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Business Systems Research

A Systems View across Technology & Economics

Special issue in Digitalization in Teaching Economic Disciplines: Past, Current and Future Perspectives

Editorial

Research articles

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Digitalization in Teaching Economic Disciplines: Past, Current and Future Perspectives

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Abstract

This special issue of Business Systems Research (SI of the BSR) highlights the past, current and future perspectives of digitalization in teaching economic disciplines. The emphasis has been put on digital competencies, the quality of e-learning, e-exams, digital tools, gamification, and digital and mobile technologies used in the teaching process in the field of economics. The main focus groups of the research are teachers and students from the economic field of education at both university and secondary school levels. Seven papers selected for this SI of the BSR present the digitalization era's impact on teaching economic disciplines. The conducted research and publication of the papers are funded under the project "Challenges and practices of teaching economic disciplines in era of digitalization" (project no. 2020-1-HR01-KA202-077771), which is co-funded by the Erasmus+ Programme of the European Union.

Keywords: digitalization of teaching process; digital tools; gamification; e-learning; e-exams; digital competencies; teachers; students; higher education; secondary school education; economic disciplines.

JEL classification: I23, O33
Paper type: Editorial

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Introduction

When it comes to using digital technology in the teaching process, one may ask what the differences are between seemingly the same terms. By searching among scientific and professional studies, there are terms used such as online learning, e-learning, distance learning, virtual learning, web-based learning, blended learning, and digital tools-supported learning. To be able to discuss the advantages and disadvantages among them, they should be briefly defined. According to the findings delivered by Moore, Dickson-Deane and Galyen (2011), distance learning is a way of learning where an instructor is in a different place from the learner. So, there is a condition of geographic distance. On the other hand, e-learning is more challenging to describe, and various researchers give various definitions (Moore, Dickson-Deane and Galyen, 2011). Some define e-learning as a type of learning that is strictly accessible using technological tools that are either web-based, web-distributed or web-capable (Nichols, 2003), while others state that the technology being used is insufficient as a descriptor (in: Moore, Dickson-Deane and Galyen, 2011). When it comes to online learning, Carliner (2004) states that it refers to learning and other supportive resources that are available through a computer, which is quite similar to the definition of e-learning. However, more detailed descriptions and views are summarized in this SI of the BSR papers.

This editorial aims to present the results of the comprehensive research carried out as part of the strategic partnership project "Challenges and practices of teaching economic disciplines in the era of digitalization" – DIGI4Teach (2020-1-HR01-KA202-077771) co-funded by the European Union's Erasmus+ program.

Challenges and practices of teaching economic disciplines in the era of digitalization: DIGI4Teach Erasmus+ project

To improve some of the identified deficiencies, eminent teachers from the University of Zagreb, Osnabrück University of Applied Sciences, Cracow University of Economics, University of Belgrade, First, Second and Third School of Economics from Zagreb, and Economy, Trade and Catering School from Samobor have applied for the Erasmus+ Programme project in the field of *Cooperation for innovation and the exchange of good practices*, the area of *Strategic Partnerships for vocational education and training*. Evaluators have recognized the importance of the project entitled *Challenges and practices of teaching economic disciplines in era of digitalization* and approved its funding from EU sources.

The project aims to exchange challenges and practices in teaching economic disciplines (in particular accounting, finance, trade, international business and tourism) in the era of digitalization. Given the set goals, it is expected that the partnership between higher and secondary education institutions will contribute to developing teaching skills that will stimulate creative thinking and further support the entrepreneurial spirit of vocational education students. The international consortium from Croatia, Germany, Poland, and Serbia strive to contribute significantly to the activities of the education process and teaching and training of teaching staff through the exchange of good practices in the application of new innovative learning tools in different fields of economics.

The primary needs and objectives of the project include the following:

(1) to improve teaching skills and teaching practices in different economic disciplines with particular emphasis pointed out to the era of digitalization by sharing existing

good practices and analyzing the use of new digital teaching and learning technologies in vocational education of economists,
(2) to encourage digitalization in participating organizations,
(3) to increase students' satisfaction with acquired knowledge and skills in developing their entrepreneurial ideas and better inclusion in the labour market.

To achieve the desired flexibility in acquiring skills and competencies in the field of economics, the improvement of effective digital, open, and innovative education, as well as practical learning tools, seems necessary. The project will enable additional support for educators and learners to use digital technologies more creatively and efficiently. Adopting innovative practices in teaching economic disciplines will empower and connect educators in both higher and secondary school education. It will have a significant impact on the sector of Vocational Education and Training for future economists.

The most important result of the project will be the development and improvement of digital competencies and skills needed for teaching economic disciplines in the era of digital transformation of the teaching process. Online and face-to-face transnational meetings, round-tables, and especially short-term joint staff training events in all countries involved in the project will ensure that partners will achieve the planned project results.

In the project's final phase, a publication in the form of a handbook is expected to unite all findings related to the use of digital technology in teaching economic disciplines between partner countries. By the end of the project and afterwards, experiences and good practices exchanged between partners will be applied in vocational educational institutions of secondary and higher education involved in the project in all partner countries.

After the completion of the project, further progress in developing new technologies and teaching tools that can be used in teaching is expected. Therefore, there is space for continuing cooperation in the form of new projects where the emphasis will be on developing new innovative intellectual outputs.

Contributions

Following the goals and editorial policy of the BSR, the papers published in this SI of the BSR are intended to present original theoretical and empirical advances in teaching economic disciplines using a wide range of methodological approaches. The emphasis of all the papers has been put on the exchange of ideas, experiences and knowledge between regions with different technological traditions, primarily in the field of education and specifically economic disciplines. Most papers evaluate the results of conducted empirical studies applying the survey method. The seven papers accepted by BSR for this SI fulfil these objectives.

In the first paper, entitled "Landscape of e-Learning during Covid-19: Case Study of Economic Disciplines in Croatia", Sever Mališ, Mamić Sačer and Žager investigate the digitalization level of the higher education system in Croatia before and during the Covid-19 pandemic. The conclusions are based on the preparedness of the regulatory framework, the applied digitalization approach on a national level, the transition agility from face-to-face to online teaching, as well as the number of delivered e-courses, online study programs and the application of e-learning platforms. In addition to analyzing the situation in Croatia, the authors investigate experiences from other countries, especially the current state at the EU level. Research results show that Croatia is well prepared for the digitalization of higher education when it comes to the regulatory framework, but the necessary infrastructure seeks significant investments. Although complete online study programs were exceptions before the

pandemic, many e-courses were offered to students. The number of e-courses in the economic field was underrepresented compared to other disciplines, but most online study programs were related to business and the economy. Experiences from e-courses combined with the support from national institutions such as CARNet and SRCE have certainly contributed to the high agility demonstrated by Croatian higher education institutions when suddenly shifting to an online environment at the beginning of the pandemic. The authors also concluded that the digitalization process in Croatia could be even more successful if the top-down approach was applied, judging from the experiences of other countries, which would imply national and university strategies and enough government funding.

In the second paper, entitled "Pros and Cons of e-Learning in Economics and Business in Central and Eastern Europe: Cross-country Empirical Investigation", Głodowska, Wach, and Knežević focus on the advantages and disadvantages of e-learning from students' perspective. Using the survey method, they researched a sample of university students from Poland, Croatia, and Serbia. Regarding the impact of e-learning on improving teaching outcomes, the results show that students rate it very highly by giving each e-learning fragment a major impact (on average almost 4 out of 5). The next part of the research refers to the statements regarding e-learning, which were grouped into four categories: communication, interaction, and motivation; learning efficiency and costs; contents and teaching materials; sustainability, ethics and social responsibility. The average answers of the students indicate that they agree with the statements at least to a moderate extent. Employing a multivariate analysis (factor analysis and principal component analysis) resulted in four factors that unite similar statements and a more transparent review of the advantages and disadvantages of e-learning perceived by students. Finally, they concluded that students see numerous benefits of e-learning and that the advantages in many areas exceed the disadvantages.

In the third paper, entitled "e-Learning in Higher Institutions and Secondary Schools during Covid-19: Crisis Solving and Future Perspectives", Brozović, Ercegović and Meeh-Bunse explore the challenges and benefits that students and educators faced with e-learning during the pandemic. In addition to the literature review, they presented the results of primary research that was conducted through a questionnaire distributed to university and high school educators and students in Croatia, Poland, Serbia and Germany. Undeniably, the pandemic forced educators and students to introduce more digital tools in the education process, as the research shows, leading to improved individual digital competencies. However, the authors concluded, using descriptive statistics and non-parametric tests, that there are certain differences in opinion between students and educators and between university and high school respondents. Namely: 1) high school students were less optimistic about the positive impact of the pandemic on applying digital tools in teaching than university students, 2) educators generally prefer traditional exams, while students generally prefer e-exams, 3) a higher proportion of university respondents believe that e-learning should be used as an important addition to traditional teaching when compared to high school respondents. In the end, they concluded that e-learning definitely would and should be used in the future, but in a form that suits educational level and ensures the adoption of learning outcomes and reliable examination of acquired knowledge, which are some of the issues that arose during the pandemic and sudden transition to e-learning.

In the fourth paper, entitled "Digital Competencies among Higher Education Professors and High-School Teachers: Does Teaching Experience matter?", Pera, Hajdukiewicz, and Ferjanić Hodak consider the potential of ICT in the teaching process

related to economic disciplines. They surveyed on self-assessment of university professors and secondary school teachers' digital competencies, particularly their proficiency and skills. The overall results show that the self-assessed level of respondents' competencies is at the intermediate level. The most emphasized differences occur from the perspective of the teaching experience approximated by the years of teaching (up to 5, 6-15, 16-25, and over 25). The competencies decrease with an increase in experience. However, those with 6-15 years of experience self-assessed their digital competencies at a higher level than those with up to 5 years of experience. Interestingly, respondents rated their knowledge more elevated than their skills, which indicates a lack of practical work. In addition, university professors have more self-confidence in their digital competencies compared to secondary school teachers.

The fifth paper is entitled "Who is more eager to use Gamification in Economic Disciplines? Comparison of Students and Educators". Authors Dečman, Rep and Titgemeyer explore if educators and students are motivated and willing to apply additional technologies as main gamification components in their work and education. Using a survey questionnaire, they collected 424 responses from educators and 2,474 from students from Croatia, Poland, Serbia, and Germany. The results reveal that educators and students, on average, agree that more digital tools should be introduced into the teaching process, and there is no significant difference between their attitudes. In addition, a statistically significant difference with a confidence level of 95% was found in the second research question that examined educators' and students' perceptions of the impact of simulation games on improving the outcome of the teaching process, where educators showed significantly higher expectations of such impact. Furthermore, research results showed that the attitude of educators and students regarding making the learning process more fun by using multimedia materials (audio and video materials, games, etc.) statistically significantly differs where, again, educators perceive a more significant impact. Finally, as expected, educators showed they need a higher level of administrative support when they use e-learning tools in the teaching process compared to students' needs for such support.

In the sixth paper, entitled "Which Digital Tools dominate Secondary and Higher Education in Economics: Google, Microsoft or Zoom?", Pavić, Mijušković, and Žager aimed to identify the most important digital tools applied by educators and students both from secondary and higher education during the pandemic and evaluate their satisfaction with applying these tools in four countries; Croatia, Germany, Poland and Serbia. Authors summarized the advantages and disadvantages of digital tools usage in education-practice. Research showed that Google tools most commonly used by students and educators are; YouTube, Gmail, Google Translate, Google Maps and Google Drive. Microsoft digital tools most commonly used by educators and students in observed countries are; Word, PowerPoint and Excel. Other digital tools most commonly used by educators are Zoom and Moodle, while students mostly use Zoom and Kahoot. Authors also identified the main reasons for the insufficient use of digital tools by educators, and they are: overload of existing teaching materials (lack of time for additional application of digital tools) and lack of time for preparing new materials. Final conclusion is that Google, Microsoft and Zoom dominate their specific domains: Google for networks, Microsoft for documents, and Zoom for online meetings.

Seventh paper is entitled "Digital Competencies in Selected European Countries among University and High-School Students: Programming is lagging behind". Authors Draganec, Jović and Novak investigated how university and high-school students in economics self-assess their digital competencies and then analyzed the identified differences. The paper's main goal was to identify university and high-school students'

current levels of digital knowledge and skills and to propose ways to improve their digital competencies with the ultimate goal of facilitating the learning process and providing a smooth transition and inclusion of university and high-school students in the labour market. A survey using questionnaire was conducted to collect data that were analyzed using non-parametric statistic tests (Mann-Whitney U test and Kruskal-Wallis H test) and Spearman Rank-Order Correlation coefficient. According to the research results, university and high-school students consider to have below intermediate level of digital competencies. High-school students self-assessed digital competencies at a higher level than university students. University students of higher years of study self-assessed digital competencies at a higher level. There is no universal pattern among high-school students of different years of study. Programming is the most lagging behind in all the observed groups. In the end, the authors concluded that consistency exists in the self-assessment of digital knowledge and digital skills. The identified below intermediate level of digital competencies and discovered discrepancies, according to authors, indicate the need for educational process improvements to provide university and high-school students with a higher degree of digital competencies.

Conclusion

Digital technologies are an indispensable part of the learning process nowadays. Current research and practice show that the education system of future economists is insufficiently attentive to the development of teachers' digital competence and, consequently, students' digital competence, especially in the secondary education system. To modernize the education and training of future economists, it is essential to promote the use of digital technology for learning in the field of vocational education. In that manner, strengthening teachers' competencies for different forms of training would promote the comprehensiveness of teaching future economists.

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References

1. Carliner, S. (2004), "An Overview of Online Learning", Second ed., Massachusetts: HRD Press Inc., available at https://books.google.hr/books?hl=en&lr=&id=cVzE-cy4GxkC&oi=fnd&pg=PP9&dq=online+learning&ots=JrpZ7J3qK-&sig=xmD1OT7_iNapEjZ3He7CmAX5oXQ&redir_esc=y#v=onepage&q=online%20learning&f=false (5 January 2022)
2. Moore, J. L., Dickson-Deane, C., Galyen, K. (2011), "e-Learning, online learning, and distance learning environments: Are they the same?" The Internet and Higher Education, Vol. 14, No. 2, pp. 129–135. https://doi.org/10.1016/J.IHEDUC.2010.10.001.
3. Nichols, M. (2003), "A theory for eLearning", available at http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.92.4852&rep=rep1&type=pdf (14 December 2021)

About the editors

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Landscape of e-Learning during Covid-19: Case Study of Economic Disciplines in Croatia

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Abstract

Background: The Covid-19 pandemic has changed the digitalisation level of education. Many institutions had some knowledge and practical background in delivering lectures online. Some countries apply a top-down digitalisation approach driven by policy or strategy and externally impacted by the government. Some other countries rather initiate digitalisation internally by teachers and universities. **Objectives:** The main goal is to investigate the digitalisation level of the higher education system in Croatia, exploring the digitalisation of economic disciplines compared to other scientific fields. **Methods/Approach:** We assess the digitalisation level of higher education based on the regulatory framework, applied approach of digitalisation, the agility of transition to online teaching and the existing number of courses and online study programs. Education digitalisation in different countries is compared with the Croatian experience. **Results:** Although the satisfactory level of higher education institutions' agility to switch online exist, there hasn't been a centralised project led by the government and supported by proper funds to increase digitalisation in Croatia. Even before the pandemic, many e-courses from economics and business had been offered to students, but online study programs were exceptions, covering mainly the economics and business field. **Conclusions:** The Covid-19 pandemic has improved the digitalisation process in the Croatian education system. A general framework for the digitalisation of education should be developed containing the detailed administrative processes and appropriate funds to be implemented.

Keywords: higher education institutions; digitalisation; economic disciplines; Croatia

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Introduction

The global epidemic and online teaching have marked the last two academic years. However, online teaching is not just a product of emergencies caused by the Covid-19 pandemic. Many universities implemented online study programs in their strategies even before that period. Universities in Croatia are just one of many universities that, before the pandemic, had also had some practical experience in online teaching. In that context, the pandemic has only fastened the level of digitalisation in higher education, but there is still plenty of work in front of higher education institutions worldwide. Digitalisation is "*the use of digital technologies to change a business model and provide new revenue and value-producing opportunities; it is the process of moving to a digital business*" (Gartner, 2022). In the light of education, the digitalisation process includes not only a change in the applied educational technologies but also certain expected administrative changes. Higher education as a sector is also a subject of digitalisation. EY Parthenon's survey (EY Parthenon, 2020) indicates that 93% of institutions expect digital tools and technology changes to impact these institutions significantly.

A certain image of digitalisation in the Croatian higher education system before the Covid-19 pandemic presents the research from 2012 conducted on the sample of the University of Osijek. This research shows that only 39.7 % of students took exams and midterm tests applying computers at that time (Dukić et al., 2012). The highest application of computers was noticed for social and technical sciences. Further, according to Dukić and Mađarić (2012), videoconferences were used for delivering lectures only in 13.7 %. This kind of lecture was mostly used in technical sciences. In addition, in 2015, more than 8000 e-courses in Croatia were registered (SRCE et al., 2022). Today, we have a perspective on increasing digitalisation in higher education.

Considering that some experience in the digitalisation of Croatian higher education has already existed even before the Covid-19 pandemic, the main goal of the paper is to investigate the digitalisation level of higher education in the Republic of Croatia. The research is based on the preliminary research of the topic in previous studies in Croatia and worldwide. Limited research about the digitalisation of higher education in Croatia, in general, has been conducted until now. Many research papers on this topic cover the impact of the Covid-19 pandemic on the digitalisation of schools or higher educational institutions worldwide (Johnson et al., 2020, Zawacki-Richter, 2020, Bond et al., 2021, Siddiquei et al., 2021, Harvard Business Publishing Education, 2020, UNESCO, 2022, Müller et al., 2020, etc.). However, a research gap can be found in analysing the regulatory framework for the digitalisation of higher education in Croatia. This kind of research in the economic field is especially lacking. Namely, this issue is highly relevant since the digitalisation of higher education can be performed as top-down or externally impacted digitalisation driven by policy, strategy, curricular reforms or re-organisation. Other than that, digitalisation could be initiated by leadership or staff as a bottom-up or internally impacted digitalisation (Tømte et al., 2019). Based on these postulates, different countries have experienced higher or lower maturity of the digitalisation of higher education. The topic of digitalisation is found to be very interesting from many research perspectives. Some of them were the direction of our paper (Brink et al., 2020, Ciurea, 2020, Korolovea et al., 2020, Johnson et al., 2020, Zawacki-Richter, 2020, Bond et al., 2021, Siddiquei et al., 2021, Rodriguez-Abitia, et al. 2021, etc.).

Furthermore, the importance of digitalisation in education is recognised not only nationally. The European Union is aware that employees lack some digital skills. According to the Digital Economy and Society Index, only 56% of European citizens „*possess at least basic digital skills and only about one-third of Europeans possess*

above basic digital skills (31%)" (DESI, 2021, p. 3). Although the survey indicated that 84% of people regularly used the Internet in 2019, the gap between having Internet access and using it with appropriate digital skills was noticed. With this issue in mind, the EU introduced the Digital Education Plan for 2021-2027. Several areas in this plan are recognised as a high priority. Among others, this document emphasises fostering the development of a high-performing digital education ecosystem and enhancing digital skills and competencies for digital transformation (European Commission, 2020, 2021a). According to the European Framework for the Digital Competence of Educators, six areas cover 22 elementary competencies (Redecker,2017). Aware of the need for digitalisation, the EU Member States should support several actions to implement the Digital Education Plan and reach Europe's digital transformation by 2030. This will certainly affect the digitalisation level of higher education in every EU Member State and Croatia.

Considering the previous research results, we find it useful to explore the digitalisation level in higher education in Croatia with a specific perspective in the economic field. To fulfil the main purpose of the paper, we set two main research questions:

- *RQ1 What was the digitalisation level of the higher education system in Croatia before the Covid-19 pandemic and compared to other countries?*
- *RQ2 What is the digitalisation level of economic disciplines compared to other higher education disciplines in Croatia?*

The paper's results could contribute to scholarly literature in the economic area and general. While some research papers included only the perspective based on the survey about the digitalisation level, our results are based on the official registers. Other than that, as some studies stress that the university funding and size could be the limitation of their studies (Rodriguez-Abitia et al., 2021, Erlam et al., 2021), our study was primarily based on the data from official national registers where the difference between private and the public university is visible. Our paper does not include only the Covid-19 impact on the digitalisation level, as some papers were specified for (e.g. Johnson et al., 2020, Erlam et al., 2021). Rather, our viewpoint includes a wider approach with a special reference to the very beginning of higher education digitalisation in Croatia. For the study, we assess the digitalisation level of higher education based on the regulatory framework, applied digitalisation approach, the agility of transition to online teaching and the existing number of courses and online study programs. Also, the overview of education digitalisation in different countries is compared with the Croatian experience.

The paper's content includes the introduction section, where we briefly explain the methodology used. The results and discussion chapter is the main part of the paper. First, we explore the regulatory framework of higher education in Croatia, then discuss the advantages and disadvantages of the top-down vs bottom-up approach of higher education digitalisation. The next sections present our discussion and main results on the agility of higher education institutions in the transition from F2F to an online teaching environment caused by the Covid-19 pandemic, as well as on the e-courses, online study programs and e-learning platforms in Croatian higher education systems with the perspective on economic disciplines. Furthermore, future expectations regarding the digitalisation of the higher education system in general and economic disciplines are given. The paper ends with the final remarks on the research questions, the study's limitations and the main conclusions.

Methodology

The evaluation of higher education digitalisation maturity in Croatia with the perspective on economic disciplines is conducted through the analysis of the higher education digitalisation level. For this study, the digitalisation level is analysed through the preparedness of the regulatory framework, the applied digitalisation approach on a national level, the agility of transition from face-to-face to online teaching regarding the Covid-19 pandemic, as well as through the number of delivered e-courses, online study programs and the application of e-learning platforms. The shaped form of research is common in education research (Johnson et al., 2020, Zawacki-Richter, 2020, Bond et al., 2021, Siddiquei et al., 2021, Müller et al., 2020, and others).

Several goals are set based on the research questions posed in the introduction. First, we investigate the overall regulatory framework for higher education in Croatia by providing the analysis of laws, the related ordinances, national and university strategies and institutional support for digitalisation in higher education. Further related to that, the analysis of different examples of the top-down and bottom-up approach of higher education digitalisation is made so the comparison to the Croatian approach could be done. In addition, our goal is to research the preparedness and actions of higher education institutions for online teaching environments before the Covid-19 pandemic and indicate the related changes. Based on that, the agility of the transition from F2F to online teaching could be estimated. Also, national statistics about e-courses, online study programs and e-learning platforms with special care on economic disciplines are investigated. Finally, we indicate future expectations of digitalisation in higher education in Croatia.

Case study of online learning of higher education in Croatia

Regulatory framework for online learning in higher education in Croatia

Croatian higher education is based on the Bologna process. This process started in 2005 and has been continuously improved. That involves, among others, offering new technical models of learning. Using modern information technology in teaching and learning is a prerequisite for the higher education system's survival, especially nowadays.

The modernisation of higher education is recognised as a high priority and is one of the goals of the National recovery and resilience plan 2021-2026 (Government of the Republic of Croatia, 2021). The reform of higher education has included, among others, the digitalisation of higher education. Due to the lack and inadequate infrastructure for implementing digital tools in higher education institutions in Croatia, there is a need for investments in a digital change of higher institutions. According to the DESI 2021 for Croatia, digital investments of EUR 158 million, including substantial measures for the digital transformation of higher education (EUR 84 million), are intended to improve digitalisation in universities and research centres. This could lead to faster digitalisation of higher education in Croatia.

So far, the digitalisation of higher education in Croatia has been conducted in line with the Digital Education Action Plan 2021-2027 (European Commission, 2020) and the Council's conclusions on digital education in Europe's knowledge societies (European Council, 2020). A strategic approach to digital transformation includes investments in digital learning infrastructure and the digitalisation of administration processes. According to the Index of readiness for lifelong digital learning, Croatia took third place in the EU concerning policies and institutions for digital learning but 21st place when it comes to the availability of digital learning (Beblavý et al., 2019).

With its 13th place, Croatia is in the European average in terms of the digital learning readiness index in Europe and is recommended to invest in digital infrastructure and train educators.

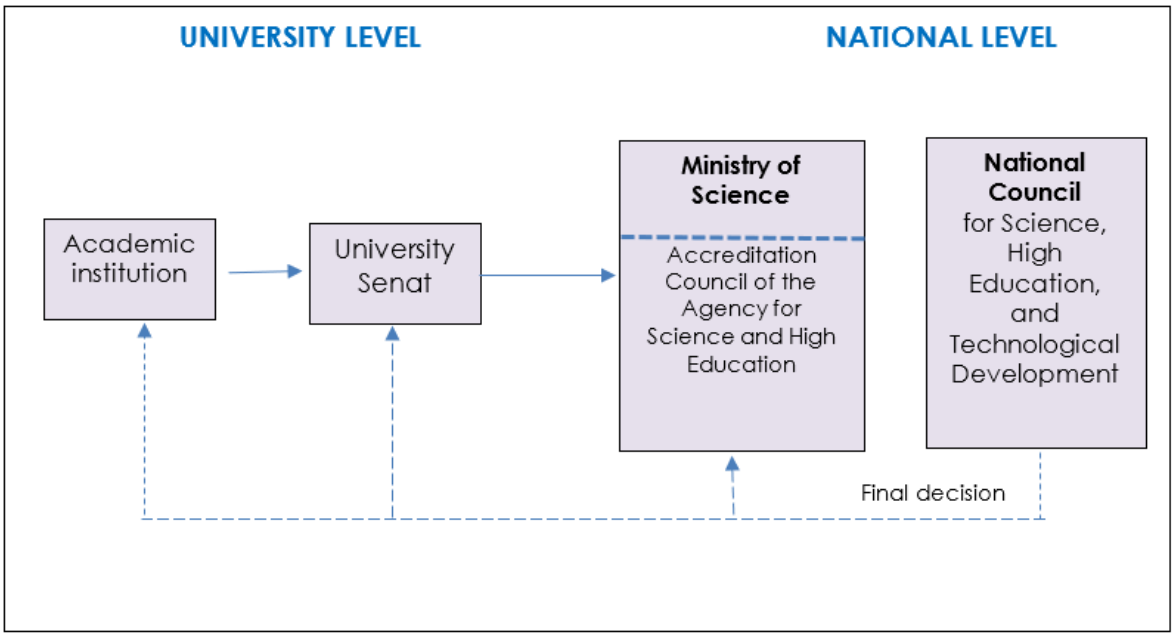
Universities are the main part of higher education institutions in the Republic of Croatia. *"Higher education institutions in the Republic of Croatia include universities (and their constituents - faculties and art academies), polytechnics and colleges. A university is an institution organising and delivering university study programs and professional study programs, and Polytechnics and colleges deliver professional study programs. The main difference between polytechnics and colleges is the number of study programs they deliver (polytechnics deliver at least three study programs in three different scientific fields)"*. (ASHE,2022). According to the ASHE (2022), in the 2018/19 academic year, 117 higher education institutions in Croatia provided lectures for 162,928 students. Higher education in Croatia is still dominantly organised as public higher education institutions (90% of students study in public HEI), while 10% of all students study in private higher education institutions.

The improvement of higher education is recognised in the Croatian National development strategy 2030 as one of the priority areas for achieving the strategic goal of „educated and employed people". According to the Strategy, digital transformation and computerisation of the educational system are significant for education in Croatia (Croatian National development strategy, 2021).

According to the Law on Scientific Activity and Higher Education, a study program can be organised as an online study program. The relevant national authority must formally regulate online teaching to be legally valid. In Croatia, it is a National Council for Science, Higher Education, and Technological Development. This Council establishes many important rules and ordinances to achieve a quality education system. One rule is the criteria and procedures for evaluating online studies (NCVO, 2016). These criteria are a part of general rules for the evaluation of study programs, so they don't cover all the determinants but only those specific to online teaching. The proposed criteria are related to the study programs where at least 50% of all courses are taught online, and an online course is a course in which at least 50% of the lecturing hours are delivered online.

Online teaching factors are infrastructure, students (learners), teacher/instructor, content, institutional, and motivational factors (Siddiquei et al., 2021). Related to that, planning for online learning *"includes identifying the content to cover and considering how different types of interactions will be supported and prioritised. Consequently, development of online courses may take up to 9 months*." (Erlam et al., 2021). To get permission for online teaching, a higher education institution in Croatia must additionally specify the purpose of the online program in detail. It must also meet the criteria prescribed for the infrastructure and technical prerequisites, personal prerequisites, and support provided for teachers and students. In addition to the criteria prescribed in detail, the guidelines for assessing students' knowledge are also provided. Those criteria were adopted in 2016, indicating that online studies were present in Croatian higher education even before the coronavirus pandemic. These prescribed rules, particular the guidelines for assessing students' knowledge, were very helpful at the beginning of the pandemic when, almost overnight, we had to switch to online teaching. The accreditation of study programs is serious and responsible work and, therefore, should be realised according to the proposed procedures. Figure 1 shows the accreditation/approval process of online studies in Croatia.

Figure 1
The Accreditation/Approval Process of the Online Study Program



Source: Author's illustration

As seen in figure 1, the approval process consists of several steps. After a long and demanding review process, the National Council for Science and Higher Education makes the final decision at the national level. A positive response means that the study program is approved. Students who complete online studies have all legal rights, and those who have studied in classic offline programs. Therefore, all these procedures and criteria should be considered when considering any study programme's learning outcomes.

A partially carried out online study and the academic names acquired by its end are towards the Law on Scientific Activity, and Higher Education is considered equivalent to other higher education teaching forms (National Gazette, 2017). This is why the intended learning outcomes and acquired competencies in online studies should not differ from those delivered in a traditional manner, i.e. onsite learning.

The University of Zagreb, the largest and oldest university in Croatia, differs three levels of e-learning. The first level is mostly directed to disclosing information (web, e-learning system), and less is used for communication between professors and students (only e-mail or forums). The second level comprises the integration of e-learning and classical lectures with the application of e-learning systems, videoconferences, webinars or e-portfolio systems. The third level concerns the greatest usage of e-learning through e-learning systems, videoconferences, webinars or e-portfolio systems and other web tools (UNIZG, 2009). The University of Zagreb issued an E-learning strategy in 2007 (UNIZG, 2007). Similar, in 2011, the University of Rijeka issued an E-learning development strategy on the University of Rijeka (UNIRI, 2011). Some other universities in Croatia have also developed their strategies. Although there isn't a strong top-down approach to the digitalisation of higher education, still, the E-learning Centre is meant to be a central institution that could provide support and training to teachers, students and institutions in the use of e-learning technologies with the main task to provide the systematic implementation of e-learning in Croatian higher education (SRCE, 2022).

To sum up, a certain regulatory framework has been developed for the digitalisation of higher education on a national and university level. Even the EU research has confirmed that Croatia is well prepared based on a strategy preparedness for digitalisation. However, necessary infrastructure seeks significant investments, which are expected to be provided in the future.

