practitioners regard online learning as a "subset of learning in general," he also stated that online learning as a subset of distance education has always been concerned with providing access to an educational experience that is more flexible in terms of time and space than campus-based education.

Anderson explored a variety of theories and models but emphasised the work of Bransford Brown and Cocking (1999). They argued that practical learning settings are framed through the lens of four overlapping perspectives: community-centeredness, knowledge-centeredness, learner-centeredness, and assessment-centeredness. These lenses served as the foundation for Anderson's development of an online education theory. He investigated in depth the features and capabilities of the Internet in relation to each of the four lenses.

7.3.3 Purpose of Distance Learning

The purposes for which students may use distance learning are tied to those of education. These aims are now more perplexing than ever before. One objective of education is to serve economies and place learners in work, especially paid work. However, it is becoming increasingly difficult. Not only has globalisation made employment a fluid phenomenon over the last two decades as businesses pursue new markets, resources, raw materials, and tax and tariff regimes, but there is growing talk of the labour market hollowing out, implying an ever-widening divide between those who manage, create, and decide and those who do manual labour jobs and thus an increasing barrier to any social mobility facilitated by education. On the other hand, discussing education for unemployment for meaningful lives outside of the economy is politically controversial in the public sphere. Over our lives, digital technologies have contributed to these tendencies, and on the horizon, artificial intelligence (AI) and the Internet of Things (IoT) will further speed these processes. Higher education institutions are under increasing pressure to create job-ready graduates, which forces the inclusion of soft skills, digital literacy, and problem-based learning in the curriculum, some of which may be more difficult to offer remotely. Outside of cash economies and paid jobs, particularly in the industrialised global North, education, and particularly distance learning, may have a more practical function of sustaining livelihoods, whether in subsistence rural livelihoods or informal urban employment. There are alternative, less practical interpretations of education's purpose and thus of distance learning. Still, these are likely to be squeezed or, at the very least, compelled to quantify and objectively describe their activities and outcomes. This has undoubtedly been the case for adult education in the United Kingdom throughout the last three decades [19].

7.3.4 Advantages of Distance Learning

While distance learning may not be the ideal option for every student interested in pursuing a college degree or university program, it still provides many benefits [20].

1. Study from Anywhere, Anytime

The best feature of distance education is that it can be completed from any location and at any time. It makes no difference where in the nation students live; they may enrol in the course and begin learning. Even if an international institution offers a course, they may rapidly gain access to course materials even if they are citizens of another country. Acquire the necessary information and training regardless of their location on the earth.

2. Saving Significant Amount of Money

A distance education degree (online or otherwise) may be significantly less expensive than a traditional on-campus degree for any given curriculum. Students seeking more affordable choices might enrol in a remote learning program. They do not need to live in the same city or nation in

order to attend the educational institution of their learning. They may learn from any location that has a computer and an Internet connection. Additionally, distance learning courses are less expensive than regular education courses.

3. No Commuting

If students choose distance education, they avoid commuting on crowded buses or local trains. They will require a computer with internet access at their house. The whole college would be housed in their bedroom, and they would not be required to leave. Commuting is the most challenging component since it consumes a significant amount of time, money, and, more significantly, energy. Nobody enjoys long commutes.

4. Flexibility to Choose

If students follow conventional education methods, they will be required to adhere to a defined timetable of learning based on the school's curriculum. However, some forms of distance learning enable learners to organise their learning according to their convenience rather than according to a predefined timetable. Even if students are disconnected from the learning process, distance learning programs provide individuals the freedom to pick their own path of learning.

7.3.5 Educational Technology Trends and Distance Learning

Distance learning's success, survival, and transformation may be contingent on its ability to align, adapt, and co-opt other trends or technologies emerging in the educational technology practice and policy spheres. The acceptance and adoption of these to distance learners is part of the issue for the distance learning community. A review of the Arab world's higher education sector highlights the following emerging tendencies [19]:

- Online learning tools
- Flipped learning
- MOOCs and online courses
- Learning Management Systems
- Education and Gamification
- Mixing and matching digital tools

7.3.6 Personalised Learning

Students learn in different ways and at different paces. On this basis, personalised learning is a teaching model where each student is assigned a "learning plan" customised to their unique learning style, prior knowledge, abilities, and interests. It is the polar opposite of the "one-size-fits-all" philosophy prevalent in the majority of schools/universities. Educators ensure that instructional programs or project-based learning meet academic criteria. Additionally, they

monitor students' performance concerning the abilities they are supposed to acquire throughout their education. Personalised education is not a substitute for special education. It is a general education strategy that can be used with an Individualised Educational Program (IEP) or other specialist intervention programs.

