

University Readiness for Inclusive Digital Education in Industry 4.0 Era: Survey Results

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Abstract. The emergence of Industry 4.0 has brought about remarkable technological progressions, leading to substantial transformations in work environments. This has created a globally shared vision that the educational and training systems should be improved to offer high-quality, inclusive, and accessible digital education to develop essential skills and abilities that guarantee job readiness and assimilation into the current labour metamorphoses of era 4.0. In Europe, the reform of education at all levels in response to the concepts of University 4.0 and Education 4.0 is outlined as a key priority. In this regard, outlining the factors for successful inclusive digital education, as well as the barriers to its implementation, is crucial. This paper presents some of the main results of a survey conducted in Bulgaria, Greece, Italy and Latvia, aiming to determine the readiness of universities to provide inclusive Industry 4.0 education.

Keywords: Industry 4.0, University 4.0, Education 4.0., Digital Education, Inclusive Education.

1 Introduction

Digital teaching and learning take place in a technologically created environment for learning and communication that allows participants to actively participate in the learning process and provides an opportunity for their inclusion in it regardless of distances or situations that do not allow face-to-face learning, such as the case of Covid-19 and the war in Ukraine. Two viewpoints are included in digital education: the pedagogical use of digital tools to assist and enhance teaching, learning, and assessment, and the growth of key 4.0 era skills among students and education and training personnel.

In recent years, numerous publications have explored the specific possibilities of different educational technologies (Evans, Pearce, Vitak, & Treem, 2017), of digitally supported collaborative learning (Yeoman & Wilson, 2019), of learning in virtual adaptive environments (Wörner, Kuhn, & Scheiter, 2022). The concept of what a Digital

University should be is another topic of study in the field of higher education (Johnston, MacNeill, & Smyth, 2019).

To aid the shift towards digital education in the industrial revolution era (Gueye & Exposito, 2020), an international initiative was initiated in March 2021. Its primary objectives are to promote sustainability, enhance prospects for innovative e-learning, and foster the development and dissemination of best practices in inclusive education. In the framework of the project were conducted multi-sectoral analyzes and studies of innovative solutions, methods, skills, and best practices in inclusive digital education. The analyzes include determining the current state of digital education, with a specific focus on higher education institutions in Bulgaria, Greece, Italy, and Latvia and contribute to the identification of current and future methodological skills, needs and tools for provision of digital education in line with Industry 4.0 paradigm.

The following sections make up the paper's structure: The concepts of a university's digital transformation are briefly described in Section 2, the methodology and study's scope are presented in Section 3, the analysis of the results is addressed in Section 4, and the conclusion is provided in Section 5.

2 University Digital Transformation: Paradigms and Concepts

Industry 4.0 paradigm can be attributed to the pervasive use of information and communication technologies (ICT), and the incorporation of digital processes into "smart" objects such as machines and products, which connect the physical world with the digital realm. This paradigm encompasses a concerted effort to tackle worldwide issues such as enhancing quality of life and fostering a more favorable work environment through the deployment of novel technologies across various domains and spheres, including but not limited to wireless sensor networks, big data, and the Internet of Things (Wang, Wan, Li, & Zhang, 2016). Quality 4.0 blends quality management models and technology to enhance business success in the Industry 4.0 era.

Education 4.0 encompasses diverse frameworks and approaches that higher education institutions can utilize to align their services and course offerings with the demands of a highly skilled workforce in the future. As the concept is novel, it has sparked concerns regarding the necessity of altering current approaches to designing and delivering education, as well as providing more intelligent learning environments, services, and tools (Bonfield, Salter, Longmuir, Benson, & Adachi, 2020). The concept of Education 4.0 is complemented by University 4.0, which involves incorporating the Industry 4.0 paradigm into higher education by enhancing the automation, customization, and adaptation of learning processes. The future of education will revolve around digital technology and personalized data, which will create a student-centered environment and enable flexible, adaptive, and dynamic learning pathways, as described by the principles of Education 4.0 and University 4.0 (Gueye & Exposito, 2020).