Top-down vs bottom-up approach of digitalisation

Tømte et al. (2019) reported that higher institutions usually miss overall digitalisation strategies, especially online learning. Rather, this is a result of individual and individual departments' initiatives. This is why in most countries, many institutions offer e-courses rather than whole online study programs. The same research states that the level of digitalisation is higher in the case of the top-down approach, as is the case of Denmark, more than in the case of Norwegian higher education, which is more bottom-up digitalisation oriented. Bond et al. (2018) confirm that the top-down approach would also be more useful in other research on these two main approaches to the digitalisation of higher education. Vivitsou (2019) illustrates the digitalisation of education driven by the government in Finland through two waves starting in 2015 (Vivitsou, 2019). Higher education in Germany has been in the process of digitalisation since 2000. The Federal Ministry of Education and Research funded the implementation of new media in education. Other than that, there were some other funds available for e-learning. Besides funding, the government effort was seen in some strategic documents and policies. Digital Agenda 2014–2017 was introduced to establish the Higher Education Forum on Digitalization to develop concepts and studies on digitalisation at universities (Zawacki-Richter, 2020). Despite the effort of the government, a small number of universities in Germany are satisfied with the level of digitalisation of learning/teaching (just 1.7 %, Gilch et al. 2019). McKinsey Global Institute (Gandhi et al., 2016) found that the USA's digitalisation level is also low in their education system.

According to the Digital Economy and Society Index (DESI) survey, Croatia is placed 19th of 27 places of all EU Member States in 2021. In education, a certain centralised effort in digitalisation has been given at a primary and secondary education levels. The top-down approach to the digitalisation of schools in Croatia has been present since 2015 through the project *e-Schools: Development of the System of Digitally Mature Schools led by CARNET and financed by EU funds and the Croatian state budget (CARNET, 2019). The project includes* 903 primary schools, 364 secondary schools and 50 art schools, and centres for upbringing and education, which strongly impacts the digitalisation of this level of education. *As a result of this project, the digitalisation of schools has improved Croatian primary and secondary education levels.* On the contrary, although the importance of digitalisation is recognised in national education strategies and laws, the digitalisation of higher education is driven by separate initiatives by academics, faculties or even universities. As the European Commission (2021b, p. 3) investigated, „*education, science and research are still reflected in the national Recovery and Resilience Plan (RRP), which is expected to boost the digital transformation of higher education*" in Croatia.

The agility of higher education institutions in the transition from Face-to-Face (F2F) to an online teaching environment caused by the Covid-19 pandemic

The Covid-19 pandemic has changed the way of living, doing business and consequently the way of teaching and learning. The pandemic has fastened

digitalisation in education more than any national or supranational strategy or university initiative. Namely, according to data from the United Nations Educational, Scientific and Cultural Organization (UNESCO), facing the global pandemic Covid -19 and lockdowns, more than 1.2 billion students worldwide had stopped having face-to-face classes by mid-May 2020 (ECLAC-UNESCO, 2020).

Today, every professor or student is aware of the many advantages of digitalisation. Many students worldwide have experienced different forms of teaching, from traditional face-to-face to online. Between these two ways of teaching, many other mixed forms include a certain level of IT support to compensate for the distance between professors and students. However, distance learning isn't a brand-new way of teaching. The University of London has considered the birthplace of distance learning, introduced in 1858 (University of London, 2021). Apart from that institution, the University of the Cape of Good Hope in South Africa, founded in 1873, followed the same way of teaching as the University of London and set academic standards and examinations for associated 'university colleges' (UNISA, 2021). Online or distance learning as a high level of education has also evolved from the remote forms of learning in Australia and New Zealand around 1922 (Erlam et al., 2021).

As the EUA's survey from 2014 points out, 91 % of institutions that participated in this survey provided some e-learning: distance learning, mixed approach to learning, problem-solving learning, lectures, experiential learning or simulations. According to the same research, 82% of respondents also offered online courses (ENQA, 2018). The results are not surprising as it is justified to expect that some kind of IT-supported lecture delivery is common in the 21st century. Some kind of blended teaching is given, even if only for disclosing learning materials through some platforms.

The public consultation with 2700 contributions the European Commission received between 18 June to 4 September 2020 highlighted ''that almost 60 % of respondents had not used distance and online learning before the crisis'' (European Commission, 2020). Hence, the research carried out by Harvard Business Publishing Education in 2020 stresses that around 63% of educators and 67 % of students involved in their study from 800 business students and educators all over the world had some pre-Covid-19 online teaching/learning experience (Harvard Business Publishing, 2020). Before the Coronavirus pandemic, as OECD's Teaching and Learning International Survey (2018) says, only 39 % of teachers in the EU felt comfortable and very well prepared for digital technology implementation in teaching (European Commission, 2020). Johnson et al. (2020) surveyed 672 US institutions. Their results confirm that American lecturers faced the same problems regarding shifting from F2F lecturing to online delivering knowledge as their colleagues from all over the world. Namely, in almost all institutions, some professors had no online teaching experience before the pandemic. Around 49 % of the faculty had some previous online experience in teaching. When shifting to online learning, US academics used synchronous video (80 %), pre-recorded lectures (65 %) and pre-recorded video from external sources (51 %). Despite the differences in the percentages, all the research mentioned above states that a significant amount of institutions and professors weren't prepared enough and had insufficient knowledge to switch from onsite F2F teaching to offsite distance learning. With this in mind, universities worldwide should prepare for administrative and technological changes within 24 hours. The global survey performed by the International Association of Universities has shown that at the beginning of the pandemic, the majority of higher education institutions on a global level prepared their selves for transition to distance learning with higher or lower efficiency (85 % in Europe, 72 % in Americas and 60 % in Asia & Pacific). Only a few suspended teaching while an institution develops an appropriate solution. Only 3 % of institutions cancelled teaching (Marinoni et al., 2020).

During the first stage of the pandemic, the so-called first total lockdown stage, in Croatia, as in other countries, a fast transition from onsite learning in the classroom to some online learning happened. During the pandemic, several recommendations for the organisation of teaching in higher education institutions have been given by the Croatian Institute of Public Health (HZJZ, 2022). These recommendations have marked the way of teaching in these institutions. Since this transition had happened overnight without any strategic planning and enough time to prepare professors, students and IT support for such a big change, many professors started by uploading some lecture materials on currently available platforms or recording audio presentations, some additional tools (quizzes, chats, forums, videos, simulations, etc.) helped bypass F2F to online teaching. Considering all the shortages of such overnight transition without any strategy, this emergency remote teaching first followed the same principles of face-to-face teaching in class. Some professors delivered their lectures and seminars as synchronous or asynchronous teaching. Emergency remote teaching involves „ *fully remote teaching solutions for instruction or education that would otherwise be delivered face-to-face or as blended or hybrid courses and that will return to that format once the crisis or emergency has abated.*" (Hodges et al., 2020). Emergency remote teaching is considered a distance education branch (Bond et al., 2021). In the second stage of the pandemic, fully online learning was an optimal solution for many institutions. At this stage, the first shock had passed; students and professors became familiar with available media for online teaching/learning and lectures were significantly adjusted for online teaching. Lectures, workshops, seminars and other student obligations were provided online (synchronous or asynchronous). With the phase of getting back to the so-called „new normal life" and finishing total lockdowns, academic institutions opened their doors to students and invited them again into classrooms. However, to be in line with the valid epidemiological measures, faculties with large numbers of students have applied a hybrid approach. Necessary IT equipment had been purchased to deliver lectures onsite and online simultaneously. Professors and students faced new challenges with delivering lectures to students in traditional classrooms as well as to the students on distance learning.

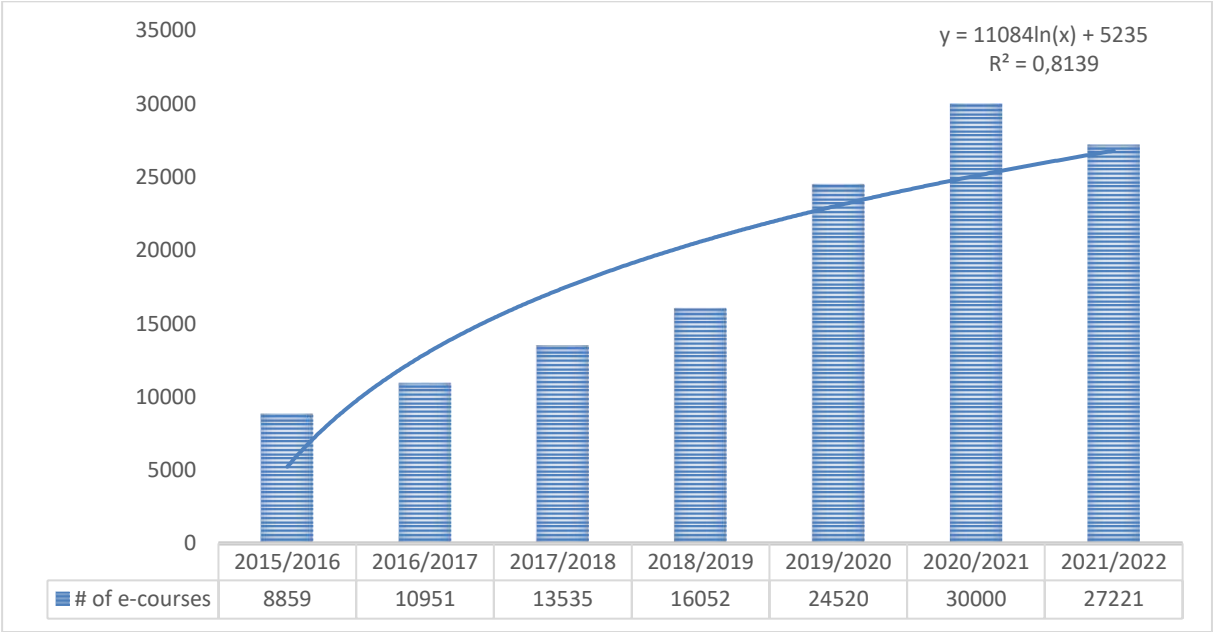
To wrap up, although there wasn't enough time to plan a switch from F2F to online teaching, Croatian higher education institutions have shown very high agility to proceed with teaching in an online environment, and none of these institutions wasn't stopped working during the pandemic.

E-courses, online study programs and e-learning platforms in Croatian higher education systems with the perspective on economic disciplines

In 2015 the Ministry of science, education and sport and the University Computing Centre (SRCE) established the Catalogue of e-courses in the higher education system in the Republic of Croatia. For this research, e-courses are defined as "*courses that use the possibility of new technologies to improve the quality performance of the curriculum and/or the teaching and learning process. We can distinguish multiple shapes or levels of e-courses, from those simple ones with only teaching materials and information on courses available on the Internet to complex ones designed precisely for the online, interactive, and collaborative environments and combine several educational components in a single study course or programme*". (SRCE, 2019, p. 4). The number of e-courses has constantly increased over the last several years (Table 1). In the academic year 2015/16, there was only 8.859 e-courses, and the most significant changes occurred during the Covid-19 pandemic when the number grew

to 30.000. The pandemic has accelerated the implementation of IT in the learning process all around the world. Countries and universities with previous experience in online teaching could adapt much easier to the new situation.

Figure 2
Number of E-courses at the Croatian Universities



Source: Adapted by authors according to SRCE and Ministry of Science and Education (2022)

Data from Table 1 were collected according to the Ordinance of the organisation and using the Catalogue of the e-courses in higher education of the Republic of Croatia (SRCE, 2019). However, due to the pandemic, many courses have been performed online in the last two academic years. Therefore, it is reasonable to expect that the number of courses performed in an online environment is even much higher. The University of Zagreb, the oldest and the largest Croatian university, is a leading university with more than 9.000 e-courses. It is more than 1/3 of all e-courses offered at Croatian universities. The largest share belongs to the university's studies (undergraduate, graduate, or integrated studies). This is in line with the number of students, as well as the number of courses. Namely, students must study at the university level (where most courses are taught). On the other side, it can also be noticed that other universities also offer e-courses to their students; for many students, that means easier access to the education system, which can lead to better professional development and competitiveness in the labour market. The same is with economic disciplines. The number of e-courses in economic discipline is presented for the largest public faculties where the economy is taught. It is worth noting that the number of e-courses from the economy field represents less than 3 % of the total number of e-courses. The number is pretty low, but it must be mentioned that these e-courses are based on the e-platforms registered in the system. Other than the e-courses provided by the faculties of economy, economic disciplines are taught at some other faculties as well, meaning that the number of e-courses from economic discipline in real is even higher, especially during the last two pandemic years.

Table 1
Number of e-courses in the higher education system in Croatia in the academic year 2021/2022

University	University studies		Other studies		Total number of e-courses
	Undergraduate, graduate, and integrated	Postgraduate	Professional studies	Study not specified	
University of Zagreb	6,053	623	1,301	1,141	9,118
Faculty of Economics and Business Zagreb	0	0	11	34	45
University of Rijeka	2,578	39	715	965	4,297
Faculty of economics and business Rijeka	162	0	0	0	162
University of Split	1,300	0	128	938	2,366
Faculty of Economics, Business and Tourism Split	0	0	0	0	0
University of Osijek	1,402	203	266	184	2,055
Faculty of economics Osijek	102	0	0	0	102
University of Zadar	3,334	0	365	29	3,728
Department of Economics	46	0	0	0	46
University of Dubrovnik	1,033	79	295	0	1,407
Department for Economics and Business Dubrovnik	175	79	125	0	379
Juraj Dobrila University of Pula	0	0	0	1	1
University North	216	1	308	0	525
Department of Business and Management in the Media	0	0	24	0	24
Department of Business Economics	22	0	0	0	22
Other universities	635	0	1,416	1,674	3,725
Total	16,551	945	4,794	4,931	27,221

Source: adapted by the authors according to SRCE and Ministry of Science and Education (2022)

To provide some level of online learning, a certain e-learning platform is needed. The two most common used e-learning systems (table 2) are SRCE's Merlin and CARNet's Loomen, and both are based on the Learning Management System Moodle (CARNET, 2022, SRCE, 2020). Besides that, some other universities use their e-learning platforms.

Table 2
Ten most common used e-learning platforms in higher education institutions in Croatia

E-learning system	2018./2019.	2019./2020.	2020./2021.	2021./2022.	Total
University system for e-learning-Merlin, SRCE	13,021	23,316	27,280	26,590	116,401
CARNet LMS - Loomen	652	815	1	0	2,908
System for e-learning, University of Rijeka	0	0	0	0	2,683
Distance learning system and online teaching support, Juraj Dobrila University of Pula	0	0	2,393	0	2,393
ELF – Faculty of organisation and informatics, University of Zagreb	307	296	326	381	2,319
Faculty of humanities and social sciences: MOODLE	542	0	0	0	1,734
Portal of the Faculty of Electrical Engineering and Computing, University of Zagreb	0	0	0	0	1,315
E-learning portal of the Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb	754	0	0	0	1,009
Sharepoint LMS – Faculty of Architecture, University of Zagreb	136	0	0	0	656
Portal Military study, University of Zagreb	178	0	0	0	624

Source: adapted by the authors according to SRCE and Ministry of Science and Education (2022)

As Table 3 shows, there are only 16 full online study programs in Croatia. Of 16 study programs that are taught online, 14 are also taught in person. Only four programs are delivered only online. Usually, online study programs in Croatia are designed as professional programs (12 undergraduate or graduate programs), and only four are university programs. Both public and private higher institutions that offer online programs are almost equally represented (9:7). Zagreb and its surrounding area offer 9 programs, and the rest are delivered by other university centres such as Split and Rijeka.

Regarding the field of study, nine of 16 studies cover economic disciplines. The higher education institutions that deliver these economic programs are mostly private (7), whereas only two public institutions offer online programs in the economic field. This is not surprising since 14 of 25 private institutes deliver study programs from the economic field (Ministry of Science and Education, 2022a). The language in which a programme is taught is mostly Croatian, and two studies offer programs in Croatian and English.

The Agency for science and higher education surveyed online studies in Croatia regarding online study programs. Based on the survey, it is concluded that students of different ages (from 18 to above 35) enrolled in online study programs, and the average yearly number of students per study is 30. Underrepresented and vulnerable groups, such as older students, students with disabilities, part-time students, travelling students, and students from rural areas, smaller towns and islands, are more likely to enrol in online study programs (ASHE, 2020).

To synthesise, there was a significant number of e-courses provided in Croatia even before the pandemic. Hence, before the pandemic, only 16 study programs were offered fully online, and half were from the economy field. Private institutions are more agile in preparing and offering such studies to be recognised on the market. To be

prepared for such a digital environment, national institutions such as CARNet and SRCE developed e-learning platforms that are accompanied by e-learning platforms of the faculties and universities in Croatia. Such platforms certainly have helped bridge the transition to online learning in the pandemic environment.

Table 3
Online study programs in Croatian higher education system in 2021

Property	Type	Location	Scientific areas	Scientific field	Modes of delivery	Languages
Public	Undergraduate university programme	Rijeka	Social sciences	Economy	1) In person 2) Online	Croatian
Private	Undergraduate professional programme	Zaprešić	Social sciences	Economy	Online	Croatian
Private	Undergraduate professional programme	Zagreb	Social sciences	Economy	Online	Croatian
Public	Specialist graduate professional programme	Split	Social sciences	Kinesiology	1) In person 2) Online	Croatian
Public	Undergraduate university programme	Zagreb	Humanities	Philology	1) In person 2) Online	Croatian
Private	Specialist graduate professional programme	Zagreb	Social sciences	Economy	Online	Croatian
Private	Undergraduate professional programme	Zagreb	Social sciences	Economy	1) In person 2) Online	1)English 2) Croatian
Private	Specialist graduate professional programme	Zagreb	Social sciences	Economy	1) In person 2) Online	1)English 2) Croatian
Public	Graduate university programme	Zagreb	Humanities		Online	Croatian
Private	Specialist graduate professional programme	Zaprešić	Social sciences	Economy	1) In person 2) Online	Croatian
Private	Specialist graduate professional programme	Zagreb	Interdisciplinary fields of science	Project manag.	1) In person 2) Online	Croatian
Public	Undergraduate professional programme	Split	Social sciences	Kinesiology	1) In person 2) Online	Croatian
Public	Undergraduate professional programme	Split	Social sciences	Kinesiology	1) In person 2) Online	Croatian
Public	Undergraduate professional programme	Split	Social sciences	Kinesiology	1) In person 2) Online	Croatian
Public	Undergraduate professional programme	Split	Social sciences	Kinesiology	1) In person 2) Online	Croatian
Public	Graduate university programme	Rijeka	Social sciences	Economy	1) In person 2) Online	Croatian

Source: adapted by the authors according to Ministry of Science and Education (2022b)

Discussion

Future expectations regarding the digitalisation of the higher education system

The pandemic additionally highlighted and accelerated the implementation of IT in the educational system all over the world. In these circumstances, "over the night" online teaching from an option has become a real necessity. But this learning and teaching model has also brought new challenges for students and professors. Education in an online environment requires new skills, knowledge, the organisation of lectures, student knowledge assessment, etc. Furthermore, institutions, faculties, high schools and universities had to invest in the new digital platform, IT equipment, technical support, seminars, and webinars for students and professors to be better prepared for new learning and teaching.

The period ahead will be marked by further digitisation of business activities. The digitalisation of „all and everywhere" requires adjustments in the way of thinking and doing things. Online teaching will become a regular part of the education system. Benefits from online teaching can especially be seen in long-life learning and teaching for part-time students. But despite all the benefits, some challenges regarding online teaching are still present. This particularly refers to the assessment of students' knowledge. To avoid any undesirable elements in the process of knowledge assessments, it would be useful to apply the motto "teaching online, but knowledge assessment offline (or under strong, controlled conditions)".

We can be sure that teaching and learning during the pandemic will affect future educational processes. Survey results show that some benefits from online teaching/learning are expected to be followed in the post-pandemic period in combination with face-to-face delivery. For instance, a survey conducted in 2020 in New Zealand concluded that 83 % of respondents voted in favour of flipped classrooms with both online and face-to-face delivery (Erlam, 2021). Yamada and Nakamura (2021) also believe there is no going back after universities fully experience online teaching/learning.

Final remarks on research questions and the limitations of the study

Based on the previously presented arguments about the digitalisation level of higher education in Croatia, with special attention on economic disciplines, final remarks on the research questions are given.

RQ1 was formed as: „What was the digitalisation level of the higher education system in Croatia before the Covid-19 pandemic compared to other countries?"

The digitalisation level is considered through four parts: regulatory framework, the approach of digitalisation, agility of transition to online teaching and the existing number of courses and online study programs. Our study results indicate that although there is a recognised necessity for digitalisation in national and university strategies and law, there was still no unique digitalisation project in the higher education system. Besides, the lack of investments in this field didn't help digitalisation. The bottom-up approach of digitalisation of the higher education system was applied, which is less effective in the digitalisation process than other countries. Hence, numerous e-courses but only 16 online study programs were offered before the pandemic. Croatian institutions showed very high mobility regarding the agility of institutions to replace the traditional way of teaching with online teaching. However, they shared the same organisational problems as other universities worldwide.

RQ2 was: „What is the digitalisation level of economic and business disciplines compared to other higher education disciplines in Croatia?"

According to the official registers by the Ministry of Science and Education, our research results show that the number of e-courses in the economic field is underrepresented compared to other disciplines. Still, most online study programs are about business and the economy.

This study faces some limitations. Firstly, the research was carried out based on the available statistical data from the Ministry of Science and Education and SRCE. The main limitation is related to the number of e-courses since the Register depends on the promptitude of the institutions in submitting e-courses to the Register. According to the Ordinance, courses shall be open for one academic year. For each new academic year, it is necessary to open a new course, and the course is archived at the end of the academic year. Another limitation is the economic disciplines submitted in the Register as e-courses. We explored only the number of e-courses delivered by the faculties of economy and business. A certain number of e-courses in the economic field are given by other faculties as well. Finally, our research was also limited by the pandemic because all or the vast majority of courses were delivered online during the pandemic.

Conclusion

The teaching and learning process has been evolving from its start. The corona pandemic has pushed many higher education institutions towards fully online learning. Many pedagogues stress that teachers shouldn't teach in the same way they had been taught since time has changed. Teachers should adapt their skills to the age they are living as their students represent new generations. We live in the Information Age, so no education should be performed without proper information technology. Certain digitalisation levels should be applied as well. Today, education is also adjusted towards its environment in an online world.

The main goal of this research was to explore the digitalisation level of higher education in Croatia with special attention on economic disciplines. The survey was performed to evaluate the digitalisation level of higher education based on the regulatory framework, applied digitalisation approach, the agility of transition to online teaching and the existing number of courses and online study programs. Also, the overview of education digitalisation in different countries is compared with the Croatian experience. The research has shown that the overall regulatory framework for higher education in Croatia in the form of laws and related ordinances, national and university strategies, and institutional support exists. Hence, as some previous research results in some countries show, in Croatia, too, the bottom-up approach of digitalisation is used since there hasn't been any global joint project of digitalisation of all higher education institutions as it has been for primary and secondary schools.

Further, significant investments are expected to increase the digitalisation level. Croatian universities, polytechnics and other higher institutions have shown high agility in switching from F2F to online teaching since the Covid-19 pandemic started. Our study has shown that many e-courses had been offered to students before the pandemic. Still, as in many other countries, complete online study programs were exceptions rather than the rule. Those online programs that were offered were mostly from the economic field. Private institutions are more involved, so a more proactive role is expected of public faculties in the economy and business. As infrastructure is a concern, e-learning platforms existed before the pandemic. It is worth mentioning that Croatia has two institutions with a supportive role in the digitalisation of education; CARNet and SRCE. However, necessary infrastructure seeks significant investments, which are expected to be provided in the future. Online learning increases

accessibility and affordability for many students, especially working professionals. The awareness of these and other benefits of online teaching will certainly change the way higher education professors teach. The Covid-19 pandemic has just started the fastening process of digitalisation. Now is the time to apply national and university strategies that involve e-courses and e-learning models, and government should ensure enough funds for that. So, our survey results could contribute managerial perspective in high education institutions regarding implementing new study programmes and introducing new e-courses.

Finally, we shouldn't forget that some distance learning existed in the past. The roots of distance or online learning, used nowadays, are from postal schooling and learning via radio or TV. So, today, these kinds of learning have been switched to online learning. It is expected to be adaptive in the future in other possible ways of transferring information and sharing and exchanging knowledge.

Considering our research limitations regarding the availability of official public data, we propose that some future research strives towards the data provided by the faculties and other higher institutions that deliver studies in the field of economic discipline. Also, the digitalisation level could be investigated more deeply, providing some empirical surveys on the topic, which will include the opinion of teachers and students.

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References

1. ASHE (2020), "Održan webinar o akreditaciji i izvođenju online studija u Hrvatskoj", available at https://www.azvo.hr/hr/azvo-vijesti/2480-odrzan-webinar-o-akreditaciji-i-izvodenju-online-studija-u-hrvatskoj (20 Dezember 2021)
2. ASHE (2022), "Higher education system", available at https://www.azvo.hr/en/higher-education/higher-education-system (20 December 2021)
3. Beblavý, M., Baiocco, S., Kilhoffer, Z., Akgüç, M., Jacquot, M. (2019), "Index of Readiness for Digital Lifelong Learning. Changing how Europeans upgrade their skills", Centre for European Policy Studies in Partnership with Grow with Google.
4. Bond, M., Bedenlier, S., Marin, V. I., Handel, M. (2021), "Emergency remote teaching in high education: mapping the first global online semester", International Journal of Educational Technology in Higher Education,Vol. 18, No. 50, pp. 1-24.
5. Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., Zawacki-Richter, O. (2018), "Digital transformation in German higher education: student and teacher perceptions and usage of digital media", International Journal of Educational Technology in Higher Education, Vol. 15, pp. 1-20.
6. Brink, H., Packmohr, S., Vogelsang, K. (2020), "The digitalisation of universities from a students' perspective", in 6th International Conference on Higher Education Advances (HEAd'20), Universitat Politecnica de Valencia, Valencia.
7. CARNET (2019), "E-škole; razvoj sustava digitalno zrelih škola (II. Faza)", CARNET.
8. CARNET (2022), "Carnet Loomen", available at https://www.carnet.hr/usluga/loomen/ (10 January 2022)
9. Ciurea, M. (2020), „Digitalization in the Romanian Higher Education in the Present Digital Era, 2nd International Scientific and Practical Conference", in Modern Management Trends and the Digital Economy: from Regional Development to Global Economic Growth" (MTDE

2020), Advances in Economics, Business and Management Research, Vol. 138, Atlantis press SARL.
10. Croatian National development strategy (2021), National Gazzete, 13/2021.
11. DESI (2021), "Digital Economic and Society Index Report - Human Capital", available at https://digital-strategy.ec.europa.eu/en/policies/desi-human-capital (15 January 2022)
12. Dukić, D., Mađarić, S., (2012), "Online učenje u hrvatskom visokom obrazovanju", Tehnički glasnik, Vol. 6, No. 1, pp. 69-72.
13. ECLAC-UNESCO (2020), "COVID-19 Report. Education in the time of COVID-19", available at https://repositorio.cepal.org/bitstream/handle/11362/45905/1/S2000509_en.pdf (20 January 2022)
14. ENQA (2018), "Opće smjernice za osiguravanje kvalitete e-učenja", available at https://www.azvo.hr/images/stories/publikacije/Considerations_for_QA_of_E-learning_provision_ENQA_2018.pdf (20 January 2022)
15. Erlam, G. D., Garrett, N., Gasteiger, N., Lau, K., Hoare, K., Agarwal, S., Haxell, A. (2021), "What Really Matters: Experiences of Emergency Remote Teaching in University Teaching and Learning During the COVID-19 Pandemic", Frontiers in Education, Vol. 6, pp. 1-14.
16. European Commision (2020), "Digital Education Action Plan 2021-2027. Resetting education and training for the digital age", available at https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en (15 January 2022)
17. European Commission (2021a), "Digital Education Action Plan (2021-2027)", available at https://education.ec.europa.eu/focus-topics/digital/education-action-plan (25 January 2021)
18. European Commission, (2021b), „Digital Economy and Society Index (DESI) 2021 Croatia", available at https://www.mac-team.eu/index.php/files/174/Digital-Economy-and-Society-Index-DESI-2021/1028/DESI-2021---HR---eng.pdf (20 January 2022)
19. European Council (2020), "Council conclusions on digital education in Europe's knowledge societies", Official Journal of the European Union C 415/22.
20. EY Parthenon (2020), "University strategy in a digital world, Can digital approaches help improve student outcomes?", available at https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/strategy/pdf/ey-university-strategy-in-a-digital-world.pdf?download (20 January 2022)
21. Gandhi, P., Khanna, S., Ramaswamy, S., (2016), "Which Industries Are the Most Digital (and Why)?. Web based Technology", available at https://hbr.org/2016/04/a-chart-that-shows-which-industries-are-the-most-digital-and-why (20 January 2022)
22. Gartner (2022), "Gartner's Glossary", available at https://www.gartner.com/en/glossary (20 January 2022)
23. Gilch, H., Beise, A. S., Krempkow, R., Müller, M., Stratmann, F., Wannemacher, K. (2019), „Digitalisierung der Hochschulen—Ergebnisse einer Schwerpunktstudie für die Expertenkommission Forschung und Innovation", Hanover, HIS-Institut für Hochschulentwicklung.
24. Government of the Republic of Croatia (2021), "National recovery and resilience plan 2021-2026", available at https://mpgi.gov.hr/eu-co-financing/national-recovery-and-resilience-plan-initiative-building-reconstruction/14307 (20 January 2022)
25. Harvard Business Publishing Education (2020), "Online Learning Report", Covid-19 Pulse Survey.
26. Hodges, C., Moore, S., Lockee, B., Trust, T., Bond, A., (2020), "The Difference Between Emergency Remote Teaching and Online Learning", available at https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning (12 January 2022)
27. HZJZ (2022), "Coronavirus – recommendations", available at https://www.hzjz.hr/sluzba-epidemiologija-zarazne-bolesti/koronavirus-najnovije-preporuke (31 January 2022)
28. Johnson, N., Veletsianos, G., Seaman, J. (2020), "U.S. faculty and administrators' experiences and approaches in the early weeks of the COVID-19 pandemic", Online Learning, Vol. 24, No. 2, pp. 6-21.