7.3.7 Precision Education

One of the difficulties that educational academics and researchers strive to address is the development of a more complete understanding of students' cognitive capacities and the underlying factors that influence their learning processes.

The rapid evolution of AI in the past years has helped the achievement of the aforementioned aims, with current attempts exploring personalised learning paths even at the early stages of education.

The first step toward personalised education is to deconstruct the conventional curriculum into 'micro lessons' with clearly defined competences and evaluation objectives.

The area of 'precision education' (PE) developed in response to researchers' desire to uncover methods and strategies that assist diagnosing learners' strengths and vulnerabilities in order to provide more personalised or 'precise' support during the educational process. These techniques are connected to digital (learning) technologies that enable the discovery of hidden patterns relating to the interaction of students' educational goals, motivation, and attitude, among other variables [21].

The term 'precision' refers to the process of evaluating and managing a wide array of occurrences via the use of data. Education researchers frequently utilise interchangeable terms (e.g., precision, customization, individualization, matching, and tailoring) to describe the variability of people with distinct issues in order to more precisely deliver tailored treatments.

The term 'precision' refers to the process of evaluating and managing a wide array of occurrences via the use of data. Education researchers frequently utilise interchangeable terms (e.g., precision, customization, individualization, matching, and tailoring) to describe the diversity of people with distinct issues in order to deliver tailored interventions. This is, in a way, the essence of PE—to make the appropriate effort for the proper individual and to have the appropriate intervention in place for the proper purpose. In other words, precision scholars do not criticise the effectiveness of an experiment; instead, they investigate what interventions have been conducted, for whom, and how. The PE method may be divided into two major categories: (a) precision instruction and (b) precision learning. A growing area of interest in personalised education is the systematic use of student data to create an individualised curriculum that is activity-based.

By definition, precision education is dependent on massive ambitions. This entails the confluence of genetics, neurology, behavioural, and psychological sciences in order to exchange perspectives on the learning process and determine whether or not learning materials and tools can be combined to meet the unique requirements of people. This also explains why advocates of PE claim that powerful computer systems may be required to handle such vast volumes of data in order to customise the learning experience. Indeed, providing PE entails collecting extensive personal data, as evidenced by continuing research initiatives in genetics, psychology, and cognitive science, which examine both people's physiological states and interior mental components [21].

7.3.8 Adaptive Learning

Since technology's rapid evolution, educators have worked to integrate it into education. Adaptive learning enables course material to be personalised for each learner, resulting in an experience that is not possible in regular classes. Adaptive learning systems or e-learning systems that are technology-based can provide students with rapid support, materials tailored to their unique learning needs, and any necessary feedback [22].

Adaptive learning environments are a subset of a new generation of computer-assisted learning systems used to deliver e-learning courses. By taking advantage of learners' learning styles, knowledge levels, personality types, cognitive potential, and other aspects, this environment provides a personalised experience throughout the learning process [23]. While adaptive models assist all sorts of learners, one group in particular benefits the most: underachievers. Students who do not often excel in school find themselves achieving their goals as a result of the program's supporting attitude. Customised assignments and a customised study schedule increase the likelihood of success for everybody who attempts this method of learning.

An adaptive learning environment is composed of four models: learner, domain, adaptive engine, and instructional. The learner model is made up of several components, such as learning styles, cognitive styles, and emotions, that can be used to build a learner profile tailored to the learning domain (e.g., personalization or adaptive learning). A personal trait is a fundamental user property that characterises an individual as a learner. Considering the learner's traits and identifying them during the learning process can benefit the learner. For example, learners who are aware of their particular preferences might raise their comprehension and confidence throughout the learning process, as well as their motivation and ability to recall appropriate learning materials in continuously changing and shifting learning scenarios. For example, learners who are aware of their particular preferences might raise their comprehension and confidence throughout the learning process, as well as their motivation and ability to recall appropriate learning materials in continuously changing and shifting learning scenarios. The term "learning materials" refers to a collection of resources containing text and multimedia used to impart knowledge to the student [23].

Typically, adaptive learning takes place via a web-based platform. The platform may take the shape of an interface, an interactive application, or a flow of learning. Alternatively, a content-based or adaptive filtering tool may be used. As several instances demonstrate, this style of paradigm is capable of reaching a varied range of pupils. The software provides all of the necessary information for the lesson and can guide students through their educational journey. As learners' complete assignments on the platform, the software can make calculated choices on the learners' best course of action. Each trip is tailored to the learners' specific needs [22].