3 Methodology and Scope of the Study

The research was conducted among students and university professors from the four project partner countries. The collection of data and information from the representatives of the specified target groups was carried out by distributing two types of online questionnaires, intended for the academic staff and for the students, respectively. Over 50 questions were included in the surveys, which were sent to both sets of respondents and divided into several sections. Age group, degree of education, role, and other basic information about the respondents were gathered in the first portion of the questionnaires. The following section had 28 questions, with 26 being closed questions aimed at identifying the requirements for digital inclusive learning. The last segment consisted of 16 questions focused on collecting feedback on respondents' positions regarding the use of new technologies and media innovations in inclusive educational environments. Additionally, the questions aimed to determine digital competencies and the provision of inclusive education in line with the Industry 4.0, Quality 4.0, Education 4.0, and University 4.0 concepts. A Likert scale of 1 to 5, with 1 being the lowest and 5 being the maximum, is used for closed-ended inquiries. The surveys also contained open-ended questions to give respondents the opportunity to expound on their views on inclusive digital education from the perspective of a particular organization, as well as in connection to the company's interactions with other stakeholders. The study was carried out between January and February of 2022. A total of 310 reviews were gathered. Fig. 1 shows the breakdown of respondents (students and lecturers/professors) by nation.

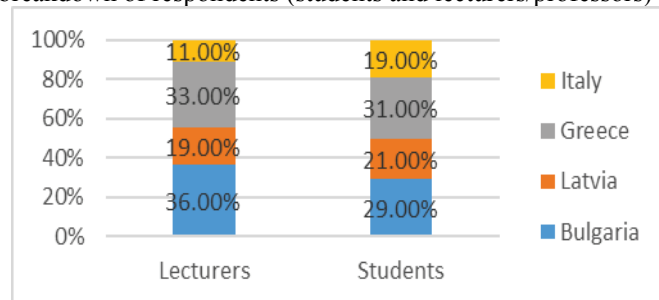


Fig. 1. Distribution of students and lecturers/professors who participated in the study by country.

4 Summary of Research Results

4.1 Results of the Conducted Research among Students from Bulgaria, Greece, Italy, and Latvia

The analysis of the information gathered by students in the four partner nations about digital education, services, and information security measures is shown in Fig. 2. The successful implementation of inclusive digital education depends on giving all students access to the necessary technology. The diagram in the figure shows that most of the

students from all four partner nations who were polled expressed their approval for utilizing digital platforms for e-learning in their universities, for advanced digital education, and for up-to-date digital equipment. The software programs they use for online learning and the technical assistance they receive from both their universities' technical staff and the IT firms that support their digital (online and blended) learning activities are both reported to be of a similar degree of satisfaction by respondents. Zoom and Microsoft Teams were indicated as the most frequently used communication platforms by most students in all countries included in the study.

According to students from the four countries participating in the study, university libraries are digitized. Regarding the offer of e-tutorials for the digital services of the university libraries, the opinion of the students from Bulgaria and Italy is positive, while that of the students from Greece and Latvia is neutral.

In relation to the evaluation of cyber security measures, the relatively low rating given by Greek students stands out. The evaluations of Bulgarian students on this indicator are the highest compared to the other three countries included in the study.

Digital technologies in education have changed the modern educational landscape. Technological advances provide easy access to all learning resources and allow convenient interaction with the instructor. Assistive technologies are now available to enable students with physical or learning disabilities to actively participate in learning. From a technology standpoint, it is evident from the research that universities are largely ready to implement inclusive digital education, so the question is of the relevant application of inclusive pedagogies considering the changing educational context.