29. Koroleva, E., Kuratova, A. (2020), "Higher Education and Digitalization of the Economy: The Case of Russian Regions", International Journal of Technology, Vol. 11, No. 6, pp. 1181-1190.
30. Marinoni, G., Land, H., Jensen, T. (2020), "The impact of Covid-19 on higher education around the world", International Association of Universities.
31. Ministry of Science and Education (2022a), "Information System of Science of the Republic of Croatia", available at https://www.croris.hr/upisnici/?lang=en (1 February 2022)
32. Ministry of Science and Education (2022b), "Register of study programmes. Official register of study programmes accredited in the Republic of Croatia", available at https://hko.srce.hr/usp/index (30 January 2022)
33. Müller, M., Varga, M. (2020), "Digital Competences of Teachers and Associates at Higher Educational Institutions in the Republic Of Croatia", Informatologia, Vol. 53, No. 1-2, pp. 8-23.
34. National Gazette (2017), "Law on Scientific Activity and Higher Education".
35. NCVO (2016), "Criteria and procedures for evaluating online studies", available at https://www.nvzvotr.hr/images/documents/Kriteriji%C2%A0i%20postupci%20za%20vrednovanje%20online%20studija.pdf (13 December 2021)
36. Redecker, C., Punie, Y. (Eds.) (2017), "European Framework for the Digital Competence of Educators: DigCompEdu", EUR 28775 EN, Publications Office of the European Union, Luxembourg.
37. Rodríguez-Abitia, G., Bribiesca-Correa, G. (2021), "Assessing Digital Transformation in Universities", Future Internet, Vol. 13, No. 52, pp. 1-16.
38. Siddiquei, M. I., Kathpal, S. (2021), "Challenges of online teaching during Covid-19: An exploratory factor analysis", Human Beaviour & Emerging Technology, Vol. 3, No. 5, pp. 811-822.
39. SRCE, Ministry of Science and Education (2022), "Catalogue of the e-courses in the higher education in Croatia", available at https://katalog-e-kolegija.srce.hr/izvjestaji?report=studiji (4 January 2022)
40. SRCE (2019), "Pravilnik o organizaciji i koristenju kataloga e.kolegija ustanova u sustavu visokog obrazovanja RH", available at https://www.srce.unizg.hr/centar-za-e-ucenje/katalog-e-kolegija-ustanova-u-vo (17 Dezember 2021)
41. SRCE (2020), "More than 20,000 e-courses on the e-learning platform Merlin", available at https://www.srce.unizg.hr/en/news/more-20000-e-courses-e-learning-platform-merlin/publ2020-03-17 (14 December 2021)
42. SRCE (2022), "University of Zagreb University Computing Centre (SRCE)", available at https://www.srce.unizg.hr/en/about-srce (17 January 2022)
43. Tømte, C. E., Fossland, T., Aamodt, P. O., Degn, L. (2019), "Digitalisation in higher education: mapping institutional approaches for teaching and learning", Quality in Higher Education, Vol. 25, No. 1, pp. 98-114.
44. UNESCO (2022), "COVID-19 Education Response", available at https://en.unesco.org/covid19/educationresponse/globalcoalition (19 January 2022)
45. UNIRI (2011), "E-learning development strategy on the University of Rijeka", available at http://rektor.uniri.hr/files/staticki_dio/propisi_i_dokumenti/Strategija_e-ucenje_2011-2015.pdf (19 January 2022)
46. UNISA (2021), "A brief history of UNISA", available at https://www.unisa.ac.za/sites/corporate/default/Unisa-History-and-Memory-Project/Themes/All-themes/A-brief-history-of-Unisa (25 January 2021)
47. University of London (2021), "History of University of London", available at https://london.ac.uk/about-us/history-university-london (25 January 2021)
48. UNIZG (2007), "E-learning strategy", available at http://www.unizg.hr/fileadmin/rektorat/Studiji_studiranje/Studiji/e-ucenje/e-ucenje_strategija/University_of_Zagreb-E-learning_strategy.pdf (25 January 2021)
49. UNIZG (2009), "Decision on university teaching forms according to the level of IT application and e-learning", available at http://www.unizg.hr/fileadmin/rektorat/Studiji_studiranje/Studiji/e-ucenje/UNIZG_oblici_svnastave_razine_e_ucenja_20091222s.pdf (25 January 2021)

50. Vivitsou, M. (2019), "Digitalisation in Education, Allusions and References", Center for Educational Policy Studies Journal, Vol. 9, No. 3, pp. 117-136.
51. Yamada, K., Nakamura, K. (2021), „Leveraging the Covid-19 crisis to advance global sustainable universities: re-creation of valuable higher education", Council of Europe.
52. Zawacki-Richter, O. (2020), "The current state and impact of Covid-19 on digital higher education in Germany", Human Behaviour & Emerging Technology, Vol. 3, No. 1, pp. 218-226.

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Pros and Cons of e-Learning in Economics and Business in Central and Eastern Europe: Cross-country Empirical Investigation

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Abstract

Background: The ongoing information and technological revolution, as well as the Covid-19 pandemic, accelerated the use of e-learning worldwide. **Objectives:** This article aims to present the results of our empirical research among students of economics and business from Central and Eastern Europe on the advantages and disadvantages of e-learning. **Methods/Approach:** The article uses a survey, and the research sample included 1647 respondents (students of economics and business) from universities in three countries: Croatia, Poland, and Serbia. We used the multivariate comparative analysis (factor analysis and principal components analysis) by applying Statistica computer software. **Results:** The assessment of individual forms of e-learning in the three countries is similar. In e-learning, investigated students appreciated, first of all, the time-saving. At the same time, it is difficult to concentrate and harder to develop the interpersonal skills needed to work in a real environment. **Conclusions:** E-learning seems to be a vital instrument complementing traditional learning, as the respondents declared. However, it should not replace traditional face-to-face education; it should only support it.

Keywords: e-learning; distance learning; factor analysis; Croatia, Poland, Serbia

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Introduction

E-learning is understood as digital or online education and interactive or digitally assisted learning (Lara et al., 2020). It has been known as a tool to support the traditional educational process for years. Alongside traditional face-to-face education, distance learning was the earliest to emerge, especially in countries with large spatial areas and low population densities (e.g. Australia, USA). Initially, correspondence courses (printed materials sent by post) were the main media used. Much later, audio and video recordings were introduced (tapes, video cassettes sent by post). Radio broadcasts (the first in 1948 by the University of Lousiville) and television broadcasts (the first in 1950 by New York University) became popular. And finally, very recently, we have new forms of e-learning (e.g. e-learning platforms such as Blackboard or Moodle, video meetings such as Zoom, MS Teams, Google Meet or ClickMeeting, and finally even massive open online courses MOOCs), while the current civilisation challenges such as technology and the industrial revolution (Rymarczyk, 2020), the millennials generation, the Covid-19 pandemic results in new social phenomena in higher education such as the internationalisation of universities (Sułkowski et al., 2020) or the use of social media and digital marketing by universities (Mazurek et al., 2018).

The education level influences economic growth, economic convergence processes, and a society's overall level of wealth (Głodowska, 2017) and is particularly important in the case of women (Głodowska, 2018). The modern industrial revolution is a natural process that has progressed due to the technological advances in social and economic systems so far (Maciejewski et al., 2020). The effects of the fourth industrial revolution are visible in the area of education, which in turn is particularly important for the mentioned social and economic systems. New technological solutions and devices, usually associated with the Internet, have modernised and improved the education (learning-teaching) process (Tarabasz et al., 2018). The Covid-19 pandemic accelerated this process. E-learning has played a special role here as the primary form of education during the pandemic. However, this is associated with fear, student anxiety, and some psychological problems for young people (Loan et al., 202; Zeqiri et al., 2022). However, e-learning has long been the focus of many researchers before the ongoing pandemic (Samir et al., 2014; Bartosik-Purgat et al., 2018; Pejic Bach et al., 2018).

With the dynamic development and use of information and communication technologies (ICT), especially the Internet, distance education began to be equated with e-learning (online distance learning). Along with the development of sharing economy, open educational resources (OER) are gaining popularity, and their dynamic development relates to the development of open-source software (OSS) and the popularisation of open content (OC), as well as the development of dedicated software for e-learning. Open educational resources (OER) are a term created by UNESCO in 2002, which is a common name for any educational resource that is openly accessible through free licensing or transfer to the public domain and made available through any information and communication technology (Wach, 2018).

The literature identifies many advantages of using e-learning at the university level of education. The saving of time and effort in travelling to university is identified as the most important (Ms et al., 2013). In the era of increasing globalisation and internationalisation, it also provides the opportunity to attend courses regardless of the geographical location of the e-learning course provider. The student becomes a self-directed learner and learns simultaneously and asynchronously at any time. Lecturers notice similar observations in terms of time-saving. However, preparing an e-learning

course requires much effort and gathering rich authoring content. On the other hand, it reduces costs connected with the organisation of classes in a traditional form. Moreover, easy access to a wide range of materials and studies contributing to the deepening of knowledge and relying on emotions are advantages (Bigos et al., 2020).

As mentioned above, e-learning favours active learning-teaching processes and manifests creativity and innovation. Entrepreneurial pedagogy has been successfully adopted in Anglo-Saxon literature; in practice, it is commonly used because entrepreneurial pedagogy deals with teaching methods that foster the formation of an entrepreneurial attitude. It is the opposite of traditional (classical) teaching, as it promotes active teaching methods, which have been dominant in pedagogy for several decades, especially in general education and specific teaching methodologies (Tasnim et al., 2013). Davies and Gibb (1991) stress that using traditional teaching methods to shape entrepreneurial competencies, awareness, and attitudes is insufficient, and hence an entrepreneurial approach to the teaching-learning process is proposed. Powell (2013) emphasises that activating (entrepreneurial) teaching methods, compared to traditional pedagogy, are not structured and are based on spontaneous teaching-learning.

The main disadvantage of using e-learning, according to the various research results, is the limitation of personal interaction between the line student–teacher and among the students themselves (Somayeh et al., 2016).

The level of sophistication of e-learning courses is also worth noting. Digital tools provide unlimited instrumental possibilities: interactive quizzes, videos, apps, and videotapes. Undoubtedly, it influences the attractiveness of made-available content and, thus, the attractiveness of learning itself. However, it is also the source of a visible discrepancy between providers who can organise such an attractive course and those who are not due to technological and information limitations. Against this background, crucial differences between developed and developing countries become visible, as pointed out by Aung and Khaing (2015) and Lizcano et al. (2020). A new perspective on e-learning arose because of the imposed obligation to use this platform as the only form of education during the Covid-19 pandemic. This period has shown that the e-learning form of education is quite widespread in universities. However, prior research results point out that the perception of e-learning differs between its participants and one of the reasons is simply cultural differences (Ms et al., 2013).

According to Maatuk et al. (2021), remote learning and the ability to deliver e-learning courses have contributed to the uptake of learning by people who would not have undertaken a degree course due to logistical constraints. On the other hand, Harandi (2015) signals a problem with low motivation for e-learning. The lack of face-to-face interaction causes the approach to learning to weaken, and self-discipline is crucial in this regard. On the other hand, Selim (2007) argues that the effectiveness of the use of e-learning is determined by the characteristics of the instructor/course organiser, then IT infrastructure and the university support for the e-learning process, as well as the characteristics of the e-learning course users – the students.

Creating and using e-learning courses determines having access to adequate computer tools and developing skills and abilities to create digital content and use it in learning and continuous learning and development (lifelong learning) due to the dynamics of changes in the digital environment. At the same time, teachers, lecturers, students, and pupils, as stakeholders in the development of e-learning, can identify the advantages and disadvantages of using e-learning in the teaching process.

The present research is a cross-country investigation to deepen the knowledge about the strengths and weaknesses of e-learning and potential opportunities and

threats resulting from this form of education. This article aims to present the results of empirical research among students of economics and business from Croatia, Poland, and Serbia on the advantages and disadvantages of e-learning. Moreover, the article aims to map the perception of e-learning in communication, interactivity, content, effectiveness, and sustainable responsibility.

The article results from an online survey among students from Croatia, Poland, and Serbia on using e-learning in the educational process. The survey was conducted at the end of 2021. More than 1500 respondents' answers became the subject of analysis using the tools of multivariate comparative analysis (factor analysis and principal components analysis). Calculations were performed using Statistica 13.3 software.

Methodology

Data on university students in economics and business was collected in November and December 2021 at the universities involved in teaching economics and business in three countries: Poland, Croatia, and Serbia (the Cracow University of Economics, University of Zagreb, and University of Belgrade). Non-probabilistic sampling methods were combined to reach a relevant number of students. Firstly, we used a snowball effect based on the social networks of university teachers in the following majors: trade and international business, accounting and finance, and tourism. Teachers were asked to share questionnaires with students in their study groups and to explain the aim of the study to their students. Secondly, as the study aimed to observe university students' attitudes, we used the convenience sampling method to reach bachelor's and master's level students in various fields of economics and business.

On the other hand, all teachers were asked to motivate, but not force by any means, their students to fill in questionnaires. Therefore, we can tell that the voluntary participation of students in the sample is another major characteristic of our sample. Targeting as many respondents as possible, we collected more than 1500 valid questionnaires from university students in Croatia, Poland, and Serbia, majoring in various fields of economics and business. Such a large number of collected questionnaires – such considerable data enabled us to reduce a potential research bias when concluding the attitudes of economics and business students regarding e-learning in all three participating countries. The brief structure of the sample is shown in Table 1.

Table 1
The structure of the research sample

Characteristic	Modalities	#	%
Level/year of study	Bachelor level – 1st year	411	25%
	Bachelor level – 2nd year	450	27%
	Bachelor level – 3rd year	425	26%
	Master-level – all years	361	22%
	Total	**1647**	**100%**
Country	Poland	696	42%
	Croatia	656	40%
	Serbia	295	18%
	Total	**1647**	**100%**

Source: Authors' work.

As the research instrument, an online questionnaire was used. The questionnaire comprised many questions regarding tools used in e-learning, e-learning environment,

e-learning as a support to traditional teaching practices, benefits and obstacles of e-learning, e-learning in the Covid-19 pandemic, future potentials of e-learning, etc. For this paper, we will describe only the part of the questionnaire relevant to the results of this particular study. Out of the complex questionnaire, for this study, we are going to analyse three groups of questions:

1. One Likert scale question on perceived various e-learning forms impact the education process.
2. Set of 39 Likert scale statements regarding e-learning aspects: communication, interaction, motivation; learning efficiency and costs; contents and teaching materials; sustainability, ethics, and social responsibility.
3. One question with one choice regarding opinions on the future of e-learning.

The statements regarding areas and issues of e-learning for Likert scale questions were based on and adapted from the following sources:

- e-learning environment; benefits and advantages of e-learning (Babic, 2012; Pozgaj et al., 2007; Nikolopoulou et al., 2021; Smedley, 2010)
- e-learning level of motivation and contribution of e-learning to achieving learning goals (Pozgaj et al., 2007; Elsalem et al., 2021)
- drawbacks, disadvantages, and obstacles of e-learning (Valantinaite et al., 2020; Babic, 2012; Pozgaj et al., 2007)
- ethical, environmental, health, and other sustainability and social responsibility issues in e-learning (Elsalem et al., 2021; Di Giacomo et al., 2021; Agarwal et al., 2021; Almseidein et al., 2020).

The question regarding the future of e-learning was based on Pozgaj et al. (2007) and Elsalem et al. (2021).

We applied the multivariate analysis tools to analyse the survey research: factor analysis with the principal components model (Kinnunen et al., 2021; Bednasz et al., 2022). The calculations were performed in Statistica 13.3. The main idea of factor analysis boils down to the following steps (Malina, 2006): 1) combining variables into a factor, 2) principal components analysis, 3) extracting principal components, 4) generalising the cases of variables into a more considerable number of variables, 5) orthogonal factors, 5) evaluation of the effects of the application of the principal analysis components. The advantage of this method is the definition of the primary variables underlying the statements given by the respondents and the identification of the structure of their ideas. Moreover, we can create a particular area of perception of reality under this study.

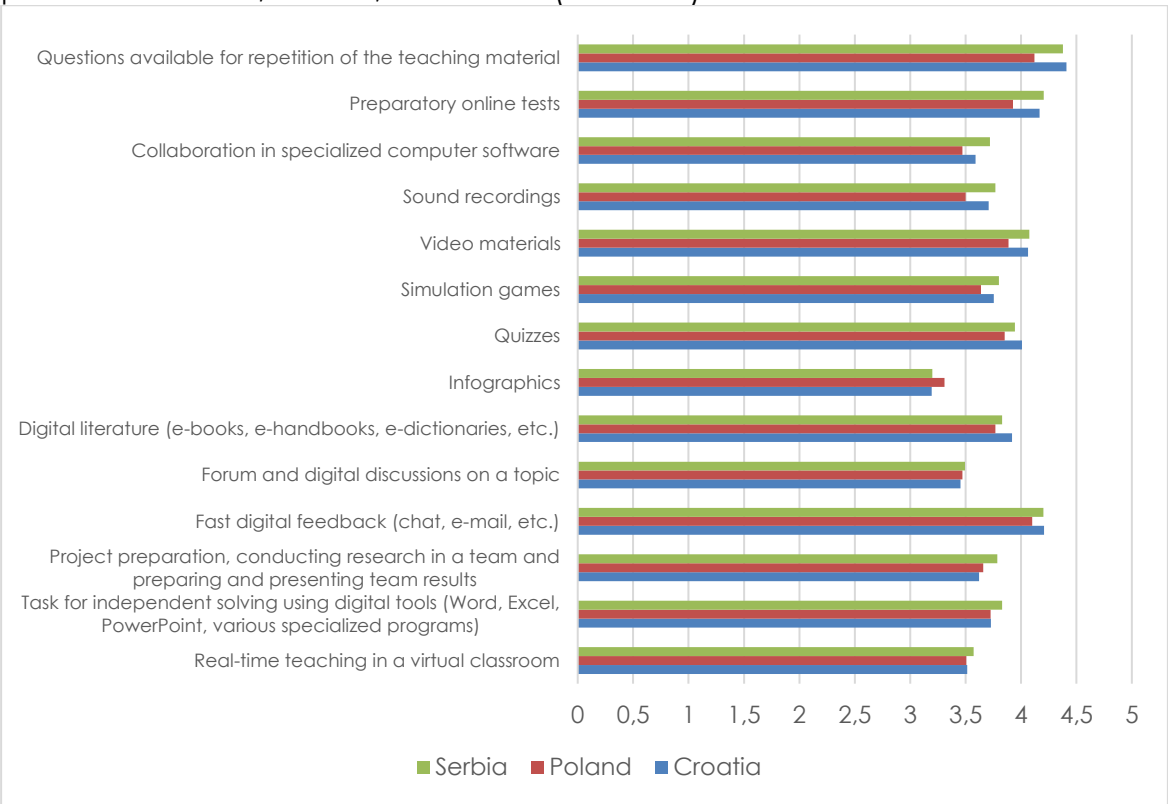
Results

The presentation of the research results consists of four stages. First, we present the evaluation results of various forms of e-learning and their impact on improving learning outcomes. It was done by referring to the direct statements of the respondents. In the second and third steps, we identify the most important factors determining the evaluation of e-learning by students from Croatia, Poland, and Serbia through multivariate analysis. Then, we assess the advantages and disadvantages of using e-learning in the analysed areas. In the last step, we present the results concerning the students' perception of e-learning in the future.

E-learning plays a vital role in the education process of students from Croatia, Poland, and Serbia. The survey results included a broad spectrum of forms of e-learning and their impact on improving the effects of education. Individual forms were

assessed on a five-point scale, indicating the strength of their effect on the learning process. Figure 1 illustrates the average values of evaluating forms of e-learning broken down into university students in economics and business from three surveyed countries: Croatia, Poland, and Serbia.

Figure 1
Average impact assessment of e-learning on improving the outcome of the teaching process in Croatia, Poland, and Serbia (scale 1-5)



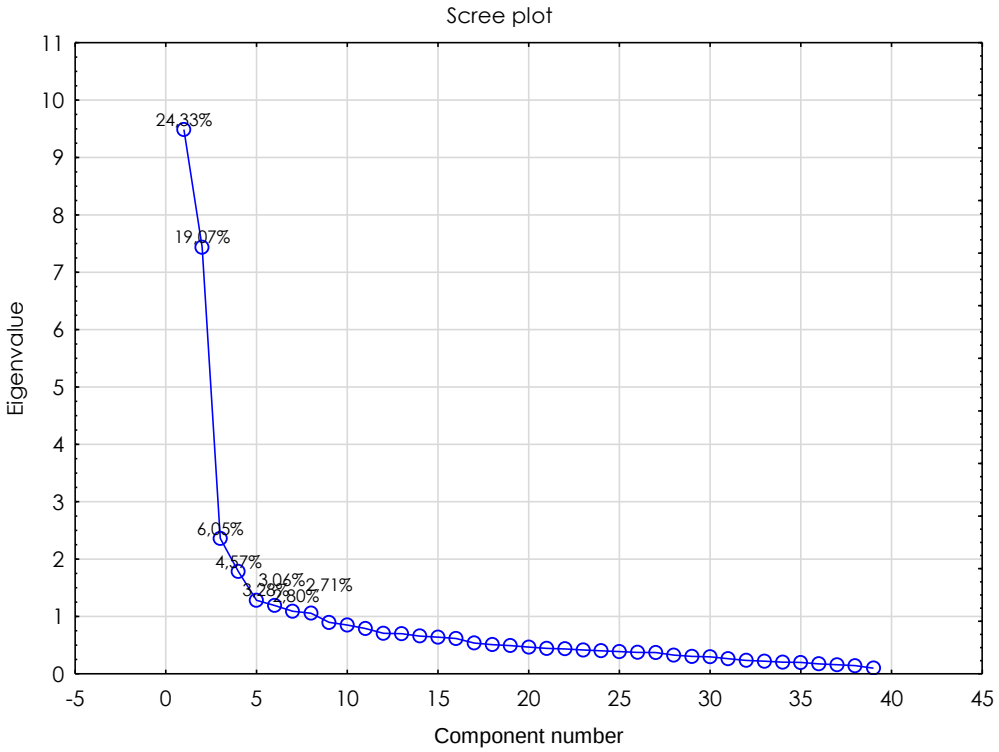
*1- insignificant impact, 2- low impact, 3 - moderate impact, 4 - major impact, 5 – extremely strong (severe) impact
Source: Authors' work.

The assessment of individual forms of e-learning in the three countries is similar. In general, the average marks are high. Only in one area the average mark slightly exceeds the value of 3, which means the moderate influence of e-learning on learning effectiveness. The other ratings are much higher. Students rate the highest scores for the possibility of permanent access to didactic materials, which allows for repeating the content, tests, etc. Online quizzes are also positively assessed, especially by students from Croatia and Serbia. Then the students highly appreciate the pace of interaction via chat and e-mail. However, on the other hand, they evaluate lower participation in online thematic discussions. Students believe that infographics or real-time teaching in a virtual classroom have a moderate impact on the effectiveness of e-learning. The evaluation of Polish students is lower than those of students from Croatia and Serbia.

In the next part of the survey, students referred to statements about e-learning, which were grouped into the following categories: 1) communication, interaction, and motivation; 2) learning efficiency and costs; 3) contents and teaching materials; 4) Sustainability, ethics, and social responsibility. These four groups contained thirty-

nine statements with which the respondents identified themselves according to a five-point scale. The average answers of the respondents indicate that they agree with the statements made at least to a moderate extent. They identify the least with the idea that e-learning motivates students to interact with each other. Most of all, with the statement that distance e-learning saves time (no need to travel). However, the assessment of individual variables (statements) is quite tricky. It is difficult to identify the differences and the most critical factors determining the perception of e-learning by students. Therefore, a multivariate analysis was used: factor analysis and principal component analysis. It allows for finding the connections between particular statements and, by reducing the variables (statements), identifying the factors characterising the perception of e-learning by students while maintaining the informational value of all analysed variables. A factor is a new variable that is not directly observable but is derived from primary variables (statements). These factors concisely reflect a significant part of the information in the data set, and at the same time, each carries a new essential content. They can also be seen as identifiers grouping the output variables into groups that are consistent in terms of the content. The choice of the number of factors retained for further analysis was made through the interpretation of the scree plot (Figure 2) and the own study of Variance (Eigenvalue – Kaiser criterion), treating each variable (statement) as an individual factor (Table 2).

Figure 2
Scree plot



Source: Authors' work.

Table 2
The eigenvalue for 39 factors (statements) and Variance

Factor	Eigenvalue	% of Variance	Cumulative Eigenvalue	Cumulative % Var.
1	**9.1611**	**23.4899**	**9.1611**	**23.4899**
2	**7.4144**	**19.0114**	**16..5755**	**42.5013**
3	**2.6293**	**6.7419**	**19.2048**	**49.2432**
4	**1.5397**	**3.9480**	**20.7446**	**53.1912**
5	**1.1587**	**2.9710**	**21.9033**	**56.1623**
6	**1.0843**	**2.7802**	**22.9876**	**58.9424**
7	0.9167	2.3506	23.9043	61.2930
8	0.8911	2.2848	24.7954	63.5778
9	0.7989	2.0485	25.5943	65.6263
10	0.7898	2.0251	26.3840	67.6514
11	0.7084	1.8165	27.0925	69.4679
12	0.6891	1.7669	27.7815	71.2347
13	0.6638	1.7022	28.4454	72.9369
14	0.6345	1.6268	29.0799	74.5637
15	0.6138	1.5738	29.6936	76.1375
16	0.5899	1.5127	30.2836	77.6502
17	0.5465	1.4013	30.8301	79.0515
18	0.5346	1.3707	31.3647	80.4222
19	0.5062	1.2979	31.8708	81.7201
20	0.4784	1.2268	32.3493	82.9469
21	0.4738	1.2148	32.8231	84.1617
22	0.4617	1.1839	33.2848	85.3456
23	0.4602	1.1801	33.7450	86.5257
24	0.4462	1.1440	34.1912	87.6697
25	0.4245	1.0885	34.6157	88.7582
26	0.4037	1.0350	35.0194	89.7933
27	0.3946	1.0118	35.4140	90.8051
28	0.3794	0.9729	35.7934	91.7780
29	0.3531	0.9055	36.1465	92.6834
30	0.3493	0.8957	36.4959	93.5792
31	0.3301	0.8464	36.8260	94.4256
32	0.3264	0.8370	37.1524	95.2626
33	0.3064	0.7855	37.4588	96.0481
34	0.3046	0.7809	37.7633	96.8291
35	0.2775	0.7115	38.0408	97.5406
36	0.2719	0.6972	38.3128	98.2378
37	0.2678	0.6867	38.5806	98.9246
38	0.2398	0.6150	38.8204	99.5395
39	0.1796	0.4605	39.0000	100.0000

Source: Authors' work.

For the analysed area, the Variance of all variables (statements) is 39 (as many as there are variables), while the first factor with a value of 9.1611 explains more than 23% of the total Variance. The scree plot in Figure 2 starts at the eigenvalue of the sixth factor, suggesting six factors for further analysis. It is also confirmed by the Kaiser criterion (Table 2), which requires choosing those factors whose eigenvalue is greater than 1. The first six factors, with a cumulative eigenvalue of 22.9876, explain more than 58% of the total Variance. These six factors can describe more than half of the information in the thirty-nine questions. Finally, we selected six factors explaining the perception of e-learning by students from Croatia, Poland, and Serbia for further analysis.

To recognise the structure of the answers given by the respondents and to determine the variables (statements) underlying the opinions presented, i.e., the search for constructs, we analysed the correlation between the initial variables (39 statements) and the new six factors (Table 3). The factor axes (Varimax) rotation was

used to obtain a simple structure of factor loadings, which facilitates the interpretation of factors. Table 3 shows the results of the correlation between the variables (statements) and factors. Only those variables whose value of the correlation coefficient exceeded 0.7 were selected. Finally, we present only four factors because a sufficiently high correlation between the variables and factors was not observed in the other two factors.

Table 3
Correlation between variables (statements) and factors (with rotation)

Variable	Cost Factor	Productivity Factor	Activating Factor	Fun Factor
E-learning significantly reduces the costs of the educational process in the long term (travel, accommodation, etc.	0.753			
E-learning saves time (no need to travel)	0.752			
E-learning is more environmentally friendly than traditional teaching	0.714			
It is easier to lose concentration during e-learning compared with traditional learning		0.747		
E-learning extends the time required to master the material		0.701		
In e-learning, less practical experience is gained because no experiments and mentoring work with the teacher are carried out		0.765		
In e-learning, the communication skills needed to work in a real environment are insufficiently developed		0.743		
In e-learning, control, external evaluation, accreditation, and quality assurance of education have not been developed as in traditional education systems		0.754		
E-learning improves communication and activity in the classroom because it reduces the fear and shame of public speaking			0.739	
E-learning motivates students to interact with each other			0.822	
E-learning enhances my engagement and creativity			0.832	
E-learning further boosts my motivation to work			0.837	
Multimedia materials (audio and video materials, games, etc.) that can be used in e-learning make the learning process more fun				0.763

Source: Authors' work.

Based on the content of the selected variables, the following factors were named:

- **Cost factor:** Relates to both financial costs and social costs. The respondents considered this to be the essential factor in assessing e-learning. Almost a quarter of the information value provided by the respondents is included in this factor. In e-learning, they appreciated the time saving and the elimination of

certain transaction costs that occur in the traditional education process. In addition, respondents stated that environmental and ecological aspects are also important. E-learning, therefore, reduces social costs and promotes social responsibility.

- **Productivity Factor:** Relates to the effectiveness of the education through e-learning and the learning outcomes, including commitment and self-discipline. In this area, respondents see a somewhat negative impact of e-learning on the learning process. In e-learning, it is difficult to concentrate and harder to develop the interpersonal skills needed to work in a real environment. Moreover, respondents indicated that more time is required to absorb content and materials. In the context of the first factor, it can be said that e-learning saves time on mobility but, on the other hand, extends the learning time itself. The productivity of learning through e-learning was also lowered by a lack of control over the quality of learning and participation in practical experiments.
- **Activating Factor:** Refers to student engagement, motivation, and creativity. E-learning has a positive effect on the indicated spheres. The respondents indicate many benefits resulting from education in the form of e-learning. It is easy for shy people who have problems with public speaking. Moreover, it encourages interactions, motivates to work, and stimulates creativity.
- **Fun factor:** Relates to the perceived pleasure of learning. This factor is described by one variable and explains only 3% of the information value of the total set of statements. It is less important but identified as an independent factor. The respondents emphasise that multimedia materials included in e-learning courses positively affect the enjoyment and joy of learning.

To identify the advantages and disadvantages of e-learning and build a kind of map of e-learning perception by respondents, the factor and main components analysis were conducted separately for each analysed area included in the questionnaire. The same methods were used (scree plot, analysis of eigenvalues).

Table 4 presents the variables correlated with individual factors in each study area separately, along with the eigenvalue and % variance.

Two factors were selected in each area of perception. In general, the distribution of factors was such that one factor determined the advantages and the other disadvantages of e-learning. The exception is the area of contents and teaching materials, where respondents see only advantages. Based on the analysis of Variance, it can be assessed which factor is of greater importance and, thus, how the respondents relativise the advantages and disadvantages of e-learning. Respondents see more advantages than disadvantages in the area of communication, interaction, and motivation. Factor 1 explains almost half of all the information in this area's statements. In turn, they assess learning efficiency and costs more negatively, which is consistent with Table 2 (productivity factor). Only positives are noticed when it comes to the contents and e-learning materials.

In contrast, in the area of sustainability, ethics, and social responsibility, respondents believe that e-learning is more harmful. It leads to the polarisation of participants, harms health and physical conditions, and increases the risk of violating intellectual property rights. As advantages, the respondents indicate the inclusive nature of e-learning (e.g., for people with disabilities) and the positive impact on ecology and the environment.