The software includes all course materials. Each concept is split into several micro-courses and is sequenced appropriately for each learning objective. The platform is extremely intelligent - it can choose relevant courses for each student, classify their replies, and offer instructor performance assessments. Assessments may be scored in real-time, providing rapid feedback to educators and indicating appropriate adjustments. This enables the instructor to tailor the lesson to each individual, making it more difficult for some and easier for others.

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8. A1.8 Selection of a Development Platform and Test Mock-up Trial (AU)

8.1 General Summary of the Fulfilled Work

The project step 8 follows the planned schedule of the overall workstream. The goal of this working package was to define a technological framework that sets the basis for the eMEDIATOR Portal development. To execute this exercise, it was needed to prepare technological requirements for the eMEDIATOR platform in order to select possible technology components. The work that has been completed is summarized in two sections describing the results in detail.

8.2 Requirements to the eMEDIATOR Portal in Preparation for Technology Selection

Requirements Engineering is a key element to work out what challenges the technology must take within the development of a digital product. eMEDIATOR should be a platform for international education and cooperation, but what does this mean in detail?

Finding out these requirements, Aalen University (AU) organized several sessions with the colleagues from Ioannis Greece to challenge the eMEDIATOR idea and develop a list of requirements helping to select between a lot of technological components that are present on the market and could solve the challenges of eMEDIATOR. Working through the process of Requirements Engineering, the team of AU prepared the questions for the requirements gathering based on the design science approach. The design science approach systematically supports the development of information systems based on structured framework. The image illustrates this framework:

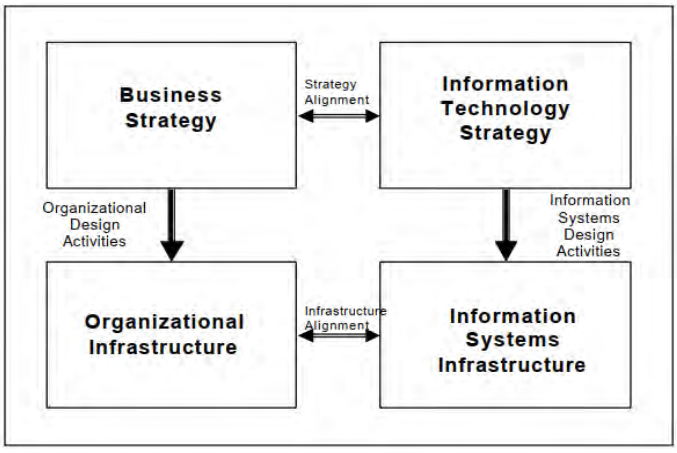

Fig. 8.2.-1 Design Science Approach (Hevner et al. 2004)

Based on this framework, AU worked out a list of questions for development of a better understanding of the systems architecture, users, goals, functions and non-functional but essential technical points.

Table 8.1 Requirement Engineering Questions

Pos.	Category	Question
1.	Goals	What is the core component that should be achieved at the end? (imagine we would not only develop a prototype)
2.	Goals	What change in education we want to achieve with eMEDIATOR?
3.	Goals	How do we see the final product? (Vision)
4.	Stakeholder and Users	Who are our users? (1st suggestions of TSI already in place in the presentation of 26th of Nov.)
5.	Stakeholder and Users	Who are our stakeholders?
6.	Stakeholder and Users	What roles can we connect to the stakeholders? • Investors, • Deciders, • Users, • etc.
7.	Context Selection and Scope	What is part of the platform and technology?
8.	Context Selection and Scope	What is NOT part of the platform and technology?
9.	Context Selection and Scope	How do we define our systems' borders? (for the first time)
10.	Context Selection and Scope	Can we specify the „field" or „frame" on/in which our platform will act?
11.	Functional Requirements	What basic functions are needed to achieve the platform's goals?
12.	Functional Requirements	Which processes should be implemented in the final solution?
13.	Functional Requirements	Can we specify how we see the functions of the platform? • Is it more related to be a data management tool? • OR Is it more desired to be an overall solution for standardizing education?
14.	Functional Requirements	Which additional functions should be realized to have a successful ecosystem?
15.	Functional Requirements	Do we include any modern AI Technologies?
16.	Non-Functional Requirements	Which technological approaches could we use to implement the functional requirements?
17.	Non-Functional Requirements	What are the most suitable database technologies?
18.	Non-Functional Requirements	Can we estimate the hardware requirements of the platform?
19.	Non-Functional Requirements	Can we estimate the number of users?
20.	Non-Functional Requirements	How the documentation should be done?
21.	Non-Functional Requirements	Are there any restrictions we must consider?