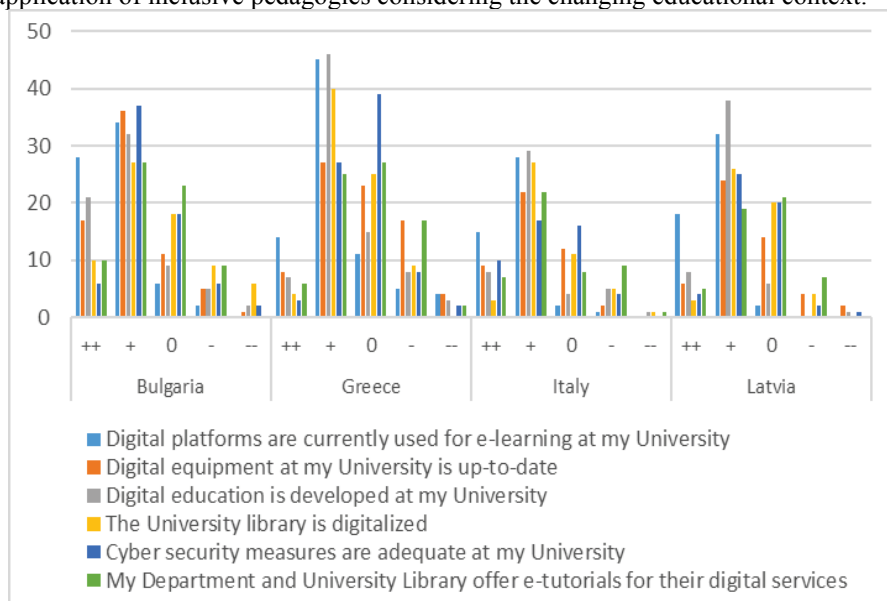


Fig. 2. Student opinions on digital platforms, e-services, and education in universities (by country)

The Education 4.0 paradigm is built on innovations in pedagogy and education, as well as the incorporation of technology made available by Industry 4.0 in education. According to the University 4.0 paradigm, modern universities are centered on the individual needs and objectives of their students and employ digital technology as teaching and learning tools.

The opinions of the students on the use of Education 4.0 and University 4.0 methodologies in universities, as well as the incorporation of Industry 4.0 and Quality 4.0 concepts into university curricula, are shown in Fig. 3.

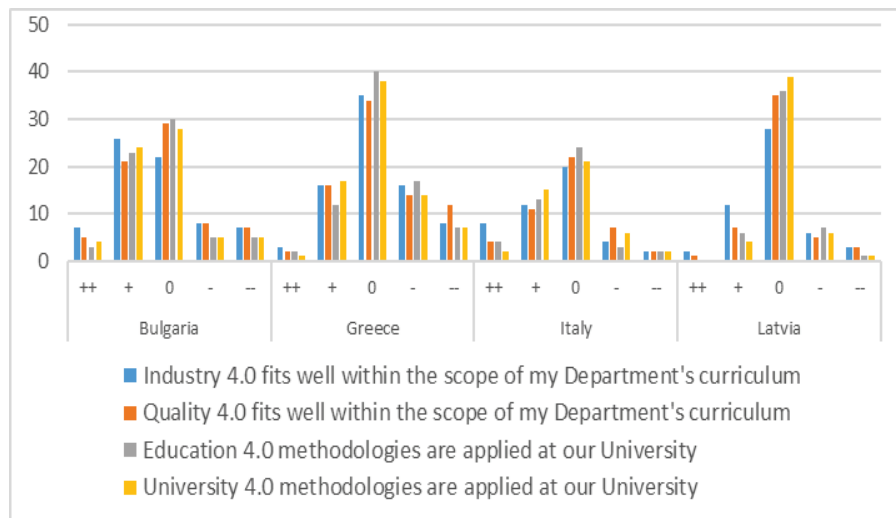


Fig. 3. Student opinion on the application of the Industry 4.0, Education 4.0, and University 4.0 concepts in universities (by country).

While students from other nations take a neutral stance, Bulgarian students think that the Industry 4.0 concept is quite effectively incorporated into the university courses in their country. Most students from all the nations included in the poll adopt a neutral stance towards the effective implementation of the University 4.0 and Education 4.0 methodologies, as well as the incorporation of the Quality 4.0 paradigm into university curriculum. Maybe they don't understand the regulations and legislation pertaining to the reproduction of digital information, which would explain this.