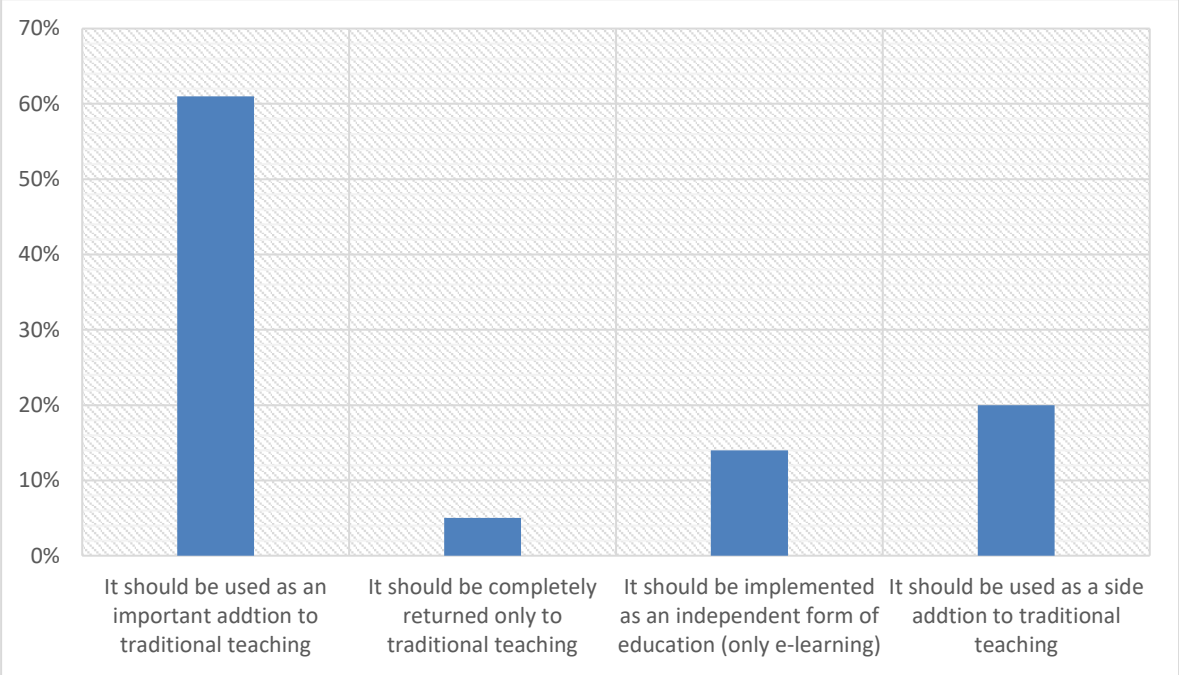
Table 4
Description of factors in the selected area of students' perception

Area of perception	FACTOR 1	FACTOR 2
Communication, interaction, motivation	It reduces the fear and shame of public speaking; It motivates students to interact with each other; It enhances my engagement and creativity; It boosts motivation to work	It lacks fast two-way face-to-face communication; It lacks social interaction between people; It is not as motivating as traditional learning
Eigenvalue	3.1290	1.8929
% of Variance	44.7002	27.0412
Area of perception	**FACTOR 1**	**FACTOR 2**
Learning efficiency and costs	There is no clear line between free time and work/study time; It is easier to lose concentration; It extends the time required for mastering the material; Less practical experience is gained (no experiments and mentoring); The communication skills needed to work in a real environment are insufficiently developed; It lacks control, external evaluation, etc.	It achieves a better balance of private and school/university obligations; It allows greater individualisation of the pace of learning which reduces stress; It reduces the costs of the educational process; It saves time; It enables the transfer of knowledge to a larger number of pupils/students
Eigenvalue	4.7323	3.3644
% of Variance	33.8021	24.0315
Area of perception	**FACTOR 1**	**FACTOR 2**
Contents and teaching materials	IT enables access to, and connection of a larger amount of content of different formats that expand knowledge, skills, and competencies; Greater learning flexibility is achieved; Materials can be viewed, listened to, or read multiple times	Multimedia materials (audio and video materials, games, etc.) that can be used in e-learning make the learning process more fun
Eigenvalue	3.0857	1.1128
% of Variance	44.0818	15.8965
Area of perception	**FACTOR 1**	**FACTOR 2**
Sustainability, ethics, and social responsibility	There is a greater occurrence of plagiarism and violation of intellectual property rights; It is less accessible to students of lower socioeconomic status; It leads to excessive use of digital technology, which negatively affects health; It negatively affects physical activity; It is difficult to check who is on the other side	It raises the level of involvement of special groups of pupils/students; It raises the level of involvement of students with disabilities; It is more environmentally friendly than traditional teaching
Eigenvalue	3.7669	2.4935
% of Variance	34.2442	22.6685

Source: Authors' work.

When asked about the future of e-learning, respondents expect it will be a vital instrument complementing traditional learning (having a complementary nature). However, they do not want the education process to be entirely replaced by digital forms (not having a substitutive nature). Therefore, they perceive e-learning as a complementary tool and not a substitute for traditional learning and teaching, which means – in other words – students opt for blended learning as a mix of both approaches (Figure 3).

Figure 3
Opinions of respondents on the future of e-learning



Source: Authors' work.

Discussion

While some previous studies investigated only some aspects of e-learning, starting from positive impacts and drivers of e-learning (Pozgaj et al., 2007; Elsalem et al., 2021; Nikolopoulou et al., 2021), gave some particular insights into obstacles and/or social responsibility issues in the e-learning environment (Valantinaite et al., 2020; Di Giacomo et al., 2021; Agarwal et al., 2021), or merely discussed theoretical frameworks and factors which influence e-learning in general (Babic, 2012; Smedley, 2010), this study brings new insights into comprehensive perceptions of university students at economic disciplines showing that students in this field, as explained before, see numerous benefits of e-learning and that advantages in many areas exceed disadvantages. The survey results confirm the importance of e-learning for students from Croatia, Poland, and Serbia. The multidimensional analysis allowed us to identify the factors describing the perception of e-learning by the surveyed students and to indicate the advantages and disadvantages. According to the respondents, the positive aspects of e-learning are more critical, and they also identify a considerable number of positive impacts on the education process.

Our finding on blended learning corresponds to prior empirical results of Pozgaj et al. (2007), where 14.53% of students claimed that only e-learning should be used for education, while 76.07% of students claimed that e-learning should be used as a supplement to traditional learning. Therefore, we can conclude that the blended

learning model, where e-learning is used as valuable support, is a preferred model for future education in economics and business.

Conclusion

Currently, we have been experiencing, as one can assume, one of the greatest reorganisations of the entire educational system, especially of teaching methods and didactic means. Contemporary civilisation challenges are completely changing the face of modern education. E-learning (online learning) and m-learning (mobile learning), or at least the combination of traditional teaching with online learning (blended learning), are gaining more and more popularity, especially among millennials. Interactive teaching using entrepreneurial didactic methods, including strategic games, becomes indispensable. Modern economy and contemporary social changes require permanent changes not only in the curricula and organisation of teaching but also in the forms of teaching.

Based on the empirical research results, we can conclude that the assessment of individual forms of e-learning in the three countries is similar. In e-learning, investigated students appreciated the time saving and the elimination of certain transaction costs that occur in the traditional education process. In addition, respondents stated that environmental and ecological aspects are also important. In e-learning, it is difficult to concentrate and harder to develop the interpersonal skills needed to work in a real environment. As the respondents declared, E-learning seems to be a vital instrument complementing traditional learning. However, it should not replace traditional face-to-face education but support it.

Our research is not free of its limitations. First, the sampling does not represent all three countries, and we cannot make generalisations. Secondly, this study does not include the internal context of e-learning experiences (how e-learning was organised in each investigated university), which might have impacted the perception of surveyed students.

Contemporary academic education requires searching for more and more new forms of knowledge transmission and communication between the lecturer and students (Wach, 2018), but also focusing on shaping entrepreneurial attitudes (Maciejewski, 2018; Wach & Bilan, 2021) or specific skills needed in the labour market. E-learning is a great tool for transferring knowledge and acquiring new skills. This type of solution suits the expectations of present-day students, mainly from the millennial generation or younger, for whom the digital world is a natural working environment. E-learning can also be used as an excellent supplement to traditional education (blended learning), especially in the lifelong learning process postulated by the European Union (Hajdukiewicz, 2018), seeing it as a desirable innovation in the academic world (Farrow, 2018), or a tool for shaping entrepreneurial attitudes among young people (Wach et al., 2019; Nowiński et al., 2020). Present-day education and e-learning require transforming and promoting green entrepreneurship and climate protection (Alvarez-Risci et al., 2021). New e-learning platforms require increasingly innovative solutions based on the latest advances in engineering science (Smatkov et al., 2019; Chang et al., 2022), including the biometric solutions already in use for verifying the person taking the final exam.

Further empirical studies should focus more on the digital transformation of modern education and higher educational institutions. It would also be interesting to investigate the efficiency of e-learning by comparing it to traditional learning based on two control groups (face-to-face group vs e-learning group).

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References

1. Agarwal, A., Sharma, S., Kumar, V., Kaur, M. (2021), "Effect of E-learning on public health and environment during COVID-19 lockdown", Big Data Mining and Analytics, Vol. 4, No. 2, pp. 104-115.
2. Almseidein, T. A., Mahasneh, O. M. K. (2020), "Awareness of ethical issues when using an e-learning system", International Journal of Advanced Computer Science and Applications, Vol. 11, No. 1, pp. 128-131.
3. Alvarez-Risco, A., Mlodzianowska, S., Zamora-Ramos, U., Del-Aguila-Arcentales, S. (2021), "Green entrepreneurship intention in university students: The case of Peru", Entrepreneurial Business and Economics Review, Vol. 9, No. 4, pp. 85-100.
4. Aung, T. N., Khaing, S. S. (2016), "Challenges of Implementing e-Learning in Developing Countries: A Review", in: Zin, T., Lin, J. W., Pan, J. S., Tin, P., Yokota, M. (Eds.), Genetic and Evolutionary Computing. GEC 2015. Advances in Intelligent Systems and Computing, Vol. 388, Springer, Cham, pp. 405-412.
5. Babic, S. (2012), "Factors that influence academic teacher's adoption of E-learning technology in Blended Learning Environment", in Guelfi, A., Pontes, E., Kofuji, S. (Eds.), E-Learning: Organisational Infrastructure and Tools for Specific Areas, InTech, Rijeka, pp. 3-18.
6. Bartosik-Purgat, M., Ratajczak-Mrozek, M. (2018), "Big Data Analysis as a Source of Companies' Competitive Advantage: A Review", Entrepreneurial Business and Economics Review, Vol. 6, No. 4, pp. 197-215.
7. Bednarz, J., Bartosik-Purgat, M., Jastrzębski, T., Cirella, G. T. (2022), "Young consumer perception towards family firms: Relationship building and gender", Entrepreneurial Business and Economics Review, Vol. 10, No. 1, pp. 161-174.
8. Bigos, K., Michalik, A. (2020), "Do Emotional Competencies Influence Students' Entrepreneurial Intentions?", Sustainability, Vol. 12, No. 2, pp. 1-18.
9. Chang, Y. C., Li, J. W., Huang, D. Y. (2022), "A Personalized Learning Service Compatible with Moodle Learning Management System", Applied Sciences, Vol. 12, No. 7, pp. 1-16.
10. Davies, L. G., Gibb, A. A. (1991), "Recent research in entrepreneurship", in Proceedings of the 3rd International EIASM Workshop, Gower, London.
11. Di Giacomo, D., Martelli, A., Guerra, F., Cielo, F., Ranieri, J. (2021), "Mediator effect of affinity for e-learning on mental health: Buffering strategy for the resilience of university students", International Journal of Environmental Research and Public Health, Vol. 18, No. 13, pp. 1-12.
12. Elsalem, L., Al-Azzam, N., Jum'ah, A. A., Obeidat, N. (2021), "Remote E-exams during Covid-19 pandemic: A cross-sectional study of students' preferences and academic dishonesty in faculties of medical sciences", Annals of Medicine and Surgery, Vol. 62, No. February, pp. 326-333.
13. Farrow, R. (2018), "MOOC and the workplace: key support elements in digital lifelong learning", International Entrepreneurship Review, Vol. 4, No. 3, pp. 139-150.
14. Głodowska, A. (2017), "Level of Education and Economic Growth in the Member States of the European Union: A Comparative Analysis", Horyzonty Wychowania, Vol. 16, No. 37, pp. 105-118.
15. Głodowska, A. (2018). "Gender Differences in Educational Attainment: The Evidence from the European Union Countries", Horyzonty Wychowania, Vol. 17, No. 43, pp. 221-230.
16. Hajdukiewicz, A. (2018), "Lifelong learning jako warunek ramowy innowacyjności gospodarek państw Unii Europejskiej w świetle metodologii European Innovation Scoreboard", Horyzonty Wychowania, Vol. 17, No. 43, pp. 187-196.

17. Harandi, S. R. (2015), "Effects of e-learning on Students' Motivation", Procedia - Social and Behavioral Sciences, Vol. 18, No. May, pp. 423-430.
18. Kinnunen, J., Georgescu, I., Hosseini, Z., Androniceanu, A.-M. (2021), "Dynamic indexing and clustering of government strategies to mitigate Covid-19", Entrepreneurial Business and Economics Review, Vol. 9, No. 2, pp. 7-20.
19. Lara, J. A., Aljawarneh, S. Pamplona, S. (2020), „Special issue on the current trends in E-learning Assessment (Guest Editorial)", Journal of Computing in Higher Education, Vol. 32, pp. 1-8.
20. Lizcano, D., Lara, J. A., White, B., Aljawarneh, S. (2020), "Blockchain-based approach to create a model of trust in open and ubiquitous higher education", Journal of Computing in Higher Education, Vol. 32, pp. 109-134.
21. Loan, L., Doanh, D., Thang, H., Viet Nga, N., Van, P., Hoa, P. (2021), "Entrepreneurial behaviour: The effects of the fear and anxiety of Covid-19 and business opportunity recognition", Entrepreneurial Business and Economics Review, Vol. 9, No. 3, pp. 7-23.
22. Maatuk, A. M., Elberkawi, E. K., Aljawarneh, S., Rashaideh, H., Alharbi, H. (2021), "The COVID-19 pandemic and E-learning: challenges and opportunities from the perspective of students and instructors", Journal of computing in higher education, Vol. 34, pp. 1-18.
23. Maciejewski, M. (2018), "Postawy i działania przedsiębiorcze w Polsce i na świecie w świetle oceny kształcenia biznesowego", Horyzonty Wychowania, Vol. 17, No. 43, pp. 209-220.
24. Maciejewski, M., Głodowska, A. (2020)," Economic development versus the growing importance of the financial sector: Global insight", International Entrepreneurship Review, Vol. 6, No. 3, pp. 77-90.
25. Malina, A. (2006), "The Factor Analysis as Method of Classification Regions in Poland", Przegląd Statystyczny, Vol. 51, No. 3, pp. 33-48.
26. Mazurek, G., Korzyński, P., Górska, A. (2018), "Social Media in the Marketing of Higher Education Institutions in Poland: Preliminary Empirical Studies", Entrepreneurial Business and Economics Review, Vol. 7, No. 1, pp. 117-133.
27. Ms, P., Toro, U. (2013), "A review of literature on knowledge management using ICT", Higher Education, Vol. 4, No. 1, pp. 62-67.
28. Nikolopoulou, K., Gialamas, V., Lavidas, K., Komis, V. (2021), " Teachers' Readiness to Adopt Mobile Learning in Classrooms: A Study in Greece", Technology, Knowledge and Learning, Vol. 26, pp. 53-77.
29. Nowiński, W., Haddoud, M., Wach, K., Schaefer, R. (2020), "Perceived public support and entrepreneurship attitudes: A little reciprocity can go a long way!", Journal of Vocational Behavior, Vol. 121.
30. Pejic Bach, M., Milološa, I., Zoroja, J. (2018, May), "Internet use for online learning among youth: Differences across European countries and educational levels", In 2018 41st International Convention on Information and Communication Technology, Electronics and Microelectronics (MIPRO) (pp. 0540-0545). IEEE.
31. Powell, B. C. (2013), "Dilemmas in Entrepreneurship Pedagogy", Journal of Entrepreneurship Education, Vol. 16, No. 1, pp. 99-112.
32. Pozgaj, Z., Knezevic, B. (2007), "E-Learning: Survey on Students' Opinion", in Luzar-Stiffler, V., Hljuz Dobric, V. (Eds.), Proceedings of the ITI 2007 29th International Conference on Information Technology Interfaces, SRCE University Computing Centre, University of Zagreb, Zagreb, pp. 381-386.
33. Rymarczyk, J. (2020), "Technologies, Opportunities and Challenges of the Industrial Revolution 4.0: Theoretical Considerations", Entrepreneurial Business and Economics Review, Vol. 8, No. 1, pp. 185-198.
34. Samir, M., El-Seoud A., Taj-Eddin, I. A. T. F., Seddiek N., El-Khouly M. M., Nosseir A. (2014), "E-learning and Students' Motivation: A Research Study on the Effect of E-learning on Higher Education", International Journal of Emerging Technologies in Learning, Vol. 9, No. 4, pp. 20-26.
35. Selim, H. M. (2007), "E-learning critical success factors: An exploratory investigation of student perceptions", International Journal of Technology Marketing, Vol. 2, No. 2, pp. 157-182.

36. Smatkov, S., Kuchuk, N., Sieja, M. (2019), "The method of centralised distribution of electronic educational resources in academic e-learning", Technical Transactions, Vol. 13, pp. 119-128.
37. Smedley, J. K. (2010), "Modelling the impact of knowledge management using technology", OR Insight, Vol. 23, No. 4, pp. 233-250.
38. Somayeh, M., Dehghani, M., Mozaffari, F., Ghasemnegad, S. M., Hakimi, H., Samaneh, B. (2016), "The effectiveness of E-learning in learning: A review of the literature", Journal of Medical Research & Health Sciences, Vol. 5, No. 2, pp. 86-91.
39. Sułkowski, Ł., Patora-Wysocka, Z. (2020), "International entrepreneurship of universities: Process-oriented and capabilities perspectives", Entrepreneurial Business and Economics Review, Vol. 8, No. 3, pp. 175-188.
40. Tarabasz, A., Selaković, M., Abraham, C. (2018), "The Classroom of the Future: Disrupting the Concept of Contemporary Business Education", Entrepreneurial Business and Economics Review, Vol. 6, No. 4, pp. 231-245.
41. Tasnim, R., Yahya, S. (2013), "Playing Entrepreneurship: Can Games Make a Difference?", Entrepreneurial Practice Review, Vol. 2, No. 4, pp. 4-16.
42. Valantinaite, I., Sedereviciute-Paciauskiene, Z. (2020), "The Change in Students' Attitude towards Favourable and Unfavourable Factors of Online Learning Environments", Sustainability, Vol. 12, No. 19, pp. 1-14.
43. Wach, K. (2018), "MOOCs jako otwarte zasoby edukacyjne wspierające edukację dla przedsiębiorczości", Horyzonty Wychowania, Vol. 17, No. 44, pp. 209-218.
44. Wach, K., Bilan, S. (2021), "Public support and administration barriers towards entrepreneurial intentions of students in Poland", Administratie si Management Public, Vol. 36, No. 1, pp. 67-80.
45. Wach, K., Głodowska, A. (2019), "The Role of University in the Development of Entrepreneurial Intentions of Younger Generations: Selected Models", in Pietrzykowski, M. (Ed.), Fostering Entrepreneurial and Sales Competencies in Higher Education, Bogucki Wydawnictwo Naukowe, Poznan, pp. 45-63.
46. Zeqiri, J., Kareva, V., Alija, S., Pejic Bach, M. (2022), "Challenges and opportunities for higher education in North Macedonia during the COVID-19 pandemics: a survey of student satisfaction and gender-related anxiety", International Journal of Technology Enhanced Learning, Vol. 14, No. 2, pp. 163-179.

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e-Learning in Higher Institutions and Secondary Schools during Covid-19: Crisis Solving and Future Perspectives

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Abstract

Background: The pandemic of Covid-19 brought significant changes to the education system and forcibly accelerated the process of digitizing teaching. Students and educators had to adapt to the new way of education, facing challenges such as technical problems and a lack of technical skills and social contact. **Objectives:** The purpose of the paper was to explore the attitudes of the university and high school educators and students towards the pandemic's impact on digitization in teaching. **Methods/Approach:** Data were collected through a questionnaire distributed to university and high school educators and students in Croatia, Poland, Serbia and Germany in the field of accounting, finance, trade, tourism, and other areas of interest, resulting in 2,897 responses. The results were analyzed using descriptive statistics and non-parametric tests. **Results:** The research showed that: 1) high school students were less optimistic about the positive impact of the pandemic on applying digital tools in teaching than university students, 2) educators generally prefer traditional exams, while students generally prefer e-exams, 3) a higher proportion of university respondents believe that e-learning should be used as an important addition to traditional teaching when compared to high school respondents. **Conclusions:** The pandemic has changed how the teaching process will be performed, but we should learn from experience and address the issues with e-learning.

Keywords: e-learning, digital tools, Covid-19 pandemic, e-exams, university, high school
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Introduction

E-learning, i.e., online learning using digital technologies in teaching, existed before the pandemic. Still, with the pandemic's arrival in the short term, the entire education system had to move from classrooms to online mode to prevent the spread of viruses among the population. Most students and educators did not encounter an online way of teaching until the pandemic, so the transition to online learning has caused several challenges. Educators had to adapt teaching materials and how knowledge was transferred to the new conditions in no to a short period to meet the learning outcomes. In addition, they had to get acquainted with and adapt to online platforms that most of them hadn't used before. Students also had to adapt to the new conditions while being isolated from their colleagues, which affected their social life. At the same time, they were to adapt to new teaching methods through online platforms. Besides the teaching process, exams during online classes are also a special challenge. It is more difficult to control student activities during the assessment of their knowledge when students are remote, given that there is an increased possibility of cheating on exams and technical disruption.

This paper aims to analyze online learning or e-learning during the pandemic, what challenges students and educators faced, and how online learning will develop in the future. Also, through the questionnaire distributed to university and high school educators and students in Croatia, Poland, Serbia and Germany, students' and educators' attitudes about the use of digital tools during the pandemic, e-exams during the pandemic, and the future of e-learning were examined.

It is expected that there is a difference in how respondents view e-learning, depending on their level of education, i.e., whether they work at or attend high school or university. The expectation is that e-learning requires more self-discipline from students and digital competencies, especially distance. Therefore, e-learning might be more appropriate for students at higher levels of education. In line with these expectations, we compared respondents across institutions and formed research propositions as follows:

- *RP1: University students value the positive impact of digital tools in teaching during the pandemic higher than high school students.*
- *RP2: University respondents put greater emphasis on e-learning as an important addition to traditional teaching in the future than high school respondents.*

Regarding e-exams, we expect more opinion differences between educators and students than between university and high school respondents. Students know only a portion of educators' efforts in preparing e-exams. In addition, some characteristics of e-exams (such as the possibility of cheating) might be viewed differently by educators and students, meaning that educators could view something as a disadvantage while students consider it an advantage. This resulted in the third research proposition:

- *RP3: Educators prefer traditional exams, while students prefer e-exams.*

The organization of the paper is as follows. Section 2 provides a literature review regarding perceptions of online learning during the pandemic, the extent of applying digital tools in teaching and the future of e-learning. Section 3 contains information about the primary research methodology, including the research sample, time frame, description of the questionnaire and methods used. Results of the research are presented in Section 4 and discussed in Section 5, while the concluding remarks are presented in Section 6.

Literature review

Perception of Online Learning During Pandemic

Digitalization has been a major case in public teaching before, but with the Covid-19 pandemic in the whole world, the process of digital transformation accelerated. It showed inequalities in the education system since some schools were better prepared than others. Since there aren't mandatory online education standards, digitalization variations exist among different schools (Andersson et al., 2021). During the pandemic, the picture of the digital divide became strong. There are differences in children's positions to engage in digitalized basic education, such as issues concerning the using technologies, with skills and competences needed to integrate digital tools in learning and teaching practices in a meaningful way. There is a difference in children's perception of new approaches during the pandemic; some benefited from the situation, and some suffered. Digital education transformation should be important to empowering children to successfully manage their digital future through basic education (Iivari et al., 2020; Zeqiri et al., 2022).

Given that there are differences in the equipment of individual schools and faculties in the education system and in the technical skills of educators and students, not all of them had the same approaches and opportunities in the transition to online teaching. As a result, there were certain problems and challenges during such a sudden transition to online teaching. The following is an overview of research conducted on students' perceptions of online teaching during the pandemic and their problems.

A survey conducted at a college in Northeastern North America showed a successful transition to online learning regarding academic outcomes and instructional standards. Results also show that students reported increased stress and anxiety and difficulties concentrating. Therefore, when planning and delivering online instructions, educators and educational specialists cannot ignore the social and affective dimensions (Lemay et al., 2021). Esteban Jr. and Cruz (2021) researched the digital divide among educator education institution students in Nueva Ecija, Philippines. Results indicated the digital divide as predicted by demographic factors: "residence, annual family income and parents' highest educational attainment" (Esteban Jr. and Cruz, 2021). Significant differences in internet access, mobile internet expenses, and the number of hours spent on the internet were also found. Analyzing the perspectives of Bhutanese students about online learning during the pandemic, research results indicated that the cost of the internet in Bhutan is too expensive, and about 70% of research participants don't have their laptops or smartphones to participate in online classes. Also, according to the research results, educators lack the knowledge and skills to manage online classes (Wangdi et al., 2021). Most PINE students from Estatal Peninsula de Santa Elena in Ecuador had never attended classes online before the pandemic. They mostly used their cell phones to connect to online classes. Only 5% never felt stressed, while 20% hardly ever felt stressed during online classes. Educators must also consider students' feelings (Carabajo Romero et al., 2021). The current pandemic scenario showed that when students were asked to use their webcam in interactive sessions, those from a lower socio-economic background were dissatisfied with others knowing their surroundings, which could affect their self-image and confidence (Varyani et al., 2020, pp. 107). The transition to online teaching and the situation itself caused stressful situations. That stress can result from more difficult adaptation due to a lack of technical skills and equipment, a difference in material and financial capabilities among students, and a lack of social interaction with colleagues and educators.

Through various research, the problem that is often mentioned is technical skills, problems with technology and the internet. According to research results in developing countries like Pakistan, online learning could not produce effective results. All the students faced the same problems, whether at the school or university level. Among the major challenges, there were a lack of internet facilities, a lack of proper interaction with students and instructors, and ineffective technology. They also indicated a lack of campus socialization, group learning problems and educator response time as a problem (Ullah et al., 2021). A study investigating challenges in online learning during the pandemic among English language learners at Taibah University in Saudi Arabia indicated problems such as difficulties in accessing the Blackboard platform as well as other technical issues (internet connectivity problems, accessing classes, downloading materials, inability to open online exams on mobile phones). Less than 50% of students are satisfied with online learning, and 43% don't fully support online education if it is not necessary, as in a crisis (Mahyoob, 2020, pp. 360). Polish medical students indicated that lack of interactions with patients and technical problems considering IT were the main disadvantages of it. They also address e-learning as less effective in increasing skills and social competencies than traditional face-to-face learning (Bączek et al., 2021). Analysis of problems faced in distance learning education during the pandemic according to the group of per-service educators studying at the faculty of education in Turkey indicated problems according to the five themes. The main problems in their themes were: lack of time spared for live courses regarding theme implementation, inability to communicate with friends, absence of internet, sound problems and lack of communication when the theme is about instructors (Özüdoğru, 2021). Ghanian students who participate in online learning at universities in China expect challenges of how to impart a sense of togetherness in a community during online learning, as well as high cost of internet data for students outside of China and slow connectivity for students in dormitories (Demuyakor, 2020, pp. 6). Lack of communication with colleagues and difficult communication with educators can be noticed as a common problem, in addition to the already mentioned problems with technical skills, equipment and the internet.

In research among Polish medical students, they indicated the ability to stay at home, continuous access to online materials, learning at their own pace and comfortable surroundings as the main advantages of online learning during the pandemic (Bączek et al., 2021). A comparative analysis between academic and high school students from Romania about their perception of the effectiveness of online education during the pandemic indicated that they react differently to online education. It depends on their expertise in online tools, ability to technically access online courses, and how educators conduct learning activities (Butnaru et al., 2021). According to the research results, the overall evaluation of e-learning experiences during the pandemic was positive for students at Hashemite University in Jordan. They mostly preferred Microsoft Teams as a platform. Problems they compound with e-learning are mostly related to technical issues (Obeidat et al., 2020). According to the survey results conducted among Ghanaian students who participated in online learning in different higher educational services in China, they perceived online learning as very useful and effective. They were satisfied with the learning resources available (Demuyakor, 2020). A survey among undergraduate students in an Indian University showed that during the pandemic, most students felt that learning is better in physical classrooms than online education. Undergraduate students in India think that educators have improved their online teaching skills since the pandemic's beginning and online education is useful now. Most of them think that adequate material study is available online and appreciate it (Chakraborty et al., 2021). During

the pandemic, a survey among educators and students in Morocco was conducted to assess distance learning in higher education. Results indicated that students and educators state that online learning isn't more interesting than the ordinary, and educators should do at least 50% of their teaching face-to-face. Results indicated limited experience with distance education among students and educators (Elfirdoussi et al., 2020). According to this, although the students pointed out the problems mentioned above, they also found positive aspects of the transition to online learning. However, some results suggest that students still prefer the traditional way of learning, face-to-face or a hybrid of traditional and online learning.

Taking exams posed a particular challenge during the pandemic. Given that students took exams from their homes, where they were not under the control of educators, it is more difficult to assess whether any unallowed actions took place during these exams. In addition, since exams require a time limit, technical difficulties during exams can cause stress to students and make it difficult for them to take exams. According to research in Morocco, 64,4% of educators think that conducting exams from a distance isn't feasible. In comparison, most students (81,45%) cannot take distance exams (Elfirdoussi et al., 2020). According to undergraduate students in India, when it comes to online assessments, 48% of them think that they can properly evaluate their knowledge, and 45,2% think that weekly tests facilitate studying. However, it must be stated that they also think online education is stressful and affects their social life and health (Chakraborty et al., 2021). Comparing the results from traditional onsite learning with the results of e-learning shows that there are higher grades during e-learning for most courses. It could be due to the extra time and effort spent on learning, but it could also be because of easier cheating at online exams (Mladenova et al., pp.1165-1166).

Digitalization in Teaching During Pandemic

During the pandemic, educators were thrown into new challenges since they had to use digital technologies to do their job in the best possible way and ensure learning outcomes. Many educators struggled to cope while using online platforms during the pandemic. Therefore, education systems should provide educators with training and support in using digital technologies, so they can adhere to pedagogical principles and best practices to successfully involve students in learning. There is a change in the social aspect of learning, so teachers should think about how to maintain connection, inclusion, awareness, reflection, and dialogue in an online environment to provide students with the same learning experience as in a traditional environment (Ben, 2020). The Covid pandemic required a change of the approach and delivery of learning and education, where educators are shifting their approach from transmitting knowledge to sharing data and guiding learners. When transitioning from on-ground to online education, the approach should be student-centered, with a clear understanding of the objectives and a plan to address each learning goal. Online education "will provide opportunities for synchronous and asynchronous interactions and require students to complete assignments and projects to demonstrate comprehension and mastery of the subject matter" (Camacho et al., 2021).

Educators faced many challenges during the pandemic. In addition to changing the way of teaching, exams, and adapting teaching materials, they also had to acquire new technological skills quickly to be successful in their work. Perifanou et al. (2021) surveyed Greek educators in primary and secondary schools who have just completed short training on using digital technologies. Research results indicate that they mostly use digital technologies to find, evaluate, and develop educational resources, such as teaching. They also used digital tools for self-study, student

assessment, and interacting and communicating with students. The use of digital tools was weak in the area of feedback, final evaluation of the students and revising the educational resources. There is also a shortcoming when using digital tools to support and advance school and education since most don't use or use a little in that area. Pozo et al. (2021) conducted a study among Spanish primary and secondary school educators about the uses of digital technologies during school lockdowns. Research results showed that educators used reproductive activities more than constructive ones, i.e., preferred educator-centred activities before student-centred ones. Also, those who stated previous use of ICT used it more and more constructive during a pandemic. In addition to the problem of rapid adaptation to the new way of transferring knowledge, educators had other problems. There were cases of educators being bullied by students or their parents on online platforms. Also, they faced the problems of students losing concentration, eating during class or sleeping (Varyani et al., 2020, pp. 107).