Based on these questions, a few only workshops have been done. In communication and clarification with the project lead's business requirements, it has been decided to categorize the requirements in a new way:

Requirement Categories:

1. Functional Requirements
    a. Functional
    b. Process
    c. Information
2. Non-Functional Requirements
    a. Security and Identification
    b. Resilience and Maintenance
    c. Technological

Based on this new structure, the final requirements list as decision base for any technology decisions has been worked out. It is represented in the following table, which represents the final requirements that will be taken into account for the technology selection.

Table 8.2. Finalized Requirements List

Pos.	Category	Subcategory	Description
1	Functional Requirements	Function	Mobile Platform for students' course modularization
2	Functional Requirements	Function	Specific study possibilities
3	Functional Requirements	Function	Adaptive Learning
4	Functional Requirements	Function	Overall Functionalities of learning and training
5	Functional Requirements	Function	Find new scientists for business purposes
6	Functional Requirements	Function	Adaptive Learning based on economic results
7	Functional Requirements	Function	Micro Learning
8	Functional Requirements	Function	Connected Learning
9	Functional Requirements	Function	Algorithm to suggest curricula developers next included content
10	Functional Requirements	Function	Integration of several existing components (Bookascience, Moodle, etc.)
11	Functional Requirements	Information	Download curricula
12	Functional Requirements	Information	Find content of study courses
13	Functional Requirements	Information	Find skill sets and learning requirements
14	Functional Requirements	Process	Create Curricula
15	Functional Requirements	Process	Aggregate Curricula
16	Functional Requirements	Process	Develop Competence Modules
17	Functional Requirements	Process	Curricula standardization
18	Non-Functional Requirements	Resilience and Maintenance	Continuous Update Process
19	Non-Functional Requirements	Resilience and Maintenance	Update Management and Version Tracking
20	Non-Functional Requirements	Resilience and Maintenance	Manage Licenses of integrated solutions
21	Non-Functional Requirements	Security and Identification	User Management and Different Roles
22	Non-Functional Requirements	Security and Identification	IAM
23	Non-Functional Requirements	Security and Identification	Different sights on the portal functions
24	Non-Functional Requirements	Security and Identification	Single Sign On
25	Non-Functional Requirements	Technological	Stability for X amount of users
26	Non-Functional Requirements	Technological	Algorithm for checking "doubles" in database
27	Non-Functional Requirements	Technological	Algorithm to suggest curricula developers next included content
28	Non-Functional Requirements	Technological	I Frame integration
29	Non-Functional Requirements	Technological	API Integration
30	Non-Functional Requirements	Technological	Different Database aggregation
31	Non-Functional Requirements	Technological	Curricula Database

8.3 Technology Selection and Benchmarking

Using the developed requirements, a primary research has been done to find out potential technology providers that can cover a lot of the desired functionalities out-of-the-box.

As it has been agreed between the partners to see the project not as a new development of a complete new platform framework but more as a „integration project". Which means that there is already a lot there on the educational market that could be used to be implemented into the eMEDIATOR portal. The following table represents the benchmarking activities and the evaluated technologies for the eMEDIATOR portal development.

Table 8.3. Technology Benchmarking

Pos.	Technology	Functions	Relevance for eMEDIATOR
1.	Typo3	1. Enterprise Content Management System 2. Open Source 3. Intranet 4. Websites and Subpages	Less functionality on integration, more focus on CMS functionalities. No included process/workflow management tool. **Fact:** Typo3 is not covering the main goals of eMEDIATOR
2.	Tibco	1. Integration Modules 2. API Descriptions 3. Visualization	Tibco is less a portal than a tech.-framework for specific requirements. The focus of Tibco is on integration, which is good, but only Integration does not cover the whole eMEDIATOR functionalities. **Fact:** Tibco could be the right choice if the project would completely focus on integration work, but there are processes that need to be implemented as workflows in the platform itself.
3.	Hivebrite	1. Alumni Portal 2. Community Portal 3. Customizable Collaboration Space	Hivebrite is a portal solution mainly for Alumni Communities. It is more a collaboration space than a platform solution. **Fact:** Collaboration is powerful when it comes to Hivebrite, but there are elements like integration, workflow and content management that are missing here.
4.	HumHub	1. Social Network for Enterprise Framework 2. Collaboration Space	HumHub focuses on Social Network elements that are well know of platforms like Facebook. It also covers Collaboration functionalities. **Fact:** HumHub fits more into the direction of Social Media instead the direction of international education platform.
5.	Liferay DXP	1. Intranet 2. Application Platform 3. Integration Platform 4. Workflow Tool 5. Collaboration Space 6. Content Management	Liferay, one could say, combines all functionalities of the other providers. Furthermore, the main components and all functionalities can be used for free without enterprise license. **Fact:** Liferay fits the requirements of the eMEDIATOR project in the best way.