Digital skills are the abilities required to access and handle information via digital devices, communication apps, and networks. These abilities range from elementary web searching and emailing to advanced programming and development. Digital skills are an important aspect of digital inclusion.

In the surveys done in Bulgaria, Greece, Italy, and Latvia, a higher percentage of students said they felt interested in their online studies and that they possessed digital skills (Fig. 4). They agree that they can utilize the right technology (IT tools) to address problems, whether they be technical, content-related, communication-related, etc. They also use the cloud to store data and evaluate the validity of online material. It's also important to note that all students are knowledgeable about internet dangers and cyber-

security procedures. Some students lack confidence in using technology appropriately for educational purposes, indicating a need for further development of digital skills. Having an established digital infrastructure in universities is a prerequisite for inclusive education, but the challenges of accessibility and usability, especially for students with special needs, must be addressed.

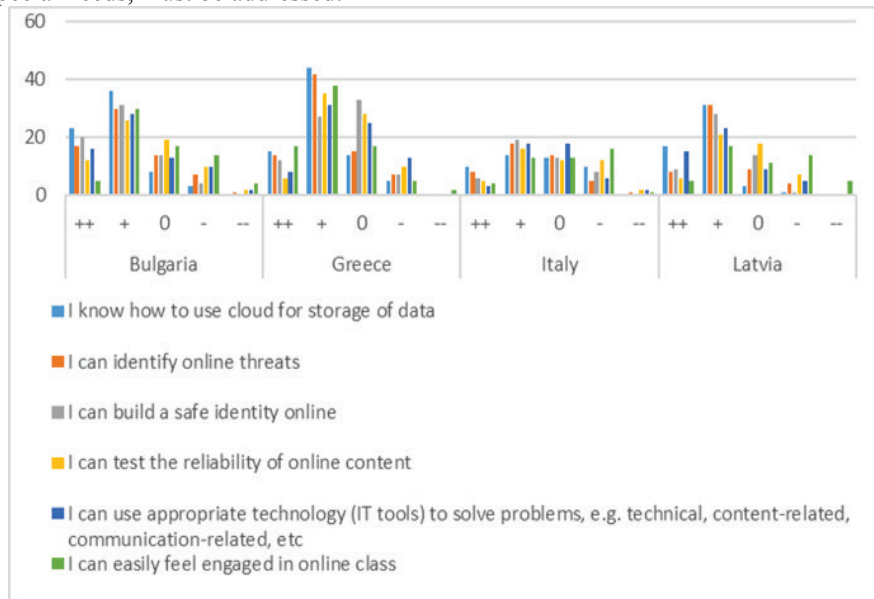


Fig. 4. Digital skills of student respondents (by country).

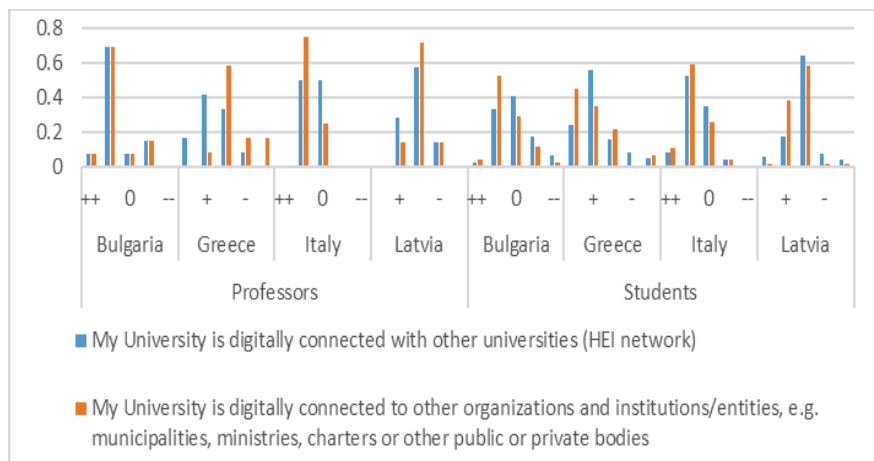


Fig. 5. Professors' and students' views on universities' digital connectivity with other organizations and universities (by country).