Based on their research results in Pakistan, Ullah et al. (2021) suggest that institutions and academic units provide and promote training for students regarding technologies that will be used in courses. Students will use commercially available tools such as Google Drive and Microsoft office, but they also will use institutionally specific ones. Lack of confidence and knowledge in using technology could be the point of failure for students. Therefore, institutions should identify the most critical need and provide and promote training opportunities.

Future of Online Education

E-learning refers to the use of information and communication technology to enhance and/or support learning, where e-learning could be divided into different types: web-supplemented, web-dependent, mixed mode and fully online (OECD, 2005). In all of them, the campus-based institution is offering the courses. E-learning is the next big thing in the education sector which is user-oriented, appropriate, and timely. Access to it is determined by factors such as availability of electricity, access to internet devices and high-speed internet (Varyani et al., 2020, pp. 102). The e-learning concept with Instructor Led Training (ILT) has advantages and disadvantages. The advantage of e-learning is that it can be nonstop accessible while ILT has scheduling conflicts and inconveniences. Another advantage is that e-learning can be cost-effective since course content can be easily modified once it is developed. At the same time, ILT is expensive since there are several costs like course development costs, good teaching professional salary, printing and paper, infrastructure, electricity, training material, travel and meal expenses and others. With e-learning, students can learn at their speed and skip unnecessary information, while with the ILT, all students are learning through all the same information at the same level as the rest of the class. Therefore, e-learning is often assessed as better, inexpensive and learner-friendly than ILT (Goyal, 2012, pp. 240).

Because of the paramount importance of knowledge, life-time learning, mobility and globalization, e-learning is gaining importance. However, having an e-learning strategy and programs is not enough to guarantee success. There should be a clear and well-thought-out implementation strategy and plan (Georgescu, 2006). Personal Learning Environment (PLE) recognizes that learning is continuing, and tools are needed to support that learning. PLE is a set of tools, many of which will be based on social software. In this concept, social software supports networks of people, content and services that can adapt and response to changes in needs and goals. It is not an application but a new approach to using new technologies for learning. PLE recognizes the role of the person in organizing their learning. Therefore this concept

provides learners with their own space where they have control and can develop and share their ideas (Attwell, 2007).

By Kadeniz (2009), flexible design for distance learning requires using different appropriate learning and teaching theories, strategies, media, technologies, interaction tools and others to enrich the learning environment. Changes today allow accessing information from everywhere and at every time; therefore, various learning environments should be blended to design the future of distance learning in which learners can decide where, how and when to learn. Since future learners are searching for flexibility in the learning process, developing, improving and expanding the technologies and pedagogical approaches is necessary to create that flexibility.

Previously in the paper, there were pointed problems with online education during the pandemic that need to be addressed in the future. Since the beginning of the pandemic, online teaching has gained relevance and will continue after the pandemic. Even though some barriers have been discovered during that process, schools and universities must be aware of them and overcome them. They should enable technical training and pay attention to digitalizing learning processes (Garcia-Morales et al., 2021). Since the measures are taken to slow down the pandemic forced remote teaching, Backes et al. (2021) stated that it allowed them to re-examine conventional teaching, test new digital and analogue concepts, and inspire curriculum-making in this century. Therefore, they indicated a need for a digital framework curriculum as a framework reflected in the respective cultures of technical subjects. It a) forms a matrix for subject-related transfer of teaching contents, methods and social forms into the change of leading media; b) takes into account referentiality, communality and algorithmic as characteristics of digital culture and c) gives orientation for educators and students. Technological producers should develop solutions that support the following: (a) technology should be cheap but work for a longer period with few updates; (b) e-learning products should be easy to use, and it should overcome language, cultural and age barriers and (c) technology should work on low data and internet speed (Varyani et al., 2020, pp. 109).

State and national governments impact the further progress of e-learning since they have a significant role in the strategic direction and funding of higher education in all OECD countries. In countries where institutions have greater autonomy, governments influence their behaviour by utilizing strategic funding or policy. In some counties, especially those that are emerging, the government needs to focus that there need for further development of infrastructure. The government should focus on developed countries' social, organizational, and legal aspects to further develop e-learning (OECD, 2005). The rise of e-learning presents new challenges for the government. They should find solutions and policies to regulate e-learning scenarios, control related crimes, and lead the education sector toward a sustainable approach to development (Varyani et al., 2020, pp. 109-110).

Online education demands adequate planning and designing instructions with available theories and models, but the pandemic caused migration, with online learning serving as an educational platform. This migration process to online education becomes questionable since it lacks proper planning, design and online instructional programs (Adedoyin et al., 2020). Although online education existed and evolved before, the pandemic accelerated the process. However, given that everything was going very fast, it was impossible to make the appropriate learning strategy that such a form requires. The pandemic pointed out all the shortcomings and problems. Thus, it allowed online learning to develop as successfully as possible because now it is known what to pay attention to. Given the aforementioned technical difficulties of students and educators, pieces of training should be held to make the whole process as

successful as possible. Certainly, reducing anxiety and dissatisfaction due to lack of socializing should be considered to solve this problem due to the increase in the scope of online learning compared to traditional face-to-face.

Methodology

Data were collected through primary research to achieve research goals and test the propositions presented in the introduction. It is comprehensive research designed and conducted by team members of the DIGI4Teach Erasmus+ project, focused on digital competencies, quality of e-learning, digital tools, mobile technology, and e-exams on a sample of high school teachers, university professors and their pupils/students in the field of accounting, finance, trade, tourism, and other interest areas. To explain the research results, the terms *teacher* and *student* (high school and university) are used in the paper. The questionnaire was distributed in Croatia, Serbia, Poland, and Germany via online platforms used for teaching. The responses for students were collected from November 2021 to January 2022, while the collection period for teachers was from December 2021 to January 2022. The the total number of responses collected is 2,897. University students dominate (1,679 responses), followed by high school students (795 responses), university professors (328 responses) and high school teachers (95 responses). University professors and high school teachers will be referred to in the text as educators.

The research instrument used in this paper is presented in Table 1. In addition to general information related to demographic characteristics, respondents were asked to answer questions divided into three segments according to the topic: 1) the impact of the Covid-19 the pandemic on digitization in teaching, 2) the e-exams, and 3) the future of e-learning. Questions depending on the group of respondents differ only in part related to e-exams, where educators were given 7 statements to assess and students 3 statements. When assessing their opinions regarding the the pandemic's impact and the advantages and disadvantages of e-exams, respondents were asked to mark from 1 to 5 the extent to which they agree with the provided statements. On the other hand, when answering how they see e-learning in the future, respondents had to choose the most appropriate statement between the 4 provided statements.

To explore the attitudes of educators and students towards e-learning in present the pandemic conditions and future post-pandemic conditions, we used a non-parametric test in the form of a Mann-Whitney test. Regarding questions answered on a Likert scale in the first and second part of the questionnaire, we first calculated measures of descriptive statistics. We used both means and medians of responses and compared them across different groups of respondents. Mann-Whitney test was first calculated/performed on individual items or statements and then on a summative or Likert scale. A summative scale is a the total score calculated for every respondent by adding values assigned to responses for each item or statement within the same question. Since different groups of respondents had different central tendency values, we tested the equality of medians (non-parametric test) between series. The test was performed in EViews.

The third part of the questionnaire was analyzed by calculating the proportions of respondents that selected each of the 4 suggested statements related to the future of e-learning. To test if there is a statistically significant difference between groups of respondents, we performed two proportion z-test.

Table 1
Research instrument

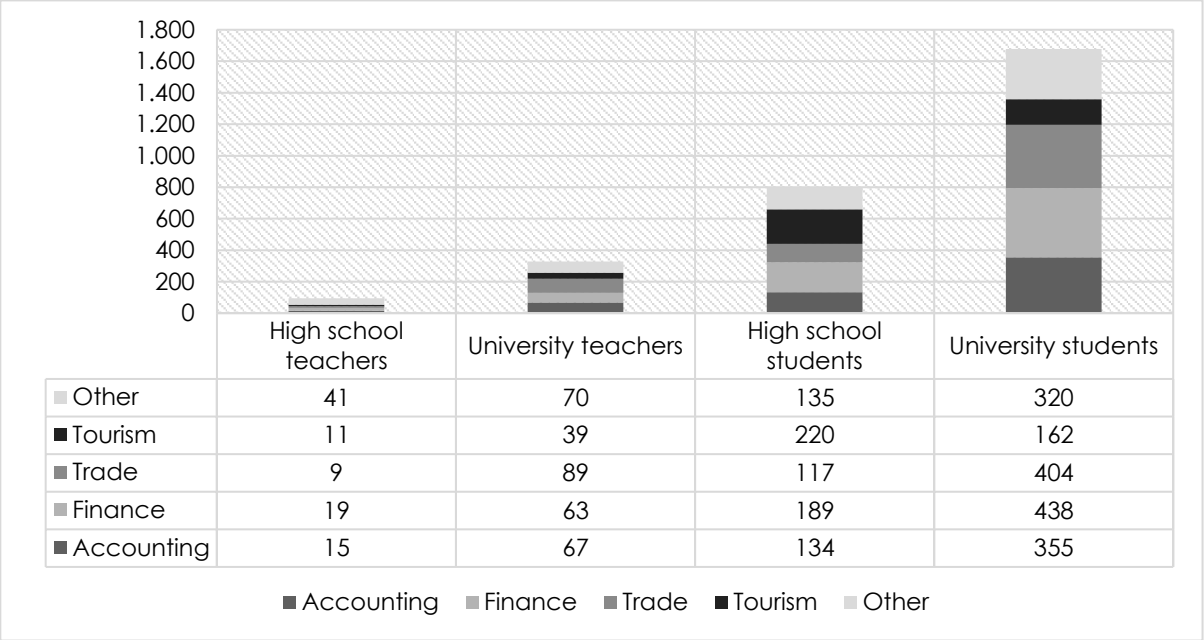
Part of the questionnaire	Group	Question	Type
General information	Educators	• Institution of employment • Main interest area • Years of teaching • Location of school/university (country & city)	Multiple choice questions Open-ended questions
	Students	• Attending institution • Main interest area • Current year of study • Location of school/university (country & city)	Multiple choice questions Open-ended questions
1st part - Impact of Covid-19 on Digitization in Teaching	Educators & Students	• 6 statements	Likert scale (1 - I completely disagree, 5 - I completely agree)
2nd part - E-exams	Educators	• 7 statements	Likert scale (1 - I completely disagree, 5 - I completely agree)
	Students	• 3 statements	Likert scale (1 - I completely disagree, 5 - I completely agree)
3rd part - Future of e-Learning	Educators & Students	• e-learning in the future	Multiple choice question (choice between 4 statements)

Source: Authors

Results

The structure of respondents according to different characteristics such as group, main field of interest, number of years teaching/studying, and location are presented in Figure 1 and Tables 2-4. Out of the total number of responses, 85% was collected from students, while the remaining 15% is related to educators. Despite the lower number of respondents in the group's *high school educators* (95) and *university educators* (328), samples are considered large for statistical tests. As seen in Figure 1, the largest group is interested in finance (24%), although there are certain variations when each group is considered separately.

Figure 1
Structure of Respondents According to Group and Main Field of Interest



Source: Authors

The distribution of respondents according to location is shown in Table 2. Most respondents work at or attend a university or school in Croatia (51%), primarily in Zagreb. Poland is the second most represented country (29%), with Cracow as the dominant location, followed by Serbia and Germany. All countries in Europe contribute to the comparability and unification of results. Since the goals of the paper are related to comparing attitudes of educators and students, for statistical analysis, respondents are divided into groups according to their status/occupation and not a geographical location.

Table 2
Structure of respondents according to the country where the attended school/university is located

Country	No. Educators	% Educators	No. Students	% Students	No. Total	% Total
Croatia	173	41%	1,298	52%	1,471	51%
Serbia	98	23%	432	17%	530	18%
Poland	137	32%	699	28%	836	29%
Germany	15	4%	45	2%	60	2%
Total	423	100%	2,474	100%	2,897	100%

Source: Authors

On average, university educators that participated in the research have more experience teaching than high school educators (Table 3). Most high school educators have up to 5 years of experience, while most university educators belong to the group with 16-25 years of teaching. However, the dispersion is high, which means that their experience varies and that all possible answers are represented in the sample. This is favourable for the correlation analysis, which was aimed to analyze to what extent experience in teaching is correlated with expressed opinions regarding e-learning. A similar conclusion applies to students in terms of their experience. Most of them are currently in their second or third year in high school or university (Table 4),

meaning they have both experiences studying in normal conditions and during the pandemic. Therefore, the respondents that participated in the research are eligible to make conclusions about the advantages, disadvantages, and prospects of e-learning. Their answers are analyzed in the following three subchapters.

Table 3
Number of years that educators participated in the research and have been teaching

	No. High School Educators	% High School Educators	No. University Educators	% University Educators	No. Total	% Total
Up to 5 Years	30	32%	36	11%	66	16%
6 – 15 Years	26	27%	108	33%	134	32%
16 – 25 Years	25	26%	119	36%	144	34%
Over 25 Years	14	15%	65	20%	79	19%
Total	95	100%	328	100%	423	100%

Source: Authors

Table 4
Current year of study for students that participated in the study

	No. High School Students	% High School Students	No. University Students	% University Students	No. Total	% Total
1	124	16%	411	24%	535	22%
2	182	23%	455	27%	637	26%
3	298	37%	449	27%	747	30%
4	186	23%	239	14%	425	17%
5	5	1%	125	7%	130	5%
Total	795	100%	1,679	100%	2,474	100%

Source: Authors

Impact of Covid-19 Pandemic on Digitization in Teaching

To assess the impact of the ongoing pandemic on e-learning and the application of digital tools in teaching, respondents were given 6 statements in Table 5.

Table 5
Codes used for statements and groups of respondents (first part of the questionnaire)

Statement / Group of Respondents	Code
The pandemic has positively impacted the application of more digital tools and materials in teaching.	DIGI-TOOLS
The pandemic pointed to the need to replace a certain part of traditional teaching with e-teaching.	E-TEACH
The pandemic has had a positive impact on increasing my digital competencies.	DIGI-COMPET-NEW
The pandemic has shown me how many more digital competencies I need to acquire and / or improve.	DIGI-COMPET-ACQ
The pandemic will significantly negatively affect the learning outcomes achieved during its duration.	NEG-LEARN
The pandemic will forever change the approach to learning and teaching.	CHANGE
High School Educators	HSCH-TEACH
University Educators	UNI-TEACH
High School Students	HSCH-ST
University Students	UNI-ST

Source: Authors

The statements are related to the extent digital tools were used in teaching, their advantages, and potential disadvantages in terms of negative impact on learning outcomes. Each statement was coded, as well as each group of respondents. Codes were used in the following tables when presenting research results.

Responses were first analyzed individually for each statement. The outcome of the descriptive statistics is presented in Tables 6-8. It should be noted that this question was formulated similarly for both educators and students, allowing a comparison of the responses between groups. Since the first 4 statements (Tables 6 and 7) are related to the positive impact of digital tools (on teaching, as well as on assessing and improving individual digital competences), mean and median values of responses across different groups of respondents, suggest that high school students are the most sceptical group. The median of their responses is 3 for the 3 out of 4 observed statements, meaning that generally, they have a neutral opinion regarding assessing if the impact was positive. For example, 51% of high school students completely disagree, mostly disagree or neither agree nor disagree that the pandemic has positively impacted the application of more digital tools and materials in teaching. However, most agree that the pandemic pointed to the need to replace a certain part of traditional teaching with e-teaching (51% mostly or completely agree).

Table 6
Descriptive statistics (first part of the questionnaire; individual items; statements DIGI-TOOLS and E-TEACH)

Measure	DIGI-TOOLS				E-TEACH			
	HSCH-ST	HSCH-TEACH	UNI-ST	UNI-TEACH	HSCH-ST	HSCH-TEACH	UNI-ST	UNI-TEACH
Mean	3.39	3.46	3.98	3.59	3.97	3.74	4.41	3.84
Median	3	4	4	4	4	4	5	4
Std. Dev.	1.45	1.36	1.00	1.17	1.12	1.18	0.80	1.09
Skew.	-0.36	-0.40	-0.66	-0.52	-0.95	-0.66	-1.38	-0.68
Kurtosis	1.80	1.97	2.89	2.63	3.13	2.59	4.83	2.59
P-Value	0.00	0.00	0.03	0.09	0.00	0.00	0.00	0.00
Obs.	795	795	95	95	1,679	1,679	328	328

Source: Authors

Table 7
Descriptive statistics (first part of the questionnaire; individual items; statements DIGI-COMPET-NEW and DIGI-COMPET-ACQ)

Measure	DIGI-COMPET-NEW				DIGI-COMPET-ACQ			
	HSCH-ST	HSCH-TEACH	UNI-ST	UNI-TEACH	HSCH-ST	HSCH-TEACH	UNI-ST	UNI-TEACH
Mean	3.34	3.86	3.60	4.05	3.40	3.91	3.69	3.88
Median	3	4	4	4	3	4	4	4
Std. Dev.	1.37	0.99	1.19	1.00	1.35	1.06	1.17	1.03
Skew.	-0.33	-0.60	-0.58	-1.04	-0.34	-0.72	-0.60	-0.87
Kurtosis	1.97	2.94	2.54	3.66	1.97	2.92	2.54	3.35
P-Value	0.00	0.06	0.00	0.00	0.00	0.02	0.00	0.00
Obs.	795	95	1,679	328	795	95	1,679	328

Source: Authors

On the other hand, university educators are the most optimistic and uniform group since their measures of central tendency are the highest, while the dispersion is the lowest. It is interesting to see that, even though educators value the positive impact of the pandemic on applying digital tools higher than students, they are, on average,

more concerned by the impact of the pandemic on achieving learning outcomes (statement NEG-LEARN in Table 8). Regardless of the differences in opinion regarding its positive and negative impacts, 60% of the total respondents agree (mostly or completely) that the pandemic will forever change the approach to learning and teaching.

Table 8
Descriptive statistics (first part of the questionnaire; individual items; statements NEG-LEARN and CHANGE)

Measure	NEG-LEARN				CHANGE			
	HSCH-ST	HSCH-TEACH	UNI-ST	UNI-TEACH	HSCH-ST	HSCH-TEACH	UNI-ST	UNI-TEACH
Mean	3.30	3.79	3.44	3.73	3.42	3.69	3.81	3.96
Median	3	4	3	4	3	4	4	4
Std. Dev.	1.38	1.24	1.24	1.08	1.35	1.24	1.10	1.01
Skew.	-0.22	-0.71	-0.30	-0.42	-0.34	-0.65	-0.69	-0.71
Kurtosis	1.84	2.50	2.10	2.28	1.97	2.48	2.79	2.85
P-Value	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.00
Obs.	795	95	1,679	328	795	95	1,679	328

Source: Authors

We used Mann-Whitney non-parametric test to examine if the measures of central tendency between groups of respondents differ enough for this difference to be statistically significant. The results are presented in Table 9.

Table 9
Test for equality of medians between series (first part of the questionnaire; individual items)

Statement	Group	Mann-Whitney U	P-value
DIGI-TOOLS	HSCH-ST VS UNI-ST	8.70	0.000***
	HSCH-TEACH VS UNI-TEACH	3.65	0.000***
	HSCH-ST VS HSCH-TEACH	3.33	0.001***
	UNI-ST VS UNI-TEACH	5.96	0.000***
E-TEACH	HSCH-ST VS UNI-ST	4.22	0.000***
	HSCH-TEACH VS UNI-TEACH	1.81	0.070*
	HSCH-ST VS HSCH-TEACH	0.61	0.539
	UNI-ST VS UNI-TEACH	1.12	0.262
DIGI-COMPET-NEW	HSCH-ST VS UNI-ST	4.08	0.000***
	HSCH-TEACH VS UNI-TEACH	1.83	0.067*
	HSCH-ST VS HSCH-TEACH	3.26	0.001***
	UNI-ST VS UNI-TEACH	6.17	0.000***
DIGI-COMPET-ACQ	HSCH-ST VS UNI-ST	4.48	0.000***
	HSCH-TEACH VS UNI-TEACH	0.19	0.849
	HSCH-ST VS HSCH-TEACH	3.25	0.001***
	UNI-ST VS UNI-TEACH	2.51	0.012**
NEG-LEARN	HSCH-ST VS UNI-ST	1.92	0.055*
	HSCH-TEACH VS UNI-TEACH	0.84	0.401
	HSCH-ST VS HSCH-TEACH	3.17	0.002***
	UNI-ST VS UNI-TEACH	3.62	0.000***
CHANGE	HSCH-ST VS UNI-ST	6.14	0.000***
	HSCH-TEACH VS UNI-TEACH	1.54	0.123
	HSCH-ST VS HSCH-TEACH	1.75	0.081*
	UNI-ST VS UNI-TEACH	1.98	0.048**

Note: *** statistically significant at 1%; ** 5%; * 10%
Source: Authors

If the probability is lower than 5%, it is concluded that the medians are not equal between observed groups. The test indicates that the median for the two groups of educators is equal, except for the statement DIGI-TOOLS, where the median for university educators is statistically significantly higher than for high school educators. When comparing two groups of students, there is a difference in opinion. Medians are higher for university students than high school students, which aligns with the previous conclusion that high school students are the most sceptical about the positive impact of digital tools.

The validity of conclusions drawn from analyzing individual items in the first part of the questionnaire was additionally tested by summing up the responses of each respondent. Statement NEG-LEARN was excluded when calculating the total score because it does not necessarily reflect the impact of digital tools on achieving learning outcomes. Achieving or not achieving learning outcomes during the pandemic might be affected by other reasons, such as students not attending classes, organizational issues, lack of communication, etc. The total score of the remaining 5 statements may be described as assessing the positive impact of applying more digital tools in teaching and learning during the pandemic. Measures of descriptive statistics (Table 10) again confirmed that high school students are less inclined to conclude that the pandemic has positively impacted applying digital tools and improving digital competencies since their mean and median is the lowest. University students are more optimistic than high school students and high school educators compared to high school students. The non-parametric test suggests that medians of the total scores between groups of respondents are statistically significantly different (Table 11).

Table 10
Descriptive statistics (first part of the questionnaire; summative scale; statements DIGI-TOOLS + E-TEACH + DIGI-COMPET-NEW + DIGI-COMPET-ACQ + CHANGE)

Measure	HSCH-ST	HSCH-TEACH	UNI-ST	UNI-TEACH
Mean	17.01	19.03	18.81	20.15
Median	18	19	19	21
Std. Dev.	5.74	4.12	4.42	3.75
Skew.	-0.39	-0.42	-0.57	-0.65
Kurtosis	2.28	2.85	2.96	2.82
P-Value	0	0.23	0	0
Obs.	795	95	1,679	328

Source: Authors

Table 11
Test for equality of medians between series (first part of the questionnaire; summative scale; statements DIGI-TOOLS + E-TEACH + DIGI-COMPET-NEW + DIGI-COMPET-ACQ + CHANGE)

Group	Mann-Whitney U	P-value
HSCH-ST VS UNI-ST	6.85	0.000***
HSCH-TEACH VS UNI-TEACH	2.40	0.017**
HSCH-ST VS HSCH-TEACH	3.03	0.002***
UNI-ST VS UNI-TEACH	4.92	0.000***

Note: *** statistically significant at 1%; ** 5%
Source: Authors

To test if the experience in teaching or the year of study is correlated with the responses, we calculated Spearman correlation coefficients and probabilities. Using a 5% significance level, we can see that the correlation is statistically significant only for

one group of respondents – university students (Table 12). Correlations that are statistically significant at 5% are in bold letters.

Table 12
Correlation between responses (individual items) and number of years an educator/student has been teaching/studying (first part of the questionnaire)

Group	Measure		DIGI-TOOLS	E-TEACH	DIGI-COMPET-NEW	DIGI-COMPET-ACQ	NEG-LEARN	CHANGE
HSCH-TEACH	Spearman Correlation	Coefficient	-0.045	-0.046	-0.099	-0.097	-0.012	-0.167
		P-Value	0.666	0.655	0.341	0.348	0.911	0.106
UNI-TEACH	Spearman Correlation	Coefficient	-0.021	0.015	-0.029	0.029	0.015	0.039
		P-Value	0.701	0.791	0.602	0.605	0.793	0.487
HSCH-ST	Spearman Correlation	Coefficient	0.034	-0.001	0.035	0.045	-0.009	-0.006
		P-Value	0.339	0.982	0.330	0.205	0.797	0.873
UNI-ST	Spearman Correlation	Coefficient	**0.128**	**0.166**	**0.147**	**0.124**	**-0.058**	**0.066**
		P-Value	0.000	0.000	0.000	0.000	0.018	0.007

Source: Authors

Positive correlation coefficients for individual statements indicate that university students in higher years of study value the positive impact of digital tools during the pandemic higher than their colleagues in lower years of study (Table 12). On the other hand, university students in higher years of study are less inclined to think that the pandemic will negatively impact learning outcomes achieved, which can be seen from negative correlation coefficients for the statement CHANGE. Although the correlation for university students is significant, it is very weak (Schober, 2018) since the absolute values of correlation coefficients range from 0.058 to 0.166.

E-exams

Educators were asked to express their agreement with 7 statements (Table 13). Statements are related to comparing traditional exams with e-exams regarding efficiency and reliability.

Table 13
Codes used for statements and groups of respondents (second part of the questionnaire responded to by educators)

Statement / Group of Respondents	Code
Conducting e-exams requires more effort than conducting traditional exams.	EFFORT
It takes more time to prepare e-exam than the traditional exam.	TIME
Correcting a traditional exam takes more time than correcting an e-exam.	CORRECTION
Written distance e-exams are a more efficient way of conducting exams than traditional written exams.	DIS-WRITT-EFFIC
Written e-exams on school premises are a more efficient way of conducting exams than traditional written exams.	SCH-WRITT-EFFIC
Oral distance e-exams are a more efficient way of conducting exams than traditional oral exams.	ORAL-EFFIC
When conducting a distance e-exam, there is a greater possibility of cheating, and it isn't easy to prevent it.	CHEAT
High School Educators	HSCH-TEACH
University Educators	UNI-TEACH

Source: Authors

E-learning often includes e-exams, although not necessarily. However, when social contacts were restricted during the pandemic, e-learning and e-examining were combined. Digital tools and competencies facilitate conducting e-exams, but educators and students face additional issues regarding e-exams. Question-related to e-exams in the second part of the questionnaire were different for educators and students, which is why the responses were first analyzed for educators, and then for students.

Results of descriptive statistics presented in Tables 14 and 15 suggest that educators think e-exams are less efficient and reliable than traditional exams.

Table 14

Descriptive statistics (second part of the questionnaire; individual items; statements EFFORT, TIME, CORRECTION and DIS-WRITT-EFFIC)

Measure	EFFORT		TIME		CORRECTION		DIS-WRITT-EFFIC	
	HSCH-TEACH	UNI-TEACH	HSCH-TEACH	UNI-TEACH	HSCH-TEACH	UNI-TEACH	HSCH-TEACH	UNI-TEACH
Mean	4.14	3.92	4.05	3.98	3.57	3.32	1.92	2.43
Median	5	4	4	4	4	3	1	2
Std. Dev.	1.10	1.20	1.13	1.15	1.37	1.45	1.19	1.26
Skew.	-1.15	-0.88	-1.07	-0.99	-0.42	-0.23	1.07	0.43
Kurtosis	3.64	2.78	3.48	3.09	1.93	1.69	3.04	2.16
P-Value	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
Obs.	95	328	95	328	95	328	95	328

Source: Authors

Table 15

Descriptive statistics (second part of the questionnaire; individual items; statements SCH-WRITT-EFFIC, ORAL-EFFIC and CHEAT)

Measure	SCH-WRITT-EFFIC		ORAL-EFFIC		CHEAT	
	HSCH-TEACH	UNI-TEACH	HSCH-TEACH	UNI-TEACH	HSCH-TEACH	UNI-TEACH
Mean	2.73	3.04	1.99	2.63	4.42	4.28
Median	3	3	2	3	5	5
Std. Dev.	1.46	1.26	1.13	1.23	0.91	0.96
Skew.	0.30	-0.10	1.03	0.23	-1.45	-1.32
Kurtosis	1.77	2.13	3.39	2.18	4.38	4.15
P-Value	0.02	0.00	0.00	0.00	0.00	0.00
Obs.	95	328	95	328	95	328

Source: Authors

Namely, 72% of high school educators and 67% of university educators agree (mostly or completely) with the statement that conducting e-exams requires more effort than conducting traditional exams. Measures of central tendency also confirm that conclusion. This especially applies to preparing e-exams since 69% of high school and 71% of university educators agree it takes more time than preparing traditional exams. There is a little less issue with correcting e-exams because the percentages are lower – 52% / 47%, probably because the application of digital tools sometimes, depending on the type of questions used in the e-exam, offers different autocorrection possibilities. Considering previous responses, it is understandable that educators, on average, disagree with the statements that e-exams are more efficient than traditional exams. Only 12% of high school educators and 20% of university educators agree that written distance e-exams are a more efficient way of conducting exams than traditional written exams. Percentages are similarly low when comparing e-exams on school premises with traditional written exams (30% / 35%) and oral distance e-exams and traditional oral exams (8% / 23%). In addition to questioning their effectiveness,

they also have issues with their reliability. In that context, 81% of high school and university educators agree that with e-exams, there is a greater possibility of cheating, and it is difficult to prevent it.

The results obtained by analyzing each statement in the question related to e-exams were compared with the results from the summative scale. When calculating the total score within a Likert scale question, all statements must have the same direction. In this case, statements DIS-WRITT-EFFIC, SCH-WRITT-EFFIC and ORAL-EFFIC were formulated in the reverse form compared to other statements. While other statements emphasize potential disadvantages of e-exams, these 3 statements emphasize potential advantages. This is why these 3 statements were reversed, as shown in Table 16. The responses were also reversed, meaning that, e.g., if a respondent answered that they completely agreed with the original statement (coded 5), the same respondent then completely disagreed with the reverse statement (coded 1).

Table 16
Codes used for reverse statements used for summative scale (second part of the questionnaire responded to by educators)

Statement / Group of Respondents	Code
Written distance e-exams are a less efficient way of conducting exams than traditional written exams.	DIS-WRITT-EFFIC(r)
Written e-exams on school premises are a less efficient way of conducting exams than traditional written exams.	SCH-WRITT-EFFIC(r)
Oral distance e-exams are a less efficient way of conducting exams than traditional oral exams.	ORAL-EFFIC(r)

Source: Authors

After reversing statements that were formulated in the opposite direction, we were able to calculate a sum of all responses. The total score can be interpreted as to what extent respondents agree that e-exams are less efficient and reliable than traditional exams. Since there were 7 statements and the answer *completely agree* is coded as 5, the maximum score possible is 35, while the minimum score possible is 7. Values of descriptive measures are presented in Table 17. Mean and median values confirm that educators are aware of the issues that come with e-exams.