The technology Liferay has been chosen as best possible alternative to cover the eMEDIATOR requirements.

The next step is: „Setup of a Mockup/Trial Installation of Liferay on Local instance to test around the functionalities and capabilities".

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4. Hivebrite https://hivebrite.com/
5. HumHub https://www.humhub.com/de/site/index
6. Liferay https://www.liferay.com/

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APPENDIX 1. Examples of Architecture and Functional Requirements for Digital Education Systems (TTI)

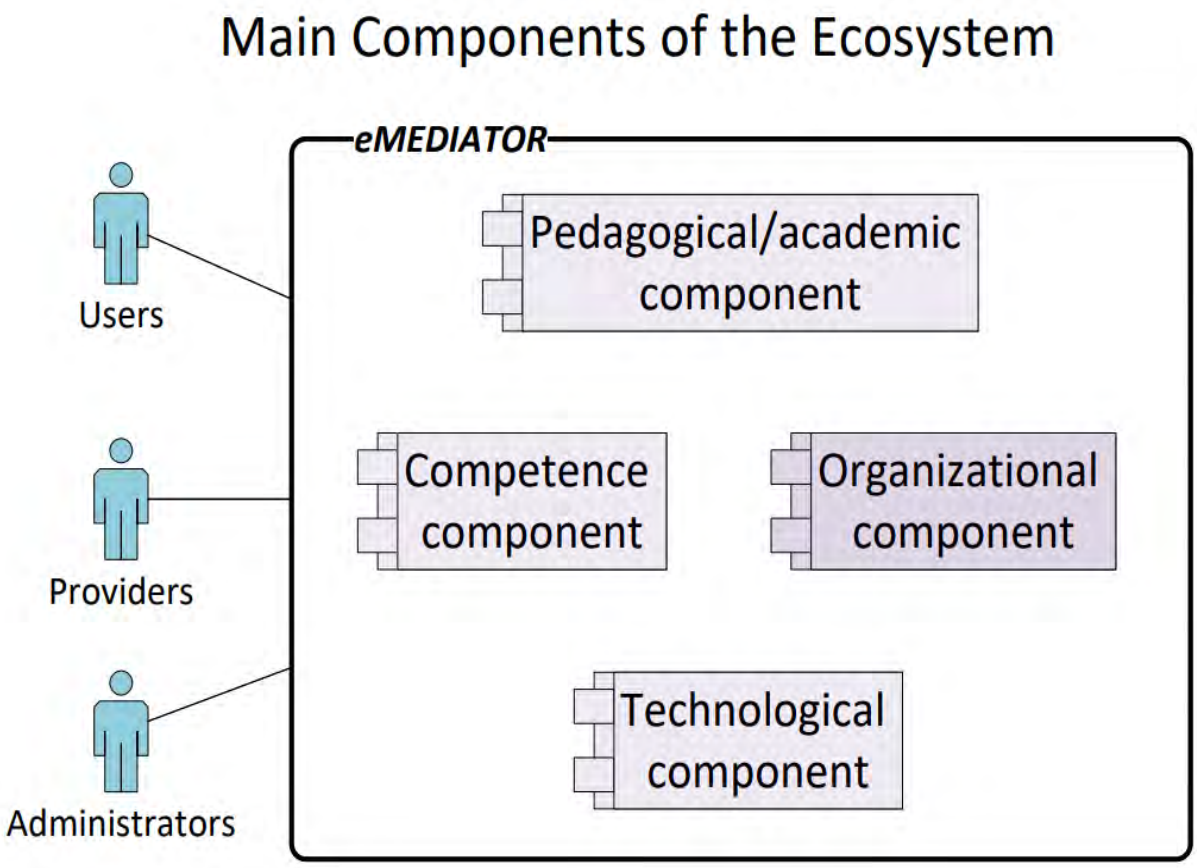

Fig. A1.1. Main Components of eMEDIATOR architecture

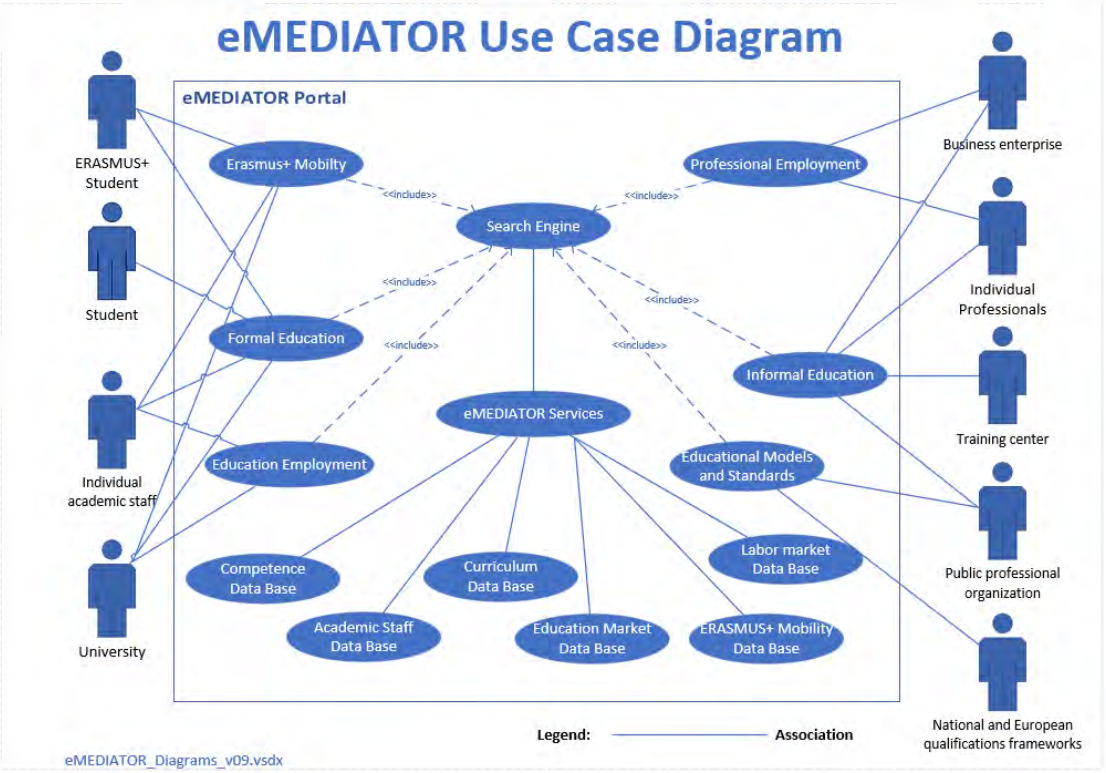

Fig. A1.2. Main functionality of eMEDIATOR portal (view 1)

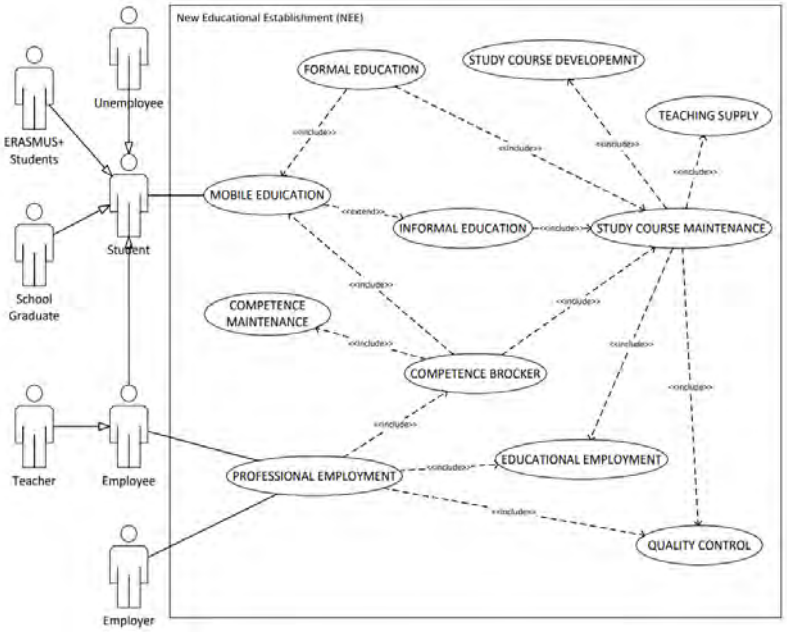

Fig. A1.3. Main functionality of eMEDIATOR portal (view 2)