Students from Bulgaria, Greece, and Italy report that their universities are digitally connected with other organizations and universities (Fig. 5).

4.2 Results of the Survey among Lecturers from Bulgaria, Greece, Italy, and Latvia

The lecturers who were questioned pointed out the importance of connections between higher education institutions and other stakeholders, including local governments, ministries, and other public or private organizations. The survey's results demonstrated that, in the respondents' opinion, Bulgarian and Italian universities are connected to other universities and organizations, but the majority of professors at Greek and Italian universities remain neutral on these issues (Fig. 5).

In general, there are no significant differences in the evaluations of university professors from the various countries included in the study regarding the degree of development of digital education and digitization processes, the provided e-services, and the available platforms for the implementation of e-learning. The lecturers think that the digital infrastructures and regulations set up in their educational institutions are sufficient. Summary results for these metrics are presented in Fig. 6.

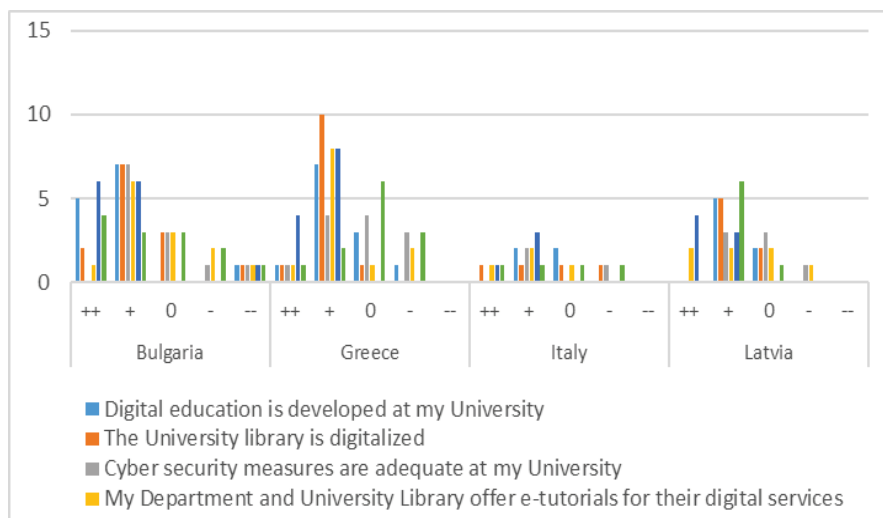


Fig. 6. Opinions of university professors on platforms, e-services, and digital education (by country).

Figure 7 presents the summarized results of the analysis of the data collected within the framework of the study regarding the opinion of university professors in the four partner countries for the implementation of the Industry 4.0 paradigm and the concepts of Quality 4.0, Education 4.0, and University 4.0 in their universities. Italian and Bulgarian lecturers express a higher level of satisfaction with the technical support provided in the framework of e-teaching and learning compared to their colleagues from Greece and Latvia.