Table 17
Descriptive statistics (second part of the questionnaire; summative scale; statements EFFORT + TIME + CORRECTION + DIS-WRITT-EFFIC(r) + SCH-WRITT-EFFIC(r) + ORAL-EFFIC(r) + CHEAT)

Measure	HSCH-TEACH	UNI-TEACH
Mean	27.55	25.41
Median	28	25
Std. Dev.	4.90	4.52
Skew.	-0.07	0.21
Kurtosis	1.79	2.68
P-Value	0.05	0.14
Obs.	95	328

Source: Authors

Interestingly, the average and median score for high school educators is higher when compared to university educators. A slight difference can also be seen when

comparing measures of central tendency for individual statements. Results of the test of equality of medians are presented in Tables 18 and 19.

Table 18
Test for equality of medians between series (second part of the questionnaire responded to by educators; individual items)

Statement	Group	Mann-Whitney U	P-value
EFFORT	HSCH-TEACH VS UNI-TEACH	1.46	0.145
TIME	HSCH-TEACH VS UNI-TEACH	0.51	0.614
CORRECTION	HSCH-TEACH VS UNI-TEACH	1.42	0.156
DIS-WRITT-EFFIC	HSCH-TEACH VS UNI-TEACH	3.59	0.000***
SCH-WRITT-EFFIC	HSCH-TEACH VS UNI-TEACH	2.08	0.038**
ORAL-EFFIC	HSCH-TEACH VS UNI-TEACH	4.50	0.000***
CHEAT	HSCH-TEACH VS UNI-TEACH	1.34	0.182

Note: *** statistically significant at 1%; ** 5%
Source: Authors

The medians for the total scores related to e-tests are not equal for both groups of respondents (Table 19). This inequality results from 3 statements (DIS-WRITT-EFFIC, SCH-WRITT-EFFIC and ORAL-EFFIC) since the tests suggest that medians are equal for the remaining 5 statements (Table 19). It can be concluded that high school educators are more sceptical about the efficiency of written and oral distance e-exams than university educators. At the same time, their opinion regarding other aspects analyzed within this question does not differ.

Table 19
Test for equality of medians between series (second part of the questionnaire responded by educators; summative scale; statements EFFORT + TIME + CORRECTION + DIS-WRITT-EFFIC(r) + SCH-WRITT-EFFIC(r) + ORAL-EFFIC(r) + CHEAT)

Group	Mann-Whitney U	P-value
HSCH-TEACH VS UNI-TEACH	3.56	0.000***

Note: *** statistically significant at 1%; ** 5%
Source: Authors

In addition to previous conclusions, the correlation analysis presented in Table 20 indicates no statistically significant correlation between the experience in teaching and educators' responses to e-exams. Therefore, the number of years of teaching does not affect the opinions or preferences of educators when comparing e-exams and traditional exams.

Table 20
Correlation between responses (individual items) and number of years an educator has been teaching (second part of the questionnaire responded to by educators)

Measure			EFFORT	TIME	CORRE-CTION	DIS-WRITT-EFFIC	SCH-WRITT-EFFIC	ORAL-EFFIC	CHEAT
HSCH-TEACH	**Spearman Corre-lation**	**Coe-fficient**	-0.077	-0.050	0.072	-0.073	-0.069	-0.031	0.107
		P-Value	0.457	0.629	0.486	0.485	0.509	0.768	0.302
UNI-TEACH	**Spearman Corre-lation**	**Coe-fficient**	-0.079	-0.016	0.019	0.030	0.043	-0.024	-0.085
		P-Value	0.154	0.771	0.734	0.591	0.434	0.669	0.127

Source: Authors

In the version of a questionnaire distributed to students, the question related to e-exams had only 3 statements. Only 1 statement is common with educators – a statement about the possibility of cheating during e-exams. In the other 2 statements, students were asked to rate to what extent they prefer written or oral e-exams to traditional exams. Statements and their codes are listed in Table 21.

Table 21
Codes used for statements and groups of respondents (second part of the questionnaire responded to by students)

Statements / Group of Respondents	Code
I prefer written distance e-exams rather than traditional written exams.	PREF-WRITT
I prefer oral distance e-exams rather than traditional oral exams.	PREF-ORAL
The distance e-exams provide an opportunity for cheating, making it difficult to prevent.	DIS-CHEAT
High School Students	HSCH-ST
University Students	UNI-ST

Source: Authors

According to descriptive measures (Table 22), students prefer written distance e-exams to traditional written exams since 54% of high school students, and 56% of university students agree with the first statement. They also mostly prefer oral distance e-exams over traditional oral exams. However, the percentage is lower than for written exams (45%/41% of high school/university students agree with the second statement, while 32%/34% do not agree). In the end, 51% of students agree that e-exams provide more opportunities for cheating and are less reliable. This is a much lower percentage than with educators (81%).

Table 22
Descriptive statistics (second part of the questionnaire; individual items; statements PREF-WRITT, PREF-ORAL and DIS-CHEAT)

Measure	PREF-WRITT		PREF-ORAL		DIS-CHEAT	
	HSCH-ST	UNI-ST	HSCH-ST	UNI-ST	HSCH-ST	UNI-ST
Mean	3.57	3.56	3.27	3.11	3.50	3.46
Median	4	4	3	3	4	4
Std. Dev.	1.41	1.40	1.46	1.46	1.39	1.30
Skew.	-0.53	-0.56	-0.24	-0.11	-0.44	-0.38
Kurtosis	2.00	2.04	1.71	1.69	1.97	2.05
P-Value	0.00	0.00	0.00	0.00	0.00	0.00
Obs.	795	1,679	795	1,679	795	1,679

Source: Authors

Responses for the first 2 statements were summed up to calculate the total score, confirming that students prefer e-exams over traditional exams. The 3rd statement was excluded from calculating the total score because it is not an indication of what type of examining students prefer (e.g., some students might prefer e-exams if they offer more opportunities for cheating, while another student might view this as a negative side because the grades are not objective). On a scale from 2 to 10, the median for

both written and oral exams is 7 (Table 23), confirming that e-exams are generally more preferred by students.

Table 23
Descriptive statistics (second part of the questionnaire; summative scale; statements PREF-WRIT + PREF-ORAL)

Measure	HSCH-ST	UNI-ST
Mean	6.85	6.66
Median	7	7
Std. Dev.	2.62	2.50
Skew.	-0.29	-0.32
Kurtosis	1.92	2.17
P-Value	0.00	0.00
Obs.	795	1,679

Source: Authors

The central tendency for the two groups of students is very close for individual statements and the total scores, suggesting that high school students and university students, on average, have similar attitudes towards e-exams. This was additionally verified by testing the equality of medians (Table 25). The test showed a difference in oral distance e-exams, which high school students prefer more than university students, which is significant at a 1% level. As for the other two statements and the total score, the medians are not statistically different.

Table 24
Test for equality of medians between series (second part of the questionnaire responded to by students; individual items)

Statement	Group	Mann-Whitney U	Probability
PREF-WRITT	HSCH-TEACH VS UNI-TEACH	0.39	0.693
PREF-ORAL	HSCH-TEACH VS UNI-TEACH	2.60	0.009***
DIS-CHEAT	HSCH-TEACH VS UNI-TEACH	1.18	0.240

Note: Statistically significant at 1%
Source: Authors

Table 25
Test for equality of medians between series (second part of the questionnaire responded by students; summative scale; statements pref-writ + pref-oral)

Group	Mann-Whitney U	Probability
HSCH-TEACH VS UNI-TEACH	1.67	0.095*

*Note: * Statistically significant at 10%*
Source: Authors

As was the case with educators and their experience in teaching, correlation analysis (Table 26) shows no statistically significant correlation between the year of study and students' responses regarding e-exams. This means that they prefer e-exams regardless of their year or class. However, this leaves a possibility that they have different reasons for preferring e-exams to traditional exams, which was not questioned as part of this survey.

Table 26
Correlation between responses (individual items) and current year of study (second part of the questionnaire responded to by students)

Group	Measure		PREF-WRITT	PREF-ORAL	DIS-CHEAT
HSCH-ST	Spearman	Coefficient	-0.026	-0.005	-0.041
	Correlation	P-Value	0.457	0.894	0.243
UNI-ST	Spearman	Coefficient	0.030	0.035	0.015
	Correlation	P-Value	0.216	0.157	0.550

Source: Authors

Future of e-Learning

In addition to assessing present aspects of e-learning during the pandemic, educators and students were asked to express their opinion regarding e-learning in the future or post-pandemic circumstances. Using e-learning and digital tools during the pandemic was more a necessity than a choice, which is why it is questionable to what extent new methods and ways of teaching and learning will continue in the future. This question was the same for educators and students, which allows for a comparison of answers. Respondents were given 4 potential answers, and the percentages are shown in Table 27. The most represented answer across all respondents is that e-learning should be implemented as an important addition to traditional learning. This indicates that the respondents have recognized the value and advantages of e-learning. Still, they are also aware of the disadvantages, which is why very few respondents think e-learning should be used as an independent form of education.

There are certain differences between groups of respondents. A higher percentage of educators (67%), compared with students (46%), agreed that e-learning should be an important addition to traditional learning. Moreover, when using a combined sample of educators and students, university respondents (52%) are more inclined to this statement than high school respondents (40%). High school students are again the most sceptical group since many view e-learning only as a side to traditional teaching.

Table 27
Respondents' view on e-learning in the future

Answers	% HSCH-TEACH	% UNI-TEACH	% HSCH-ST	% UNI-ST
It should be used as an important addition to traditional teaching.	53%	66%	38%	50%
It should be used as a side addition to traditional teaching.	46%	28%	37%	31%
It should be implemented as an independent form of education (only e-learning).	0%	5%	13%	14%
It should be completely returned only to traditional teaching.	1%	2%	12%	5%
Total	100%	100%	100%	100%

Source: Authors

To test if there is a statistically significant difference in the way different groups of respondent value e-learning in the future, we conducted the two proportion one-tailed z-tests. With a 5% significance level, it can be concluded that the proportion of educators that chose the first answer is statistically higher than that of students. The

same applies to university respondents were compared with high school respondents. The remaining results are presented in Table 28.

Table 28
Results of the two-proportion z-test (one-tailed, a =0.05) related to statements reflecting respondents' view on e-learning in the future

Statement	Educators VS Students	High School Respondents VS University Respondents
It should be used as an important addition to traditional teaching.	z = 6.4651 p< 0.001***	z = -5.9628 p< 0.001***
It should be used as a side addition to traditional teaching.	z = -0.4047 p = 0.34458	z = 4.2427 p< 0.001***
It should be implemented as an independent form of education (only e-learning).	z = -5.7391 p< 0.001***	z = -0.7459 p = 0.22663
It should be completely returned only to traditional teaching.	z = -4.7561 p< 0.001***	z = 5.9007 p< 0.001***

*Note: *** statistically significant at 1%*
Source: Authors

Discussion

Overall research results presented in the previous chapter confirmed that the pandemic forced educators and students to introduce more digital tools than they were using before the pandemic. This is understandable, considering the conditions in which the teaching process was mostly performed during the pandemic. The need to substitute traditional learning with e-learning led to improving individual digital competencies of both educators and students but also understanding that they still have a lot to learn when it comes to digital tools and their possibilities. However, results have also shown that educators were to some extent concerned about achieving learning outcomes during the pandemic, which might be partially caused by the fact that introducing digital tools and new teaching methods at the beginning of the pandemic was sudden and forced rather than systematically planned. As with previous researchers (e.g., Lemay et al., 2021, or Carabajo Romero et al., 2021), it is understandable that this increased students' stress levels. Since most educators and students were inexperienced in e-teaching/e-learning, this change has certainly caused some insecurities about the final effect, especially since there were challenges in controlling students and verifying that they participated. High school students were less optimistic about the positive impact of the pandemic on applying digital tools in teaching than university students. This confirmed the first research proposition (RP1). There are several potential reasons for such results. University students are older and expected to be more independent and self-disciplined, meaning they probably better adapted to the transition. The finding that aligns with this claim is that even university students with higher years of study value the positive impact of digital tools during the pandemic higher than their colleagues at lower years. They are also less inclined to think that it will negatively impact the achieved learning outcomes. In addition, during the pandemic, university students had more classes online than high school students, which consequently means that they probably used digital tools more and/or longer.

Regardless of the differences in opinions between different groups of respondents, it seems certain that the pandemic has forever changed the way the teaching and learning process has been performed. Despite several disadvantages of e-learning, some forms will be kept even when the pandemic is over. Research results confirm this

assumption since a very small percentage of respondents answered that we should completely return to traditional teaching. However, it was confirmed that a statistically higher proportion of university respondents (educators and students combined) believe that e-learning should be an important addition to traditional teaching compared to high school respondents. This confirms the second research proposition (RP2). The reasons behind these results may be similar to already explained potential reasons why university students are more optimistic about the pandemic's positive impact by introducing more digital tools in teaching. Both educators and students know that e-learning, especially distance, requires self-discipline, self-motivation and independence, which is easier to accomplish at higher levels of education, such as the university level. A compromise solution might be implementing e-learning in high schools and universities but in different forms. High school students might respond better to using different digital tools in classrooms, while university students are more equipped to adapt to distance e-learning and individual work.

One of the challenges during the pandemic, when we suddenly switched from traditional to online teaching, was how to conduct exams. Different forms of e-exams were introduced, and different ways of supervising students during e-exams. Not all courses were equally suitable for distance e-examining, and there was certainly a learning curve both for educators and students. Even before conducting the research, it was expected that educators and students, at least to some extent, would differ in opinion when asked if they prefer e-exams rather than traditional exams. Research results showed that educators generally prefer traditional exams because they are more aware of the disadvantages of e-exams compared to the advantages, while students generally prefer e-exams. This finding confirms the third research proposition (RP3). The disadvantages from the standpoint of educators refer to more time they spend preparing and correcting e-exams, which is why they believe they are less efficient than traditional exams.

However, a more serious issue is the questionable reliability of e-exams since many educators believe that they offer more opportunities for cheating. This might also suggest that most educators have not been able to implement appropriate supervision measures to ensure students are not cheating. We believe that this is because these supervision measures must be researched, developed, supported and implemented at the institutional level, meaning that schools and universities should provide solutions and instructions that would prevent non-academic behaviour rather than leaving this issue to be resolved by each educator. At the same time, a mutually accepted code of conduct could be supportive. Different approaches, lack of institutional support and viewing e-exams as a temporary solution during the pandemic have possibly made them less reliable.

On the other hand, e-exams (especially distance) for most students have more advantages than disadvantages. They usually do not require more preparation and can be more efficient because students do not have to travel to school or university or be nervous about being late. From the standpoint of university students, who start to work during their studies, the ability to write exams from their workplace might be especially valuable. However, some uncertainty still exists because IT technology used for conducting e-exams might fail before or during the exam. Another reason for potentially preferring e-exams is the different approach some educators had to implement when switching from traditional to distance e-exams. Aware that it is difficult to prevent students from consulting available literature and online sources, certain exams were converted to open-book exams, which might suit students better than closed-book examinations. In the end, although educators viewed the higher possibility of cheating during e-exams as a negative side, at least some students might

view this as a positive side of e-exams. Our research results align with the conclusions from Maroco, where Elfirdoussi et al. (2020) found that educators believe that it is not feasible to conduct exams from a distance. In addition, Mladenova et al. (2020) stated that students achieved higher grades during the pandemic, which might also result from cheating. Therefore, the integrity of the examination process in online circumstances is widely recognized.

Limitations of the research are related to sample sizes and the truthfulness of the respondents. Although the total sample is very large, more responses were collected from students than educators, especially high school educators. In addition, the questionnaire was completely anonymous. Still, there is always the possibility that some respondents were not truthful when giving their opinion due to superficial reading of questions, disinterest, etc.

Conclusion

With the appearance of the Covid-19 virus during the pandemic, there have been significant changes in the education system. In a short time, there was a digitalization of the entire school system, given that classes were held online, both in schools and universities. Since it all happened suddenly, there wasn't time to develop a strategy for such a way of teaching, which caused certain problems. Students and educators do not have the same prior knowledge and experience in using digital technologies in online learning, which leads to different perceptions about the satisfaction of online teaching concerning traditional, face-to-face teaching. In addition to technical difficulties and difficulties with the internet, problems are also manifested in stress among students and the lack of social interaction. Given that online teaching will certainly be maintained in a certain proportion even after the pandemic, all identified shortcomings should be analyzed and corrected so that online learning is as effective as traditional, face-to-face learning.

Undeniably, the pandemic forced educators and students to introduce more digital tools in the education process, as the research shows, leading to improved individual digital competencies. On a sample of 2,897 educators and students from four European countries, it is evident that there are certain differences in opinion between students and educators, as well as between university respondents and high school respondents. When assessing the positive impact of the pandemic on applying digital tools, high school students are less optimistic than university students, which might be partially caused by the fact that university students had more classes online and, therefore, more opportunities to use digital tools. During the pandemic, high schools and universities were forced to implement e-exams, at least during one period, which resulted in discussions regarding their effectiveness. Research results showed that educators are more aware of the disadvantages of e-exams, which is why they prefer traditional exams, while students are more inclined towards e-exams.

Regarding the future of e-learning, it should be noted that e-learning, especially distance, requires self-discipline, self-motivation and independence, which is why it might be more appropriate for students at higher levels of education. This might explain why a higher proportion of university respondents, compared to high school respondents, believe that e-learning should be an important addition to traditional learning. In conclusion, the results of our research, as well as the results of the previous research, proved that e-learning definitely would and should be used in the future, but in a form that suits educational level, ensures the adoption of learning outcomes and reliable examination of acquired knowledge, which are some of the issues that arose during the pandemic and sudden transition to e-learning.

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References

1. Adedoyin, O. B., Soykan, E. (2020), "Covid-19 the pandemic and online learning: the challenges and opportunities", Interactive Learning Environments, https://doi.org.10.1080/10494820.2020.1813180 (3 January 2022)
2. Andersson, P., Mattsson, L. G. (2021) "Future digitalization of education after COVID-19" available at https://www.hhs.se/contentassets/419c7b2f06a94ee183bf52ca748c98b5/a54.pdf (3 January 2022)
3. Attwell, G. (2007), "Personal Learning Environments – the future of ELearning?", eLearning papers, Vol. 2, No. 1, pp. 1-8.
4. Backes, S., Baumann, I., Harion, D., Sattler, S., Lenz, T. (2021), "Why flipping the classroom is not enough: Digital curriculum making after the the pandemic", Prospects, Vol. 51, pp. 347-361.
5. Bączek, M., Zagańczyk-Bączek, M., Szpringer, M., Jaroszyński, A., Wożakowska-Kapłon, B. (2021), "Students' perception of online learning during the COVID-19 the pandemic: A survey study of Polish medical students", Medicine, Vol. 100, No. 7, pp. 1-6.
6. Ben, F. (2020), "Forced into it: Digital Technologies for Teaching and Learning During a Global Pandemic", in 1st International Conference on Information Technology and Education (ICITE 2020), Atlantis Press, pp. 588-592.
7. Butnaru, G. I., Niță, V., Anichiti, A., Brînză, G. (2021), "The effectiveness of online education during covid 19 the pandemic—a comparative analysis between the perceptions of academic students and high school students from Romania", Sustainability, Vol. 13, No. 9, pp. 1-20.
8. Camacho, D. J., Legare J. M. (2021), "Pivoting to online learning – The future of learning and work", The Journal of Competency-Based Education, Vol. 6, No. 3.
9. Carabajo Romero, I. R., González Reyes, S. D., Quinto Ochoa, E. D., León Abad, E. G. (2021), "The impact of COVID-19 from FACE to FACE to ONLINE learning", available at: https://www.adayapress.com/wp-content/uploads/2021/06/refpred18.pdf (3 January 2022)
10. Chakraborty, P., Mittal, P., Gupta, M. S., Yadav, S., Arora, A. (2021), "Opinion of students on online education during the COVID-19 the pandemic", Human Behavior and Emerging Technologies, Vol. 3, No. 3, pp. 357-365.
11. Demuyakor, J. (2020), "Coronavirus (COVID-19) and online learning in higher institutions of education: A survey of the perceptions of Ghanaian international students in China", Online Journal of Communication and Media Technologies, Vol. 10, No. 3, pp. 1-9.
12. Elfirdoussi, S., Lachgar, M., Kabaili, H., Rochdi, A., Goujdami, D., El Firdoussi, L. (2020), "Assessing distance learning in higher education during the COVID-19 the pandemic", Education Research International, Vol. 2020, pp. 1-13.
13. Esteban Jr., A. M., Cruz, M. J. P. (2021), "Digital Divide in Times of Pandemic among Teacher Education Students", Open Access Library Journal, Vol. 8, pp. 1-12.
14. García-Morales, V. J., Garrido-Moreno, A., Martín-Rojas, R. (2021), "The transformation of higher education after the COVID disruption: Emerging challenges in an online learning scenario", Frontiers in Psychology, Vol. 12, pp. 1-6.
15. Georgescu, M. (2006), "The Future of E-Learning: Designing Tomorrow's Education", available at https://www.researchgate.net/publication/228242459 (3 January 2022)
16. Goyal, S. (2012), "E-Learning: Future of Education", Journal of Education and Learning, Vol. 6, No. 2, pp. 239-242.

17. Iivari, N., Sharma, S., Ventä-Olkkonen, L. (2020), "Digital transformation of everyday life–How COVID-19 the pandemic transformed the basic education of the young generation and why information management research should care?", International Journal of Information Management, Vol. 55, pp. 1-6.
18. Kadeniz, S. (2009), "Flexible design for the future of distance learning", Procedia - Social and Behavioral Sciences, Vol. 1, No. 1, pp. 358-363.
19. Lemay, D. J., Bazelais, P., Doleck, T. (2021), "Transition to online teaching during the COVID-19 the pandemic", Computers in Human Behavior Reports, Vol. 4, pp. 1-9.
20. Mahyoob, M. (2020), "Challenges of e-Learning during the COVID-19 Pandemic Experienced by EFL Learners", Arab World English Journal (AWEJ), Vol. 11, No. 4, pp. 351-362.
21. Mladenova, T., Kalmukov, Y., Valova, I. (2020), "Covid 19–A major cause of digital transformation in education or just an evaluation test", TEM journal, Vol. 9, No. 3, pp. 1163-1170.
22. Obeidat, A., Obeidat, R., Al-Shalabi, M. (2020), "The Effectiveness of Adopting e-Learning during COVID-19 at Hashemite University", International Journal of Advanced Computer Science and Applications, Vol. 11, No. 12, pp. 96-104.
23. OECD (2005), "Policy brief. E-learning in Tertiary Education", available at https://www.oecd.org/education/ceri/35991871.pdf (3 January 2022)
24. Özüdoğru, G. (2021), "Problems faced in distance education during Covid-19 Pandemic", Participatory Educational Research, Vol. 8, No. 4, pp. 321-333.
25. Perifanou, M., Economides, A., Tzafilkou, K. (2021), "Teachers' digital skills readiness during COVID-19 the pandemic", International Journal of Emerging Technologies in Learning - iJET, Vol. 16, No. 8, pp. 238-251.
26. Pozo, J. I., Pérez Echeverría, M. P., Cabellos, B., Sánchez, D. L. (2021), "Teaching and learning in times of COVID-19: uses of digital technologies during school lockdowns", available at https://www.frontiersin.org/article/10.3389/fpsyg.2021.656776 (3 January 2022)
27. Schober, P., Boer, C., Schwarte, L. A. (2018), "Correlation coefficients: appropriate use and interpretation", Anesthesia and Analgesia, Vol. 126, No. 5, pp. 1763-1768.
28. Ullah, A., Ashraf, M., Ashraf, S., Ahmed, S. (2021), "Challenges of Online Learning during the COVID-19 Pandemic Encountered by Students in Pakistan", Journal of Pedagogical Sociology and Psychology, Vol. 3, No. 1, pp. 36-44.
29. Varyani, H., Navaneeth, M. S. (2020), "The Past, Present and Future of E-Learning: In India", International Journal of Policy Sciences and Law, Vol. 1, No. 1, pp. 99-118.
30. Wangdi, N., Dema, Y., Chogyel, N. (2021), "Online learning amid COVID-19 the pandemic: Perspectives of Bhutanese students", International Journal of Didactical Studies, Vol. 2, No.1, pp. 1-10.
31. Zeqiri, J., Kareva, V., Alija, S., Pejic Bach, M. (2022), "Challenges and opportunities for higher education in North Macedonia during the COVID-19 pandemics: a survey of student satisfaction and gender-related anxiety", International Journal of Technology Enhanced Learning, Vol. 14, No. 2, pp. 163-179.

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Digital Competencies among Higher Education Professors and High-School Teachers: Does Teaching Experience matter?

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Abstract

Background: To provide high-quality education and remain innovative, thus contributing to sustainable development goals, educational institutions use digital tools and implement ICT in the teaching process. In addition to providing technical resources, it requires the appropriate education of teachers who should have the appropriate knowledge and skills to take full advantage of the opportunities provided by ICT. **Objectives:** The main objective of this article is to identify the current state of ICT knowledge and skills of university professors and high school teachers and to establish if there exists a relationship between their digital competencies and teaching experience. We strive to discover areas where digital competencies are already relatively high and ICT knowledge and skills gaps. **Methods/Approach:** Survey was conducted on a sample of university and secondary school professors who were asked to estimate their perceived level of knowledge and skills in various ICT domains. **Results:** The results of our research show that the total self-assessed level of competence is intermediate, with slightly higher values for ICT knowledge than for ICT skills. The results vary depending on the different subcategories of competencies and the years of respondents' teaching experience. **Conclusions:** Our research findings, which revealed variations and gaps in digital knowledge and skills among professors and teachers, may have significant policy implications for policymakers and educators committed to ensuring quality education.

Keywords: digital competencies; ICT knowledge; ICT skills; digitalisation of education; university professors; high school teachers
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Introduction

There is a global commitment for all countries to ensure the right to quality education throughout life. It is reflected in Goal 4 of the United Nations' 2030 Agenda for Sustainable Development (UNESCO, 2017). The implementation of this goal creates challenges for national educational systems in the field of, among other things, increasing access to quality education and developing information and communications technology (ICT) skills among children and adults, which are nowadays necessary for employment, decent jobs and entrepreneurship (Rodríguez-Abitia et al., 2020; Hajdukiewicz et al., 2020; Leal Filho et al., 2017; Alonso-García et al., 2019). This, in turn, requires the appropriate preparation of teachers at various levels of education, who should possess the knowledge and skills needed to take full advantage of the opportunities offered by ICT in the teaching process (Winter et al., 2021).

The scientific debate about using digital technologies in education has been steadily growing in recent years. Various authors point to the benefits and limitations of integrating ICT in teaching-learning (Livingstone, 2012; Ramírez-Montoya, 2020). The outbreak of the COVID-19 pandemic has further highlighted the need for the proper use of new technological supports, technological advances, and ICT technology-supported didactic strategies in education (Mseleku, 2020). Resistance to distance learning had to recede into the background due to the need to quickly launch this form of teaching in secondary schools and universities (König et al., 2020). At the same time, it further strengthened the need to research the application of new technologies in education to enable the achievement of sustainable development education goals in the new conditions created by the health crisis. It resulted in several publications on the challenges and opportunities of online learning during the pandemic (Adedoyin et al., 2020; Mishra et al., 2020; Dhawan, 2020), which on the other hand caused distress (Zeqiri et al., 2022).

This article aims to identify university professors and high school teachers' current state of digital competencies and to examine potential relationships among ICT knowledge, skills and teaching experience. We strive to discover areas where digital competencies are already relatively high, as well as those where there are gaps in knowledge and skills, also considering some of the existing links in this regard. In particular, we wanted to investigate the relationship between particular types of knowledge and skills, between competencies and teaching experience measured by the number of years of work in education, and between competencies and the level of education (university or high school). To reach the main goal, we conducted a thorough literature review. We used a survey research method to collect primary data directly from university professors and high school teachers.

We believe that the turbulence resulting from the global Covid-19 pandemic caused changes in the educational environment and posed new challenges for teachers. Therefore, we believe there is a research gap regarding the current digital competencies possessed (or missed) by professors and teachers. Our article provides an overall picture of teaching professionals' digital competencies and gives a better understanding of their level from a teaching professional's perspective. The achieved results correspond to the findings of Rodríguez-Abitia et al. (2020) and Hämäläinen et al. (2021), providing further evidence for the existence of digital differences and gaps in higher and tertiary education.

The following research questions were defined:

- *RQ1. What is the average level of high school teachers and university professors' proficiency in using digital tools and mobile technology in teaching economic disciplines?*

- *RQ2. Are there significant differences in ICT knowledge and skills between high school teachers and university professors depending on the teachers' years of experience?*
- *RQ3. Which ICT competencies and skills are missing or weak, which are the highest and are they correlated?*

This study explores how high school teachers and university professors self-assess their digital skills and competencies. First, the ICT skills and competencies and the factors influencing the implementation of digital skills and competencies were discussed. Second, we characterised the research sample and the quantitative methods to obtain the results and answer the research questions. The data presented in the article were collected through a survey of 423 respondents from Croatia, Germany, Poland and Serbia. Third, the empirical exploration of 10 different subcategories of ICT skills and knowledge in the emerging technological landscape was presented and discussed.

We believe that our research findings may have significant policy implications for policymakers and educators at the state, regional and school levels. Most importantly, policymakers should focus on program and investment strategies that build a digitally competent teaching workforce of high-quality individuals who continually deepen their digital knowledge and learn new digital skills.

Theoretical background

Educational institutions in the 21st century face new challenges concerning ICT integration (Albion et al., 2015)because ICT has entered all aspects of people's lives. Almost every generation uses ICT in everyday activities, from banking, shopping, communicating with others, travelling, etc. To provide high-quality education and remain innovative, educational institutions use digital tools and implement them in teaching (Bøe et al., 2015). Recognition of the importance of ICT skills and competencies, together with the digitalisation of education, is constantly growing with national and international policies (Bond et al., 2018).

Skill can be defined as the ability to do an activity or job well (Bartman et al., 2011). ICT skills are the ability to comprehend and utilise digital processes and tools (Hsu, 2011). Competence includes the ability to do something successfully or efficiently (Vitello et al., 2021). Digital competence involves the confident and critical use of electronic media for work, leisure, and communication. It includes attitudes, knowledge, skills, awareness, and values related to logical and critical thinking, high-level information management, and well-developed communication skills (Levano-Francia et al., 2019).

Maximising ICT potential in the education process should be one of the strategic goals of every educational institution, due to numerous positive impacts. It is undoubtedly that ICT implementation leads to numerous benefits for all parties involved. They can improve the teaching process to a large extent, ease the knowledge transfer process and make it more interesting for the pupils and students. Furthermore, ICT becomes a channel for communication and information, which leads to an open and interactive environment (García-Valcárcel et al., 2014) and brings together traditionally separated educational technologies (books, telephone, television, etc.), and crates intersect places of learning (home, school, work and community (Livingstone, 2012).