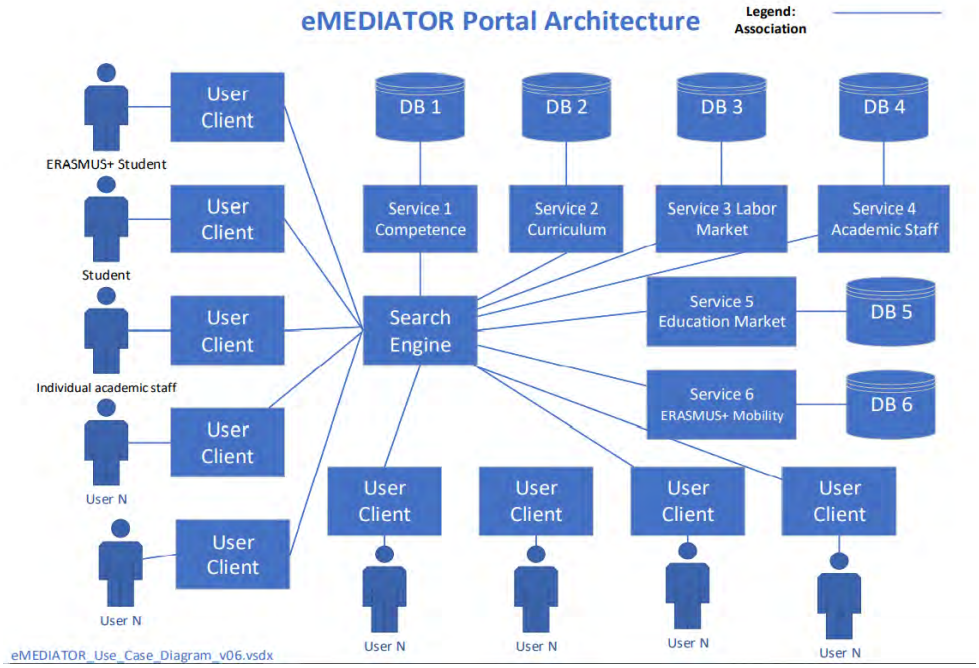

Fig. A1.4. The eMEDIATOR portal architecture (view 1)

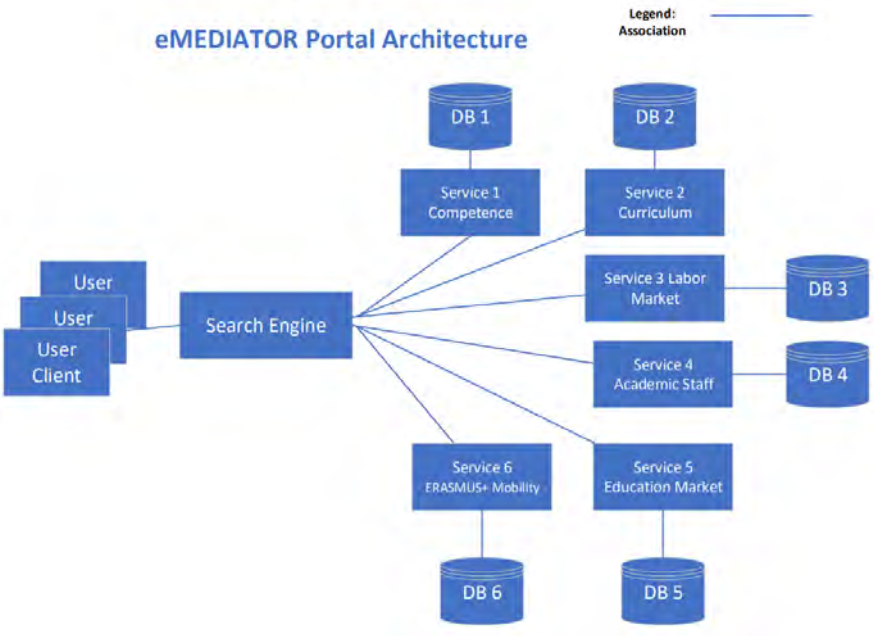

Fig. A1.5. The eMEDIATOR portal architecture (view 2)

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APPENDIX 2. Digital Capabilities in Learning Design, Learning Processes with Emerging Skill Sets (UL)