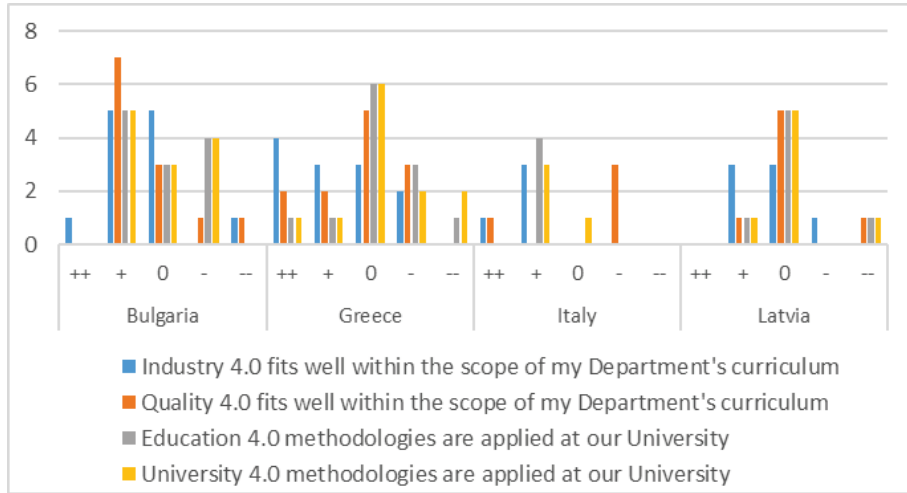


Fig. 7. University lecturers' opinion on the application of the Industry 4.0, Education 4.0, and University 4.0 concepts in universities (by country)

The surveyed professors share the opinion that computer culture and digital skills are key factors in achieving maximum efficiency of the services offered by higher education institutions (Fig. 8). There is also a broad consensus regarding the need for the public and private sectors to invest in and promote the development of digital competences, as they are the guarantee of sustainability, growth, and competitiveness.

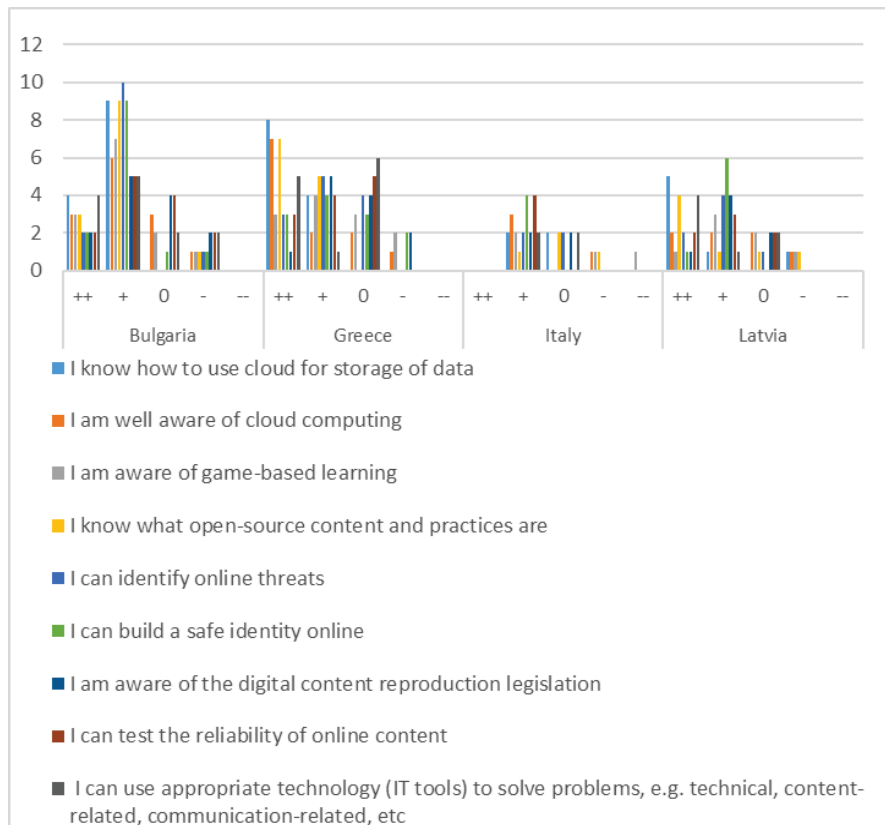


Fig. 8. Professors' views on digital skills (by country).

5 Conclusions

Universities play a crucial role in promoting inclusive education by collaborating with various networks of stakeholders who share knowledge and experience in this area. To ensure the delivery of effective special education services in online universities, to evaluate specific program elements and to improve the skills of teachers and administrators, it is essential to establish partnerships between universities and all other stakeholders to exchange good practices and know-how in promoting inclusive digital education.

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