Despite mentioned benefits, the implementation of ICT is very complex and depends on different variables. Several models predict whether a new technology will be adopted or not. One of the most frequently used models is Technology Acceptance Model (TAM) developed by Davis (1989). The model is based on two

scales composed of different items, which determine two main factors. With the fast expansion of technology implementation, the initial model was justified and used for research in many different fields, such as medicine, education, finance or construction (Hussein, 2017; Mortenson et al., 2016; Sepasgozaar et al., 2017). Petko (2012) argued that the TAM model is not the best model for predicting ICT usage in education because it was originally used for internet banking and telecommunication services and cannot be transformed for the education system. The same author proposed the Will, skill, tool model as a better one. It is a model tested by asking teachers to evaluate their ICT activities using a descriptive step model. These models include factors influencing ICT implementation and can be divided into two main groups, external and internal.

External factors, among others, include material resources, time and technical support. Although most institutions aspire to implement ICT, there is often a lack of material resources, including computers and other devices, but also different programmes and applications. Institutions are raising funds from different national and international projects, enabling them to acquire all necessary material resources. These material resources require technical support and the education of teachers, which takes away a lot of time. Internal factors are related to the individual, including attitudes, confidence, and perception of benefits, and these factors are more complex and harder to affect. As Siddiq et al. (2016) stated, most research on teachers' intention to use ICT in classrooms is focused on teacher beliefs. Research on attitudes toward ICT in education also has a long tradition which dates from the emergence of educational technology (Scherer et al., 2018).

ICT implementation can be slugged or dimmed if previously mentioned factors become barriers. Much empirical research focuses on ICT adoption barriers (Al-Senaidi et al., 2009). Eickelmann and Vennemann (2017) pointed out a lack of technology-based infrastructure in educational institutions, time-based constraints and a lack of technical or pedagogical support as external barriers, while internal barriers include beliefs about teaching and ICT and unwillingness to change educational practices. Besides mentioned, Al-Senaidi et al. (2009) emphasised the lack of sharing best practices across the system, lack of institutional and financial support and lack of time to learn new technology. One of the barriers is also a budget available for skills-based training programmes, as it often results in only new teachers attending those programmes (Kreijns et al., 2013a). These programmes are important because they reduce the "digital divide" between teachers and their students (Fernández-Cruz et al., 2016). They can also bridge the gap between digital communication among teachers due to differences between generations and previous digital competencies and skills.

Furthermore, the teacher will be motivated to ICT implementation if they feel that the technology is easy to use and beneficial, but also if they do not need to provide much effort into learning how to use new technology (Mac Callum et al., 2014). ICT usage depends on different factors (e.g. age, education level, duration of ICT usage etc.) One of the important internal factors (Eteokleous, 2008) is teachers' personal association with constructivist techniques (the higher preference for constructivist techniques, the better ICT integration in classrooms). Most teachers still use ICT only to complete simple tasks (Tezci, 2011), while more complex implementation is still scarce.

Analyses of factors and barriers lead to the conclusion that factors can become barriers and vice versa, which mostly depends on educational institutions' management and willingness to implement ICT in their institution. "A new technology will be increasingly diffused if potential adopters perceive that innovation: (1) has an advantage over previous innovations; (2) is compatible with existing practices; (3) is

not complex to understand and use; (4) shows observable results; (5) can be experimented with on a limited basis before adoption."(Gulbahar et al., 2008) Unfortunately, "teachers are more often reluctant rather than willing to use ICT" (Kreijns et al., 2013b). Managers should engage teachers in ICT implementation policy planning (Lim et al., 2013). Teachers are a valuable source of information concerning the teaching process and potential benefits and possibilities of ICT implementation. Furthermore, teachers involved in decision-making will be more motivated to execute planned measures. Another important issue is ensuring sufficient motivation for teachers by providing support and encouragement to overcome their fears and show them new ways of doing things (Ward et al., 2010).

As Martin et al. (2011) stated, implementation of ICT in the education system often seems to be based on fashion rather than organised diffusion models developed on evidence-based decision-making. Plans and actions connected with ICT implementation in the educational system must be based on detailed current state information, including digital competencies and skills of students and teachers.

Methodology

The study's main objective is to identify the current digital competencies of university professors and high school teachers and to investigate potential relationship among their ICT knowledge, skills and teaching experience.

In our attempt to reach this goal and answer the research questions, we applied a quantitative research approach based on a survey conducted on the sample of university professors and high school teachers representing selected economic areas. First, we developed a questionnaire consisting of questions that allowed teachers and professors to self-assess their digital competencies (self-assessment assertions), considering 10 different subcategories of ICT knowledge and skills. In the next step, we collected the data using a Web survey (CAWI – Computer Assisted Web Interview) method. The answers were provided by professors and teachers from Croatia, Germany, Poland, and Serbia. A total of 423 respondents answered our survey, 328 of whom were employed at the universities in one of the four countries, and 95 were employed at high schools of economics. Both groups, university professors and high school teachers, were internally differentiated according to the number of years of teaching experience (Table 1).

Table 1
Characteristics of the Research Sample

Type/Teaching experience	Up to 5 years	6 to 15 years	16 to 25 years	Over 25 years	Total
University professors	36	108	119	65	328
High school teachers	30	26	25	14	95
Total	66	134	144	79	423

Source: Authors' work

The three-item rating scale was used in the questionnaire to conduct high school teachers' and university professors' self-assessments of digital competencies. Each attribute label was assigned a value: foundation level (1), intermediate level (2), and advanced level (3). Our scale was summated, which meant that a summation of all attribute values of each subcategory selected by a respondent could be used.

Table 2
Research instrument

Digital competence	Knowledge /skill	Foundation level (1)	Intermediate level (2)	Advanced level (3)
Browsing, searching and filtering data, information, and digital content	Knowledge (Respondent chooses one of the three levels)	I know how to recognise and distinguish basic search engines in a digital environment.	I know how to search for and select advanced options for searching in a digital environment.	I know how to combine various resources (e.g. data basis, digital services) to get appropriate content.
Browsing, searching and filtering data, information, and digital content	Skills (Respondent choose one of the three levels)	I can apply basic search based on basic concepts and filtering options (e.g. text, images, videos) in a digital environment.	I can search by using advanced options (e.g. logical operators, complex expressions, symbols, and filters that enable a better result).	I can combine various sources for searching and make a solution for search based on tracking the Internet by using specialised tools like Really Simple Syndication.
Data, information, and digital content management	Knowledge (Respondent chooses one of the three levels)	I know how to recognise and distinguish simple formats for content storage.	I know how to interpret which data format is appropriate for storing various content.	I know how to reconsider different data formats and evaluate their durability and availability over a long period.
Data, information, and digital content management	Skills (Respondent choose one of the three levels)	I can consider and locate a place of local storage, show the organisation through folders, and show how to retrieve data based on the document name simply.	I can perform data storage through the appropriate format (e.g. photo in TIFF instead of JPEG format) and at different storage locations (e.g. local computer or another user's computer).	I can organise content storage and accessibility through the network environment (e.g. cloud) or digital repositories.
Data, information, and content sharing via digital technologies	Knowledge (Respondent chooses one of the three levels)	I know how to recognise that the content can be shared via digital technology (e.g. documents, calendars, and tasks can be sent via e-mail).	I know how to discover different applications for sharing information and content and how to interpret copyrights on information and content	I know how to distinguish professional and general systems for content sharing, choose a system that enhances interaction, communication and teamwork, and recognise the principles of open educational resources.
Data, information, and content sharing via digital technologies	Skills (Respondent choose one of the three levels)	I can demonstrate content sharing by using simple tools and applications (e.g. e-mail, MMS, social media) and present simple referencing of the information source.	I can follow the functionalities of digital tools for content sharing, implement protection of my content, and reference content sources or locations.	I can organise and combine content sharing through appropriate applications and adjust copyrights (permissions) to protect my information and content.

Digital competence	Knowledge /skill	Foundation level (1)	Intermediate level (2)	Advanced level (3)
Interacting (collaboration) through digital technologies	Knowledge (Respondent chooses one of the three levels)	I know how to describe and demonstrate some collaboration tools and their functionalities (e.g. document assignments, track changes, and comments).	I know how to interpret collaboration principles and ethics and demonstrate procedures that can be used in collaboration (e.g. document refreshing, demonstrating specifics of individual collaboration tools, and predicting the dynamics of collaboration).	I know how to devise real-time collaboration in a digital environment, predict collaboration tools that enable screen sharing and work in real-time on a document or task.
Interacting (collaboration) through digital technologies	Skills (Respondent choose one of the three levels)	I can demonstrate track changes functionalities using (e.g. changes, comments) in work on documents and apply simple collaboration tools for document sharing.	I can interact with different digital collaboration tools (e.g. social media and file sharing via cloud services) and follow advanced functionalities to achieve collaboration outcomes.	I know how to critically judge content creation for education and business and explore new formats for content creation.
Developing digital content	Knowledge (Respondent chooses one of the three levels)	I know how to recognise simple digital tools for creating different kinds of content and tools for knowledge presentation. I also demonstrate that digital content can be created by linking text, sound, and video.	I know how to use different digital tools and applications for creating and editing digital content and demonstrate the advantages and limitations of different digital formats.	I know how to critically judge content creation for education and business and explore new formats for content creation.
Developing digital content	Skills (Respondent choose one of the three levels)	I can apply several basic functions for creating digital content in simple form and demonstrate linking the content into a unit (outcome).	I can conduct my expression through different media (formats) and prepare my content for a different audience.	I can customise and edit digital content to create valuable and original content.
Programming	Knowledge (Respondent chooses one of the three levels)	I know how to describe a computer system's components and how it works and how automatic devices work.	I know to interpret and apply the basic principles of computational thinking and describe and give an example of an algorithm.	I know to distinguish programming languages, comment on the process of designing applications and programmes, and judge the connection between algorithms and programming languages.
Programming	Skills (Respondent choose one of the three levels)	I can demonstrate modification of some functions that the programmes use and interaction with a simple automated device.	I can perform writing a simple algorithm.	I can demonstrate a computer problem, apply procedures for problem-solving, and demonstrate the writing and modification of programming code.

Digital competence	Knowledge /skill	Foundation level (1)	Intermediate level (2)	Advanced level (3)
Protecting devices	Knowledge (Respondent chooses one of the three levels)	I know how to recognise the possibility that an unauthorised person can access the device without necessary permission and that computer viruses can harm digital content.	I know how to interpret actions that can make my digital environment (devices, applications) vulnerable to threats.	I know how to evaluate possible risks and their consequences on my own and other people's digital devices and digital content and analyse relevant standards and best protection practices.
Protecting devices	Skills (Respondent choose one of the three levels)	I can demonstrate how to install an antivirus program and create a strong password.	I can perform program and operating system upgrades and respond to non-default Internet downloads.	I can demonstrate diagnosing security threats and implementing a security storage procedure in case security measures fail.
Protecting personal data and privacy	Knowledge (Respondent chooses one of the three levels)	I know how to recognise the importance of personal data protection in a digital environment due to possible dangers and threats and to sort out which personal information I can publish.	I know how to explain the advantages and disadvantages of synchronising my profile with other tools and network services. I know how to apply measures in case of threats or digital violence.	I know how to evaluate the availability of my information in a digital environment and create and apply access restriction procedures.
Protecting personal data and privacy	Skills (Respondent choose one of the three levels)	I can choose a nickname to protect my identity and apply advanced passwords for personal accounts and devices.	I can perform identity protection by applying advanced profile settings options and creating different identities for personal protection against threats and fraud.	I can create my strategy for personal data and digital identity protection
Solving technical problems	Knowledge (Respondent chooses one of the three levels)	I know how to give an example of a technical problem with a digital device, operating system, and user program and to identify where I can find relevant information to solve the problem	I know how to interpret the mode and functionality of a digital device, operating system, and user program.	I know how to predict the emergence of a technical problem and categorise technical problems. I know how to assess the impact of technical problems on related activities within work and business.
Solving technical problems	Skills (Respondent choose one of the three levels)	I can identify a simple technical problem and choose the basic activities to solve it.	I can react to a technical problem appearance, seek the cause of the malfunction or problem, and implement a solution to the problem while finding an alternative way.	I can break the problem into smaller subproblems to optimise the solution and manage the error and fault monitoring system.

Digital competence	Knowledge /skill	Foundation level (1)	Intermediate level (2)	Advanced level (3)
Creative problem-solving by using digital technologies	Knowledge (Respondent chooses one of the three levels)	I know how to recognise that technology may be used for solving practical problems and creating new opportunities and more efficient execution of daily activities.	I know how to apply different digital tools functionalities to solve conceptual problems.	I know how to critically evaluate ways digital technologies contribute to knowledge creation and conceptual problem-solving.
Creative problem-solving by using digital technologies	Skills (Respondent choose one of the three levels)	I can demonstrate simple solutions to a particular problem with the help of simple technology and use simple program functionalities that enable the solution of a practical problem.	I can use different digital devices, tools, and programs and connect different digital technologies in designing solutions to conceptual problems and problem situations	I can design new processes and tools using digital technology, create innovative processes using digital technology, and develop new processes for applications, devices, tools or practice.

Note: Respondent chooses Foundation level, Intermediate level or advanced level for each knowledge and skill
Source: Authors' work

Collected data provided an opportunity to examine digital competencies according to various dimensions, e.g. by high school teachers and university professors, by individual and aggregated subcategories selected according to the knowledge, skills and both categories together, and by the length of experience in teaching. In examining the aggregate data addressing the proficiency level in knowledge and skills, as well as both categories, we designed two additional rating scales based on the total number of points that could be obtained.

Since there are ten categories, for each category the respondent could gather maximum of 6 points (3 points for skill or knowledge), indicating that the maximum value of digital competence is 30 points. If knowledge and skill are taken into account together, the maximum value of digital competence is 60 points.

To assess aggregated proficiency level of knowledge and skills, we assumed that foundation level was attained if a minimum of 10 and not more than 16 points. In the intermediate level, the range values were 17-23 points, and the advanced level was achieved if the number of points was higher than 23 but didn't exceed 30 points. Focusing on the knowledge and skills, we had to double the number of achievable points and the size of the ranges (foundation level - 20-33; intermediate level 34-47, and advanced level – 48-60).

To study the sample in-depth and better organise the obtained results, we used measures of descriptive statistics (e.g. mean, mode, median, quartile, minimum, maximum and skewness index). The last but not least step of our research, we checked how the proficiency level of digital knowledge and skills are correlated with each other.

Results

Summary analysis

The data show that the average level of self-assessed proficiency in digital tools and mobile technology is 36.0, which is at an intermediate level. It is higher for university professors than high school teachers in every presented dimension. In the case of

knowledge and skills taken separately, the proficiency level for knowledge is higher compared to skills (Table 3). The level of digital competencies is assessed as intermediate for the group of professors and teachers taken together and for professors only. However, in the case of teachers, it is intermediate for knowledge and low (but close to the intermediate limit) for skills.

Table 3
The average level of self-assessed high school teachers and university professors' proficiency in using digital tools and mobile technology in teaching economic disciplines

The average level of proficiency	Average university professors and high school teachers together	University professors	High school teachers
Average knowledge & skills together	18,0	18,6	**16,0**
Average Knowledge	18,4	18,9	16,5
Average Skills	17,6	18,2	15,4

Note: The value ranges for the total average proficiency are: foundation level – 20–33; intermediate level – 34–47; and advanced level – 48–60. The value ranges for knowledge and skills taken separately are foundation level 10–16 points, intermediate level 17–23, and advanced level 23–30.
Source: Authors' work

Teaching experience

A further study considered the level of digital competencies of the high school teachers and university professors' groups distinguished according to the length (number of years) of teaching experience (Table 4).

Table 4
Breakdown of high school teachers and university professors' digital competencies in teaching economic disciplines according to the length of teaching experience

Proficiency level	Up to 5 years	6 to 15 years	16 to 25 years	Over 25 years
High school teachers and university professors' group structure by proficiency level and the length of teaching experience (in%)[a]				
Foundation level	41%	33%	47%	61%
Intermediate level	41%	50%	35%	29%
Advanced level	18%	17%	18%	10%
Descriptive statistics measures[b]				
Mean	36.7	38.4	35.6	32.1
Median	37.0	39.0	34.5	29.0
Mode	38.0	40.0	31.0	20.0
1st quartile	29.0	31.0	27.0	23.0
3rd quartile	43.5	45.0	43.3	40.0
Minimum	20.0	20.0	20.0	20.0
Maximum	60.0	60.0	60.0	60.0
Skewness index	0.3	0.2	0.3	0.6

Note: [a]The % values express the share of teachers and professors in a total number of teachers and professors belonging to the reference group identified by the number of collected points in the self-assessment survey; Note: [b] Foundation level – 20–33; intermediate level – 34–47; and advanced level – 48–60.
Source: Authors' work

It can be noticed that the distributions of proficiency levels among teachers' and professors' teaching experience differ depending on the teaching experience length. The obtained results reveal that the distribution of proficiency is skewed positively for each of the highlighted periods. A low skewness coefficient and mean value

approximated to the median and mode values indicate that the distribution is fairly symmetrical for the 2 groups with maximum teaching experience of up to 15 years. Moreover, a higher share of teachers and professors with advanced competencies was reported for the first three groups (i.e. up to 5 years, 6 to 15 years and 16 to 25 years of teaching experience) than the fourth group (over 25 years of the length of teaching experience). Digital competencies are near the minimum proficiency level for the latter group. Their respondents assessed digital competencies at the minimum level (20 points were the most frequent value in this group), although 50% achieved at least 29 out of the possible 60 points. Teachers and professors with 6 to 15 years of teaching experience are the most digitally proficient. 75% of all teachers and professors in this group assessed their competencies above 31 out of 60 possible points. The professors and teachers working for more than 25 years rated their digital competencies at the lowest level among all listed categories. For the latter group, only 25% of the surveyed teachers and professors estimated their digital competencies at 40 or more points out of 60. But the self-assessment results are at the level of 40 points or below for 75% of the members of this group. Comparing the overall level of proficiency of the surveyed group, it should be recorded that more than 60% of the teachers and professors estimated their level of digital competencies at the foundation level in the group of teachers/professors with the longest teaching experience. Meanwhile, every second teacher/professor had digital competencies at the intermediate level in the group of teachers/professors working for at least 6 years but no more than 15 years (Table 4).

Comparing high school teachers and university professors' proficiency in using digital technologies and tools, we notice that it was at a similar level for the group of 16 to 25 years and up to 5 years of teaching experience. The most significant differences were recorded between the group of university professors and high school teachers with 16 to 25 years of teaching practice. For the 6 to 15 years employed by teachers and professors, the level of digital competencies achieved the value above most relevant groups at the same proficiency (about 1 to 2 points). At the same time, the group with the longest teaching experience was at the lower level compared to other groups on foundation and advanced levels (by about 2 or 3 points). Respondents with the longest teaching experience rated their intermediate level of digital competencies highest compared to all other groups (Table 5).

Table 5

The comparison of high school teachers' and university professors' proficiency levels of digital knowledge and using digital tools and mobile technology in teaching economic discipline according to the length of teaching experience

Proficiency level	Up to 5 years	6 to 15 years	16 to 25 years	Over 25 years
University professors and high school teachers (average value per reference group)				
Foundation level	27.1	27.0	26.2	24.6
Intermediate level	39.6	40.5	39.5	40.9
Advanced level	51.8	53.9	52.0	51.8
University professors (average value per reference group)				
Foundation level	26.5	27.9	27.0	25.0
Intermediate level	39.8	40.6	39.1	40.9
Advanced level	51.9	53.9	52.3	51.9
High school teachers (average value per reference group)				
Foundation level	27.5	25.1	22.6	23.3
Intermediate level	39.3	40.2	42.0	42.0
Advanced level	51.5	53.0	49.0	51.0

Note: Foundation level – 20–33; intermediate level – 34–47; and advanced level – 48–60.
Source: Authors' work

Then, a more detailed analysis of the knowledge possessed by teachers and professors and their ability to apply it in teaching economic courses were conducted, followed by the groups' characteristics and structure distinguished by proficiency level and the length of teaching experience (Table 6).

Table 6
Breakdown of high school teachers' and university professors' knowledge and skills regarding digitised instruments and technologies according to the length of teaching experience

Proficiency level	Up to 5 years	6 to 5 years	16 to 25 years	Over 25 years
Knowledge				
High school teachers and university professors' group structure according to proficiency level and the length of teaching experience (in%)				
Foundation level	38%	32%	42%	62%
Intermediate level	39%	43%	37%	25%
Advanced level	23%	25%	21%	13%
Descriptive statistics measures				
Mean	18.7	19.6	18.2	16.4
Median	18.0	19.0	17.0	15.0
Mode	14.0	14.0	17.0	10.0
1st quartile	14.0	15.0	13.0	12.0
3rd quartile	23.0	24.0	22.0	21.0
Minimum	10.0	10.0	10.0	10.0
Maximum	30.0	30.0	30.0	30.0
Skewness index	0.2	0.2	0.4	0.7
Skills				
High school teachers and university professors' group structure by proficiency level and the length of teaching experience (in%)				
Foundation level	38%	31%	48%	62%
Intermediate level	48%	54%	40%	30%
Advanced level	14%	16%	12%	8%
Descriptive statistics measures				
Mean	18.0	18.8	17.3	15.7
Median	18.0	19.0	17.0	15.0
Mode	20.0	20.0	10.0	10.0
1st quartile	14.0	15.0	13.0	11.0
3rd quartile	21.0	22.0	21.0	20.0
Minimum	10.0	10.0	10.0	10.0
Maximum	30.0	30.0	30.0	30.0
Skewness index	0.4	0.1	0.3	0.7

Note: The % values express the share of teachers and professors in a total number of teachers and professors belonging to the reference group identified by the number of collected points in the self-assessment survey: foundation level – range between 10–16 points; intermediate level – range between 17–23 points; advanced level – range between 24– 30 points.
Source: Authors' work

The breakdown of competencies into knowledge and skills results partly confirm the earlier findings. They also indicate inferior results in teachers' and professors' ability to use digital tools and mobile technologies compared to their knowledge in this field. One in 4 or 5 teachers and professors indicated having advanced knowledge of digitised teaching in the 3 identified groups up to 25 years of teaching. At the same time, only 13% of teachers and professors employed for more than 25 years rated their knowledge at this level. Moreover, most of the first two groups rated knowledge and skills at an intermediate level, and a foundation level was dominant among teachers

and professors working for at least 16 years. The mean value for each indicated group is at a lower level in the case of skills compared to knowledge, similar to the values obtained for the 3rd quartile. Thus, considering the latter index, a conclusion can be drawn that 75% in each group rated their skills in applying methods and tools of digitised education at least one or two points lower concerning their knowledge (Table 6).

Digital competencies subcategories

Similar observations, as in the case of analysing the proficiency level of using digital technologies and tools, can be made if the knowledge and skills are considered separately. Thus, it can be stated that the longer the teaching experience is, the lower the self-assessed knowledge of digitised tools among teachers and professors belonging to reference groups and the lower the self-assessed skills. Moreover, teachers and professors with 6 to 15 years of teaching experience are the most proficient in applying digital tools and technologies and have the most advanced knowledge in this area (Table 3 and Table 7).

Table 7

Self-assessment of the knowledge and skills possessed by high school teachers and university professors regarding digitised instruments and technologies according to the length of teaching experience

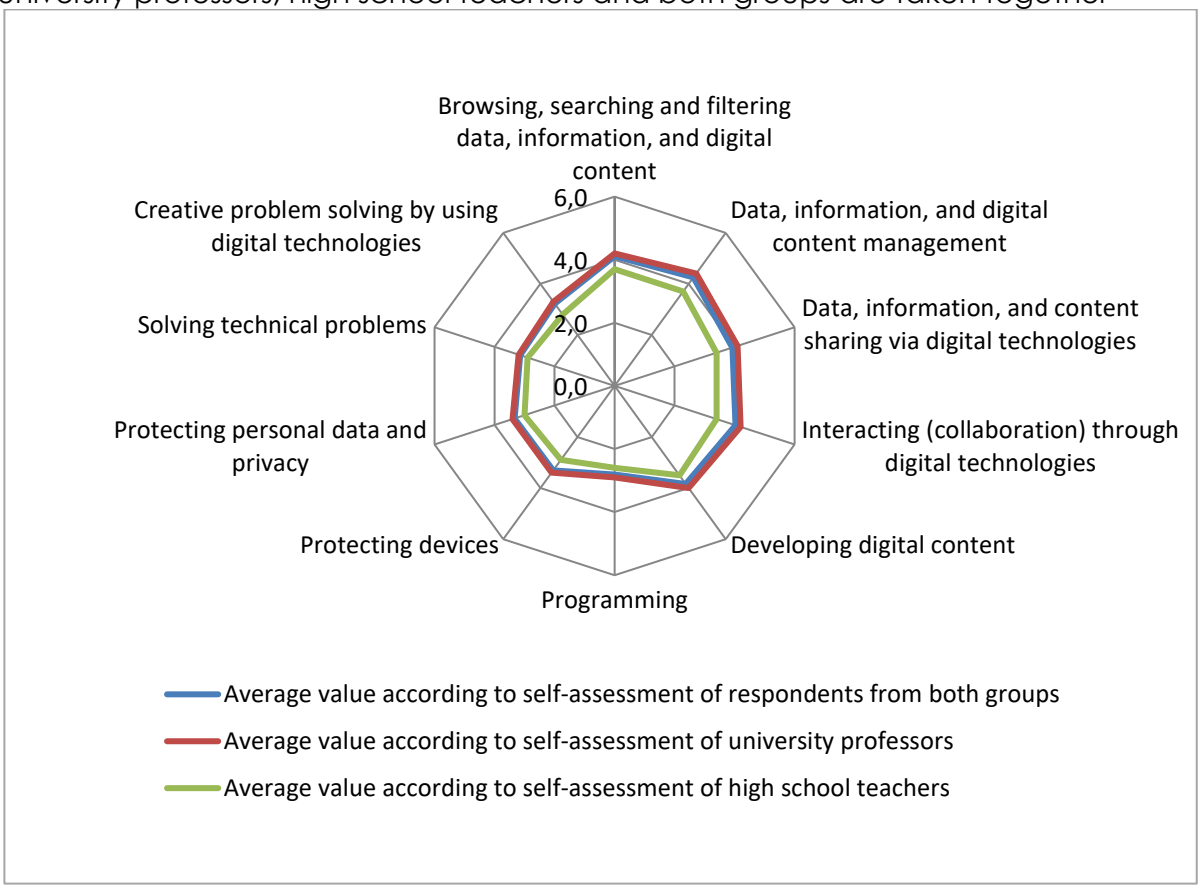
Proficiency level	**Up to 5 years**			**6 to 15 years**			**16 to 25 years**			**Over 25 years**		
Knowledge												
University professors and high school teachers (average value per reference group)												
	UniP & HST	UniP	HST	UniP & HST	UniP	HST	UniP & HST	UniP	HST	UniP & HST	UniP	HST
Foundation level	13.2	12.3	13.9	13.5	13.8	13.0	12.9	13.1	12.3	12.5	12.8	11.8
Intermediate level	19.6	19.9	19.3	20.0	20.0	20.0	19.6	19.5	20.8	20.9	20.8	22.0
Advanced level	26.1	26.4	25.3	26.6	26.7	25.3	26.6	26.9	24.8	26.6	26.6	27.0
Skills												
University professors and high school teachers (average value per reference group)												
	UniP & HST	UniP	HST	UniP & HST	UniP	HST	UniP & HST	UniP	HST	UniP & HST	UniP	HST
Foundation level	13.1	13.3	13.0	13.0	13.4	12.3	12.9	13.3	11.4	12.2	12.4	11.3
Intermediate level	19.6	19.8	19.3	19.8	19.8	19.7	20.1	19.9	21.0	20.3	20.3	20.0
Advanced level	26.2	26.0	28.0	26.6	26.6	26.0	26.1	26.3	24.0	25.8	26.2	24.0

Note: UniP&HST – University Professors and High School Teachers, UniP – University Professor, HST – High School Teacher; Foundation level – 20–33; intermediate level – 34–47; and advanced level – 48–60.

Source: Authors' work

The study on digital knowledge and its implementation into practice by high school teachers and professors was complemented by analysing categories distinguished in them.

Figure 1
The average value of the self-assessment of digital competence subcategories by the university professors, high school teachers and both groups are taken together



Note: Following the previously established rules for self-assessment of proficiency level, each respondent could assign between 1 (foundation level), through 2 (intermediate level) to 3 (advanced level) for each of the 10 listed subcategories relating separately to digitised knowledge and skills. When both components of digital competencies were considered together, it was possible to obtain between 3 and 6 points for one of the 10 subcategories.
Source: Authors' work

The average value of the self-assessment of digital competencies (knowledge and skills) is the highest in the case of data, information, and digital content management (Table 8 and Figure 1). It is also relatively high in the subcategories of knowledge and skills: Browsing, searching and filtering data, information, and digital content; Interacting (collaboration) through digital technologies; Data, information, and content sharing via digital technologies; Developing digital content. The lowest is in the case of Programming. A relatively low value of self-assessment is for: Solving technical problems, Creative problem solving by using digital technologies, Protecting devices, and Protecting personal data and privacy. It is worth emphasising that although the values of competency assessments are slightly lower for teachers than for professors, greater differences occur in the case of those types of digital knowledge and skills, which generally achieve relatively higher values of self-assessment. It refers especially to: Interacting (collaboration) through digital technologies; Browsing, searching and filtering data, information, and digital content; Data, information, and content sharing via digital technologies; Data, information, and digital content management (in skills). In the case of other types of competencies, the differences are smaller.

Table 8
The average level of digital competence subcategories in high school teachers and university professors' self-assessment (1-Foundation, 2-Intermediate, 3-Advanced)

Digital competence category	Average total (university professors and high school teachers together)		University professors		High school teachers	
	Knowledge	Skill	Knowledge	Skill	Knowledge	Skill
Browsing, searching and filtering data, information, and digital content	2.3	1.8	2.4	1.9	2.1	1.6
Data, information, and digital content management	2.0	2.2	2.1	2.4	1.9	1.8
Data, information, and content sharing via digital technologies	2.0	1.9	2.1	2.0	1.8	1.7
Interacting (collaboration) through digital technologies	2.1	2.0	2.1	2.1	1.8	1.7
Developing digital content	1.9	2.0	1.9	2.0	1.7	1.7
Programming	1.4	1.4	1.5	1.4	1.3	1.3
Protecting devices	1.7	1.6	1.7	1.7	1.5	1.4
Protecting personal data and privacy	1.7	1.6	1.8	1.7	1.5	1.5
Solving technical problems	1.6	1.6	1.6	1.6	1.4	1.4
Creative problem-solving by using digital technologies	1.6	1.6	1.7	1.6	1.4	1.4

Note: Self-assessment of digital competence: 1- Foundation, 2- Intermediate,3-Advanced
Source: Authors' work

Table 9 provides a more detailed overview of the proficiency level of knowledge on using certain digital tools and mobile technology. As in the previous analysis, the data show differences between groups of respondents with different lengths of teaching experience. But at the same time, there are similarities between the group with up to 5 years of teaching experience and the group with 6 to15 years of teaching experience. In both of these groups, the greatest gaps in knowledge (the highest percentage of indications for the basic level of knowledge) were found in the case of Programming, Solving technical problems, Creative problem-solving using digital technologies and Protecting digital content. The respondents from these groups demonstrate the highest level of knowledge measured by the highest share of indications for the advanced level of knowledge concerning Browsing, searching and filtering data, information, and digital content, as well as Interacting (collaboration) through digital technologies. They assessed their level of knowledge as moderate, with the highest percentage of indications for an intermediate level of knowledge concerning data, information, and digital content management and data, information, and content sharing via digital technologies.