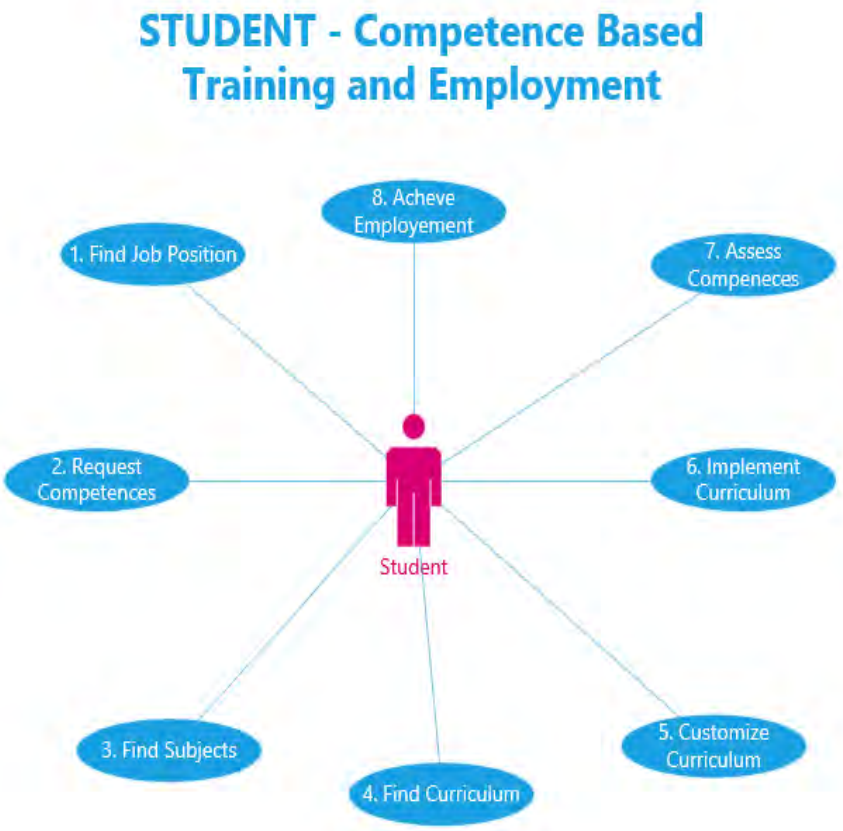

Fig. A2.1. Competence based training and employment use cases

Table A2.1 Requirement description

Requirement Description		
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 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).

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APPENDIX 3. Requirements of Reusable Competence Repository Management (UM)

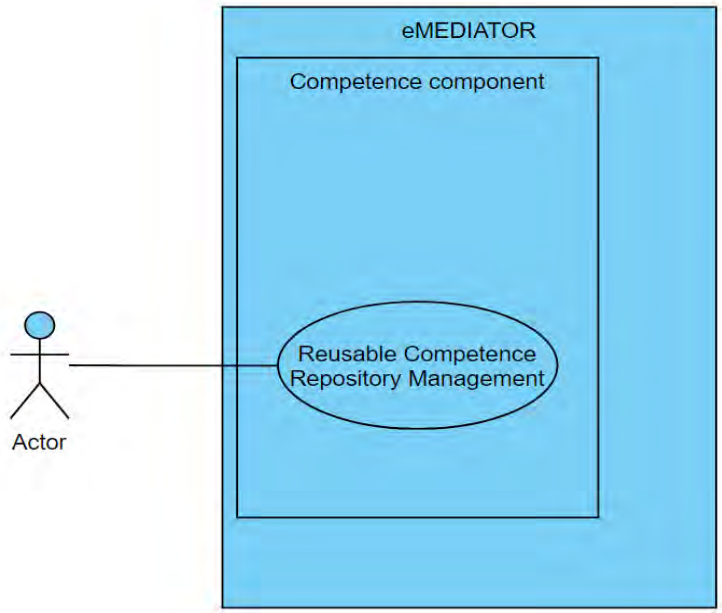

Fig. A3.1. Use case diagram for services

Table A3.1. Initial requirements for eMEDIATOR services I

Requirements Description		
Unique Service ID	Service Name	Brief Service Description
Cmp-INF-001	Reusable Competence Repository Management	Create, read, update, delete operations on a repository of standard-compliant, harmonized competences
Gen-TEC-001	Accessibility compliance	Compliance with AA level of WAI WCAG 2.1
Gen-TEC-002	Internationalization support	Inclusion of internationalization features and software localization
Gen-TEC-003	Energy-awareness	Green-powered hosting and energy efficiency concerns on development and deployment

Legend (USID): XXX-YY-NNN (XXX – Work Product code, Y – Service type, NNN – Service number withhin the product)

Table A3.2. Initial requirements for eMEDIATOR services II

Work Product codes		
No.	**Work Product**	**WP Code**
1	Architectural model	Arc
2	Pedagogical model	Ped
3	Organizational model	Org
4	Competence model	Cmp
5	Technological model	Tec
6	Demo implementation	Demo
7	Whole ecosystem	Gen
8	Management document	Mgt

Table A3.3. Initial requirements for eMEDIATOR services III

Service type codes		
No.	**Service Type**	**ST code**
1	Functional	FUN
2	Process	PRO
3	Information	INF
4	Security	SEC
5	Resilience	RES
6	Computational	COM
7	Technological	TEC
8	Identification	IDE
9	Maintenance	MNT

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