Table 9
The proficiency level of knowledge on digital technologies and tools (in %)

Digital competence category	Up to 5 years			6 to 15 years			16 to 25 years			Over 25 years		
	Found.	Int.	Adv.	Found.	Int.	Adv.	Found.	Int.	Adv.	Found.	Int.	Adv.
Browsing, searching and filtering data, information, and digital content	18%	35%	47%	7%	40%	53%	14%	38%	49%	22%	51%	28%
Data, information, and digital content management	23%	59%	18%	13%	57%	30%	26%	49%	25%	33%	48%	19%
Data, information, and content sharing via digital technologies	29%	45%	26%	20%	49%	31%	28%	35%	36%	41%	38%	22%
Interacting (collaboration) through digital technologies	30%	26%	44%	28%	25%	46%	35%	27%	38%	43%	28%	29%
Developing digital content	32%	38%	30%	28%	45%	28%	39%	33%	28%	53%	30%	16%
Programming	61%	27%	12%	58%	33%	9%	63%	30%	7%	76%	16%	8%
Protecting devices	44%	35%	21%	38%	45%	17%	52%	31%	17%	61%	29%	10%
Protecting personal data and privacy	42%	38%	20%	36%	39%	25%	55%	25%	20%	66%	20%	14%
Solving technical problems	53%	33%	12%	45%	37%	19%	55%	36%	9%	65%	30%	5%
Creative problem-solving by using digital technologies	45%	39%	15%	43%	40%	16%	52%	36%	12%	62%	27%	11%

Found. – Foundation level, Int. – Intermediate level, Adv. – Advanced level
Note: The percentage of indications in a given group of teaching experience
Source: Authors' work

At the same time, the answers from the respondents from the other two groups, which include people with long experience in teaching, differ from the earlier ones. Still, they also show some similarities concerning each other. The highest number of indications for a low level of knowledge occurs in both groups (of 16 to 25 and 26 and more years of teaching experience) concerning Programming, Protecting personal data and privacy and Solving technical problems. The percentage of foundation-level indications is much higher in this respect than in groups with lower teaching experience. At the same time, in the case of the advanced level of knowledge category, there are differences between the two groups because for the group with 16 to 25 years of experience, the indications were mainly for Browsing, searching and filtering data, information, and digital content, and for the group over 25 years - Interacting (collaboration) through digital technologies. The intermediate level of knowledge was indicated by the respondents from groups 16 to 25, mainly concerning

data, information, and digital content management, and from the above 25 group - Browsing, searching and filtering data, information, and digital content (Table 9).

Table 10 presents the self-assessed proficiency level of digital skills possessed by high school teachers and university professors with different lengths of teaching experience.

Table 10
Self-assessment of possessing digital competencies (digital skills) (%)

Digital competence category	Up to 5 years			6 to 15 years			16 to 25 years			Over 25 years		
	Found.	Int.	Adv.	Found.	Int.	Adv.	Found.	Int.	Adv.	Found.	Int.	Adv.
Browsing, searching and filtering data, information, and digital content	36%	56%	8%	23%	64%	13%	33%	52%	15%	45%	49%	6%
Data, information, and digital content management	21%	32%	47%	14%	28%	58%	24%	32%	44%	34%	42%	24%
Data, information, and content sharing via digital technologies	27%	53%	20%	24%	51%	25%	32%	45%	23%	42%	44%	14%
Interacting (collaboration) through digital technologies	23%	55%	23%	17%	52%	31%	35%	36%	29%	44%	41%	15%
Developing digital content	29%	47%	24%	28%	37%	35%	33%	38%	29%	47%	35%	18%
Programming	68%	20%	12%	72%	16%	12%	74%	18%	8%	81%	10%	9%
Protecting devices	45%	42%	12%	37%	48%	16%	54%	34%	12%	66%	29%	5%
Protecting personal data and privacy	42%	41%	17%	43%	47%	10%	51%	40%	10%	59%	34%	6%
Solving technical problems	47%	39%	14%	45%	44%	11%	58%	36%	6%	63%	32%	5%
Creative problem-solving by using digital technologies	42%	48%	9%	42%	48%	10%	52%	43%	5%	59%	34%	6%

Found. – Foundation level, Int. – Intermediate level, Adv. – Advanced level
Source: Authors' work

The results are somewhat similar to digital knowledge self-assessment, but with some differences. Again, there are similarities between the group with up to 5 years of teaching experience and the group with 6 to 15 years of teaching experience. In both of these groups, the greatest gaps in digital skills (the highest percentage of indications for the foundation level of knowledge) were found in the case of Programming and Solving technical problems, but this is also the case with teachers and professors from the 16 to 25 years of experience, even if their skills gap seems to be smaller in this

respect. The highest number of indications for a low level of skills was recorded in the group with 26 and more years of teaching experience concerning Programming and Protecting devices. The gap in these skills is much greater than that of the other three groups of teachers with fewer years of teaching experience. Teachers and professors with up to 5 years of teaching experience and the group with 6 to15 years of teaching experience assessed their level of skills as moderate, mostly in the case of data, information, and content sharing via digital technologies and Interacting (collaboration) through digital technologies. In turn, the highest percentage of teachers and professors of 16 to 25 and above with 25 years of experience assessed their skills as intermediate in Browsing, searching and filtering data, information, and digital content and data, information, and content sharing via digital technologies. In all the groups, the types of digital skills indicated most often as advanced (compared to other skills) were data, information, and digital content management. However, the percentage of indications is different depending on the experience range – the highest is for professors and teachers with 6 to 15 years of experience (58%), and the lowest is for respondents with over 25 years of teaching experience (24%) (Table 10).

Table 11
The correlation between knowledge and skills in self-assessment of digital competencies by university professors and high school teachers

Proficiency	Up to 5 years		6 to15 Years		16 to 25 years		Over 25 years	
	UniP	HST	UniP	HST	UniP	HST	UniP	HST
Browsing, searching and filtering data, information, and digital content	0.59***	0.64***	0.32***	0.56***	0.58***	0.61***	0.62***	0.65**
Data, information, and digital content management	0.42**	0.42***	0.47***	0.53**	0.62***	0.69***	0.76***	0.47*
Data, information, and content sharing via digital technologies	0.59***	0.67***	0.52***	0.60***	0.69***	0.88***	0.62***	0.44
Interacting (collaboration) through digital technologies	0.48***	0.45**	0.65***	0.50***	0.70***	0.92***	0.79***	0.83***
Developing digital content	0.61***	0.73***	0.74***	0.79***	0.78***	0.95***	0.79***	0.86***
Programming	0.86***	0.63***	0.79***	0.65***	0.71***	0.77***	0.86***	0.81***
Protecting devices	0.78***	0.64***	0.65***	0.67***	0.60***	0.61***	0.78***	1.00
Protecting personal data and privacy	0.71***	0.75***	0.57***	0.55***	0.74***	0.79***	0.78***	0.78***
Solving technical problems	0.69***	0.70***	0.73***	0.91***	0.67***	0.73***	0.81***	1.00
Creative problem-solving by using digital technologies	0.75***	0.71***	0.66***	0.72***	0.76***	0.79***	0.80***	1.00

*Note: UniP – university professor; HST – high school teacher, Statistical significance: *** p<0.01; ** p<0.05; *p<0.1*
Source: Authors' work

The correlation analysis results carried out using the Pearson correlation index generally indicate a moderate (in the range of 0.4-0.6) to strong (in the range of 0.6-0.8) level of correlation between individual components of digital knowledge and

skills. Very strong dependence was rarely noted. There were no big differences between teachers and professors with different professional experiences, while a stronger correlation was noted for some particular subcategories (Programming, Solving technical problems) (Table 11).

Discussion

Our research revealed that the total average level of self-assessed proficiency in using digital tools and mobile technology in teaching economic disciplines is intermediate for the group of professors and teachers. Both for knowledge and skills, digital competencies are not perceived as weak. Still, the results leave room for improvement since values do not exceed the high-level limit in any of the dimensions under consideration. And in the teachers' case, their digital skills were even assessed as low. These findings, providing evidence for the existence of digital differences in higher and tertiary education related to the research questions RQ1 and RQ2, are in line with some other studies which also show existing gaps in digital knowledge and skills, even if they were conducted with the use of different methodology (Radovanović et al., 2015; Rodríguez-Abitia et al., 2020; Hämäläinen et al., 2021). The shift towards digital learning during the global Covid-19 pandemic has revealed the medium's advantages in interactive, immersive and personalised learning.

On the other hand, the change has also brought to light the serious challenges that educators and policymakers are faced with - while trying to foster digital skills and to ensure digital literacy education for all, in line with The UN's 2030 Agenda for Sustainable Development (Duraiappah 2020). The need for permanent improvement and development of digital teaching skills was underlined by Fernandez-Batanero et al. (2021). Based on a review and analysis of the literature, they concluded still scarce ICT knowledge and teaching training in this field, which according to the authors, is one of the essential elements of the teaching-learning process.

One of the most striking findings of our research concerning the research question RQ2 was that the proficiency level varies depending on the number of years of teaching experience. Still, teachers with the most experience (over 25 years) do not have the highest digital competencies. Moreover, people who teach with the lowest experience - up to 5 years, do not have them either. The most digitally literate are people with teaching experience from 6 to 15 years. This may indicate the need to motivate people with longer work experience to constantly improve their competencies and learn long life, which aligns with the priorities captured in Sustainable Development Goal 4 (SDG 4) (UNESCO, 2017). In this regard, there is not much difference between university professors and high school teachers. However, there are bigger differences between these two groups of educators when considering the more detailed subcategories of digital knowledge and skills.

The results revealed some strengths and weaknesses regarding these subcategories, thus providing an answer to one of our key research questions (RQ3). Competence is the highest in the case of data, information, and digital content management (Table 7 and Figure 1). It is also relatively high in the case of such types of knowledge and skills as Browsing, searching and filtering data, information, and digital content; Interacting (collaboration) through digital technologies; Data, information, and content sharing via digital technologies; Developing digital content. The lowest is in the case of Programming. Relatively low is for: Solving technical Problems, Creative problem solving by using digital technologies, Protecting devices, and Protecting personal data and privacy. It is worth emphasising that although the values of competency assessments are slightly lower for teachers than for professors, greater differences occur in the case of those types of digital knowledge and skills

which, in general, achieve relatively higher values of self-assessment, such as, e.g. Interacting (collaboration) through digital technologies; Browsing, searching and filtering data, information, and digital content; Data, information, and digital content management, Data, information, and content sharing via digital technologies. In the case of other types of competencies, the differences are smaller.

Further answering the research question, in part regarding the correlation between knowledge and skills, we observed with some surprise that there is a correlation between the categories, but not very strong. A higher level of knowledge does not always translate into higher skills.

Study limitations are based on self-assessment of competencies by professors and teachers. Thus the results cannot be fully reliable, e.g. data gathered can be overestimated or underestimated. On the other hand, other research has affirmed reliability in similar cases, however, to a modest extent. The research instrument itself, which is the CAWI survey, has its typical limitations - if a question isn't easily understood, the lack of direct contact may be considered a drawback. Alternatively, a survey that fails to keep the respondent's attention may result in low-quality responses and skewed data. Yet, we believe that it provided wide access to the opinions of professors and teachers from different countries.

Conclusion

An important outcome of the study is a deeper understanding of digital competencies from university professors' and high school teachers' perspectives. Our results reveal that the total self-assessed competence level is intermediate, with slightly higher values for ICT knowledge than ICT skills, and for university professors than for teachers. Considering the different subcategories of competencies, the average value of the self-assessment of digital competencies (knowledge and skills) is the highest in the case of Data, information, and digital content management; Browsing, searching and filtering data, information, and digital content; Interacting (collaboration) through digital technologies; Data, information, and content sharing via digital technologies; Developing digital content. The lowest is for: Programming. The relatively low value of self-assessment is for: Solving technical problems, Creative problem solving by using digital technologies, Protecting devices, and Protecting personal data and privacy.

The proficiency level varies depending on the number of years of teaching experience, but teachers with the most experience do not have the highest digital competencies. The most digitally literate are people with teaching experience from 6 to 15 years. This may indicate the need to motivate people with longer work experience to improve their competencies and learn long life constantly.

We believe that our research findings, which revealed variations and gaps in digital knowledge and skills among professors and teachers, may have significant policy implications for policymakers and educators committed to ensuring quality education.

The main limitation of our research is that it focuses only on the self-assessment of digital competencies by professors and teachers. Thus, the results are subjective and cannot be fully reliable, e.g. data gathered can be overestimated or underestimated.

Further and broader research is needed to identify the tools supporting the knowledge and skills development specific to a different area of interest in the economic discipline. Further research directions could be complemented by analysing students' evaluation of digital methods and tools in teaching and learning. Future research could be deepened regarding appropriate tools and technologies to support learning and enhance knowledge. The latter issue is especially important for

high school teachers. Further research could also identify weaknesses, strengths, and areas of interest within the economic discipline. We looked at digital competencies only from the teachers' perspective, and it would also be important to identify the gaps that exist from the student's perspective.

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References

1. Adedoyin, O. B., Soykan, E. (2020), "COVID-19 Pandemic and Online Learning: The Challenges and Opportunities", Interactive Learning Environment, pp. 1-13. Albion, P. R., Tondeur, J., Forkosh-Baruch, A., Peeraer, J. (2015), "Teachers' professional development for ICT integration: Towards a reciprocal relationship between research and practice", Education and Information Technologies, Vol. 20, No. 4, pp. 655-673.
2. Alonso-García, S., Aznar-Díaz, I., Cáceres-Reche, M.-P., Trujillo-Torres, J.-M., Romero-Rodríguez, J.-M. (2019), "Systematic Review of Good Teaching Practices with ICT in Spanish Higher Education. Trends and Challenges for Sustainability", Sustainability, Vol. 11, No. 24, pp. 1-15.
3. Al-Senaidi, S., Lin, L., Poirot, J. (2009), "Barriers to adopting technology for teaching and learning in Oman", Computers and Education, Vol. 53, No. 3, pp. 575-590.
4. Baartman, L. K. J., de Bruijn, E. (2011). "Integrating knowledge, skills and attitudes: Conceptualising learning process towards vocational competence", Educational Research Review, Vol. 6, No. 2, pp. 125-134.
5. Bøe, T., Gulbrandsen, B., Sørebø, O. (2015), "How to stimulate the continued use of ICT in higher education: Integrating Information Systems Continuance Theory and agency theory", Computers in Human Behavior, Vol. 50, pp. 375-384.
6. Bond, M., Marín, V. I., Dolch, C., Bedenlier, S., Zawacki-Richter, O. (2018), "Digital transformation in German higher education: student and teacher perceptions and usage of digital media", International Journal of Educational Technology in Higher Education, Vol. 15, No. 1, pp. 1-20.
7. Davis, F. D. (1989), "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology", MIS Quarterly, Vol. 13, No. 3, pp. 319-340.
8. Dhawan, S. (2020), "Online Learning: A Panacea in the Time of COVID-19 Crisis", Journal of Educational Technology Systems, Vol. 49, No. 1, pp. 5-22.
9. Duraiappah, A. (2020), "Recreating Novel Learning Spaces for the Post-Pandemic World", available at: https://unesdoc.unesco.org/ark:/48223/pf0000374276 (18 July 2022)
10. Eickelmann, B., Vennemann, M. (2017), "Teachers'attitudes and beliefs regarding ICT in teaching and learning in European countries", European Educational Research Journal, Vol. 16, No. 6, pp. 733-761.
11. Eteokleous, N. (2008), "Evaluating computer technology integration in a centralised school system", Computers and Education, Vol. 51, No. 2, pp. 669-686.
12. Fernández-Batanero, J. M., Román-Graván, P., Montenegro-Rueda, M., López-Meneses, E., Fernández-Cerero, J. (2021), "Digital Teaching Competence in Higher Education: A Systematic Review", Education Sciences, Vol. 11, No. 689, pp. 1-10.
13. Fernández-Cruz, F. J., Fernández-Díaz, M. J. (2016), "Generation z's teachers and their digital skills", Comunicar, Vol. 24, No. 46, pp. 97-105.
14. García-Valcárcel, A., Basilotta, V., López García, C. (2014), "ICT in collaborative learning in the classrooms of primary and secondary education", Comunicar, Vol. 21, No. 42, pp. 65-74.

15. Gulbahar, Y., Guven, I., (2008), "A survey on ICT usage and the perceptions of social studies teachers in Turkey", Journal of Educational Technology & Society, Vol. 11No. 3, pp. 37-51.
16. Hajdukiewicz, A., Pera, B. (2020), "Education for Sustainable Development—The Case of Massive Open Online Courses". Sustainability 2020, Vol. 12, No. 20, Art. 8542, pp.1-20.
17. Hämäläinen, R., Nissinen, K., Mannonen, J., Lämsä, J., Leino, K., Taajamo, M. (2021), "Understanding teaching professionals' digital competence: What do PIAAC and TALIS reveal about technology-related skills, attitudes, and knowledge?", Computers in Human Behavior, Vol. 117, pp. 1-15.
18. Hsu, S. (2011), "Who assigns the most ICT activities? Examining the relationship between teacher and student usage", Computers and Education, Vol. 56, No. 3, pp. 847-855.
19. Hussein, Z. (2017), "Leading to Intention: The Role of Attitude in Relation to Technology Acceptance Model in E-Learning", Procedia Computer Science, Vol. 105, pp. 159-164.
20. König, J., Jäger-Biela D. J., Glutsch, N. (2020), "Adapting to online teaching during COVID-19 school closure: teacher education and teacher competence effects among early career teachers in Germany", European Journal of Teacher Education, Vol. 43, No. 4, pp. 608-622.
21. Kreijns, K., van Acker, F., Vermeulen, M., van Buuren, H. (2013a), "What stimulates teachers to integrate ICT in their pedagogical practices? The use of digital learning materials in education", Computers in Human Behavior, Vol. 29, No. 1, pp. 217-225.
22. Kreijns, K., Vermeulen, M., Kirschner, P. A., van Buuren, H., van Acker, F. (2013b), "Adopting the Integrative Model of Behaviour Prediction to explain teachers' willingness to use ICT: A perspective for research on teachers' ICT usage in pedagogical practices", Technology, Pedagogy and Education, Vol. 22, No. 1, pp. 55-71.
23. Leal Filho, W., Wu, Y. J., Brandli, L. L., Veiga Avila, L., Azeiteiro, U. M., Caeiro, S., Rejane da Rosa Gama Madruga, L. (2017), "Identifying and overcoming obstacles to the implementation of sustainable development at universities", Journal of Integrative Environmental Sciences, Vol. 14, No. 1, pp. 93-108.
24. Levano-Francia, L., Sanchez Diaz, S., Guillén-Aparicio, P., Tello-Cabello, S., Herrera-Paico, N., Collantes-Inga, Z. (2019), "Digital Competences and Education", Journal of Educational Psychology - Propósitos y Representaciones, Vol. 7, No. 2, pp. 569-588.
25. Lim, C. P., Tondeur, J., Chai, C. S. (2013), "Bridging the Gap: Technology Trends and Use of Technology in Schools" Educational Technology & Society, Vol. 16, No. 2, pp. 59-68.
26. Livingstone, S. (2012), "Critical reflections on the benefits of ICT in education", Oxford Review of Education, Vol. 38, No. 1, pp. 9-24.
27. Mac Callum, K., Jeffrey, L., Na, K. (2014), "Factors Impacting Teachers' Adoption of Mobile Learning", Journal of Information Technology Education: Research, Vol. 13, pp. 141-162.
28. Martin, S., Diaz, G., Sancristobal, E., Gil, R., Castro, M., Peire, J. (2011), "New technology trends in education: Seven years of forecasts and convergence", Computers& Education, Vol. 57, No. 3, pp. 1893-1906.
29. Mishra, L., Gupta, T., Shree, A. (2020), "Online Teaching-Learning in Higher Education during Lockdown Period of COVID-19 Pandemic", The International Journal of Educational Research Open, Vol. 1, pp. 1-8.
30. Mortenson, M. J., Vidgen, R. (2016), "A computational literature review of the technology acceptance model", International Journal of Information Management, Vol. 36, No. 6, Part B, pp. 1248-1259.
31. Mseleku, Z. (2020), "A literature Review fo E-Learning and E-Teaching in the Era of Covid-19 Pandemic", International Journal of Innovative Science and Research Technology, Vol. 5, No. 10, pp. 588-597.
32. Petko, D. (2012), "Teachers' pedagogical beliefs and their use of digital media in classrooms: Sharpening the focus of the "will, skill, tool" model and integrating teachers' constructivist orientations", Computers and Education, Vol. 58, No. 4, pp. 1351-1359.
33. Radovanović, D., Hogan, B., Lalić, D. (2015), "Overcoming digital divides in higher education: Digital literacy beyond Facebook", New Media & Society, Vol. 17, No. 10, pp. 1-7.
34. Ramirez-Montoya, M. S. (2020). "Challenges for Open Education with Educational Innovation: A Systematic Literature Review", Sustainability, Vol. 12, No. 17, pp. 1-16.

35. Rodríguez-Abitia, G, Martínez-Pérez, S., Ramirez-Montoya, M. S., Lopez-Caudana, E. (2020), "Digital Gap in Universities and Challenges for Quality Education: A Diagnostic Study in Mexico and Spain", Sustainability, Vol. 12, No. 21, pp. 1-14.
36. Scherer, R., Tondeur, J., Siddiq, F., Baran, E. (2018), "The importance of attitudes toward technology for pre-service teachers' technological, pedagogical, and content knowledge: Comparing structural equation modeling approaches", Computers in Human Behavior, Vol. 80, pp. 67-80.
37. Sepasgozaar, S. M. E., Shirowzhan, S., Wang, C. (2017), "A Scanner Technology Acceptance Model for Construction Projects", Procedia Engineering, Vol. 180, pp. 1237-1246.
38. Siddiq, F., Scherer, R., Tondeur, J. (2016), "Teachers' emphasis on developing students' digital information and communication skills (TEDDICS): A new construct in 21st century education", Computers and Education, Vol. 92-93, pp. 1-14.
39. Tezci, E. (2011), "Factors that influence pre-service teachers' ICT usage in education", European Journal of Teacher Education, Vol. 34, No. 4, pp. 483-499.
40. UNESCO (2017), "Education for Sustainable Development Goals. Learning Objectives", The United Nations Educational, Scientific and Cultural Organization, UNESCO Publishing, Paris.
41. Vitello, S., Greatorex, J., Shaw, S. (2021), "What is competence? A shared interpretation of competence to support teaching, learning and Assessment", available at https://www.cambridgeassessment.org.uk/Images/645254-what-is-competence-a-shared-interpretation-of-competence-to-support-teaching-learning-and-assessment.pdf (17 July 2022)
42. Ward, L., Parr, J. M. (2010), "Revisiting and reframing use: Implications for the integration of ICT", Computers and Education, Vol. 54, No. 1, pp. 113-122.
43. Winter, E., Costello A., O'Brien, M., Hickley, G. (2021), "Teachers' use of technology and the impact of Covid-19", Irish Education Studies, Vol. 40, No. 2, pp. 235-246.
44. Zeqiri, J., Kareva, V., Alija, S., & Bach, M. P. (2022). Challenges and opportunities for higher education in North Macedonia during the COVID-19 pandemics: a survey of student satisfaction and gender-related anxiety. International Journal of Technology Enhanced Learning, 14(2), 163-179.

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Who is more eager to use Gamification in Economic Disciplines? Comparison of Students and Educators

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Abstract

Background: In this paper, the focus is on the application of digital and mobile technologies as supporting tools for the implementation of gamification in the field of education of future economists. **Objectives:** The paper's main objective is to explore whether educators and students are motivated and willing to apply additional technologies as main gamification components in their work and education. Moreover, the paper aims to assess how their more comprehensive application affects the quality of teaching, work flexibility, new learning opportunities, and outcomes. **Methods/Approach:** The survey method was used to collect answers from educators and students primarily interested in accounting, finance, trade and tourism from higher and secondary education institutions in Croatia, Poland, Serbia and Germany. Afterwards, the responses were compared using statistical methods. **Results:** Research results confirm that educators and students are willing to use gamification in teaching. Still, they also expressed the need for better administrative support in using particular e-learning tools. Surprisingly, educators are more eager to use gamification in their work than students. **Conclusions:** The study's general conclusion is that educators and students are both aware of the advantages of using e-learning tools provided through digital and mobile technologies and are eager to implement more gamification in the teaching process. However, continuous education in applying new digital technologies is needed on both sides.

Keywords: Gamification; digital technologies; mobile technologies; teaching process; students; educators; secondary education; higher education; economic disciplines

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Introduction

It is an indisputable fact that the teaching process needs to be regularly innovated, updated and made more accessible and acceptable to the students for whom they are intended, which means keeping up with modern teaching methods and technology development. According to Qureshi et al. (2021, p. 35), "consistent development and technology enlargement create space for the digital transformation of education." Nowadays, it is often emphasized that educators should use different teaching methods and approaches that will enable the active participation of students in the teaching process with strong motivation and engagement in their learning (Kiryakova, 2014). In this context, new innovative teaching methods that educators can apply in the teaching process, such as gamification, flipped learning, project-based learning, role-based learning, non-formal education, learning by doing and others, stand out. In recent years, particular emphasis has been placed on applying gamification at different levels of education, from primary, secondary, and higher to adult education. Rabah et al. (2018, p. 2) define gamification in education as the "use of game design elements in the teaching to support the acquisition of course-specific learning objectives." There are many different positive effects of the application of gamification in education, such as increasing student motivation and achievement in the classroom (Stott et al., 2013), optimizing students learning (Smiderle et al., 2020), enhancing learners' engagement and improving learning outcomes (Nah et al., 2014) as well as improving teaching and learning environments (Parra-Gonzalez et al., 2021). Moreover, the gamification of the teaching process can foster innovation in education and make them sustainable (Llorens-Largo et al., 2016).

Although the use of gamification in education is not a new concept, according to DeBurr (2013), it dates back to the 1980s, its wider use has only intensified in recent years, and its popularity is constantly growing (Majuri et al., 2018). According to bibliographic research (Swacha, 2021), there has been a continuous growth of publications in the field of gamification in education in the last seven years, with the USA, Spain, the UK and Germany leading in the number of surveys on this topic. In addition to education, gamification is widely applicable in business, marketing, corporate management, fitness, wellness, health and ecology (Rabah et al., 2018; Dicheva et al., 2015). Dicheva et al.'s (2015) study shows that the early adopters of gamification in education are mostly computer science/IT educators. It is worth noting that, with the emergence of new technologies and ubiquitous digitalization, the trend of gamification in education and learning is even more pronounced.

Namely, it is known that the application of gamification in teaching is possible with and without the use of digital technologies. In this paper, the focus is on the application of digital and mobile technologies as supporting tools for the implementation of gamification in the field of education of future economists. Therefore, the paper's main objective is to explore whether educators and students in faculties of economics and secondary economic schools are motivated and willing to apply different digital tools to the teaching process. This survey aims to assess how their wider application affects the quality of teaching, flexibility in work, new learning opportunities, and learning outcomes. Since gamification can be implemented through digital or mobile technologies, it is necessary to distinguish these terms. It can be said that digital technologies are a broader concept than mobile technologies where Stegmann (2020, in Sailer et al., 2021, p. 4) defines digital technologies as "computer-based technologies that present domain-general and domain-specific content and/or allow for interaction with or about the content and support educators and/or students during that interaction". On the other hand, mobile technologies are

"any kind of Internet or communication service or electronic device (smartphones, tablets, laptops and similar) that supports educators and students in learning activity" (Davison et al., 2015, p. 35).

The research on the attitudes of the respondents about the application of more digital tools in the education processes was conducted on a sample of educators and students of economic faculties and secondary economic schools, i.e. partner institutions implementing the DIGI4Teach Erasmus+ project of strategic partnership as well as other associated partners from partner countries of Croatia, Poland, Serbia and Germany. In this paper, "educators" refers to both secondary school educators and university educators, while "students" refers to secondary school students and university students unless otherwise stated. The research was developed using the questionnaire and was conducted between November 2021 and January 2022. For this paper, questions regarding the impact of simulation games on improving the teaching process's outcomes have been analyzed to see whether educators and students are ready to apply gamification for educational purposes. To respond to the set goals of this research, four research questions (RQs) were set:

- *RQ1: Are the attitudes of educators and students about the introduction of more digital tools into the teaching process different?*
- *RQ2: Whether the perception of educators and students regarding the impact of simulation games on improving the outcome of the teaching process differs?*
- *RQ3: Whether both educators and students think that multimedia materials (audio and video materials, games, etc.), which can be used in e-learning, make the learning process more fun?*
- *RQ4: Does educators' perception of the necessity for greater administrative support they need while using e-learning tools in the teaching process differ from the perception of students' need for such support?*

The paper is structured through six main chapters. After the introduction, the concept of game-based learning was defined, and the advantages and disadvantages of applying digital technologies in the teaching process were presented and discussed. After that, the methodology and the most significant descriptive and inferential statistics results were presented. Finally, in the discussion section, the results and expectations of the authors regarding all the research questions were analyzed.

To get acquainted with the key terminology, the nature of the problem and the current state of knowledge, below is a theoretical framework that explains the motives of the research as well as the gap in the existing literature of the research on this topic.

Background

"Gamify your life!" (Strahringer et al., 2017). This sounds simple but requires a deeper look. The term gamification is used in various contexts these days. For example, customers can collect points at the supermarket, hotel customers can submit ratings, or students can learn by taking quizzes. Game mechanisms are used in corporate information systems and education at schools and universities. In particular, leader boards, progress indicators, and rewards are designed to increase motivation. This raises the question of suitable tools and applications, the right approach, and the effects that actually arise. The game itself and the resulting benefits have to be considered (Strahringer et al., 2017). To deal with the topic in a well-founded manner, the following definitions of the relevant terms are necessary.

Game-based learning

The heart of game-based learning is the learning of knowledge based on a game. This general definition covers many day-to-day situations. It makes no statement about the form of the game, the type of relevant knowledge, the framework conditions, or the target group. The game choice is based on the desired outcomes (Feil et al., 2005; Teuteberg et al., 2017). A wide variety of games is possible. Strategic games, for example, could teach how to use resources efficiently. Role-playing games train certain behaviours. Action games, on the other hand, improve motor skills. An important element of any game is the social sub-action among the participants (Teuteberg et al., 2017).

Board game simulations and digital game-based learning can be distinguished as game-based learning. The board game simulations are simple haptic games that are not digital. They can help to learn basic knowledge for a topic. In contrast, digital game-based learning refers to a learning process using digital players (Breuer et al., 2010; Teuteberg et al., 2017). A common feature with board game simulations is the possibility of rule-based management and control of participants' actions and interactions. However, in digital game-based learning, there are more decision parameters and interactions among the parameters than in board game simulations. This results in greater complexity. In addition, various digital components serve as support. For example, audio-visual effects are important to stimulate more attention and willingness to continue playing. Another difference is that digital games can be stored. Furthermore, active networking with other players is possible (Teuteberg et al., 2017).

Serious games are to be distinguished from game-based learning, and these represent a variant of game-based learning. Here, games serve as an instrument for imparting knowledge and supporting learning (Abt, 1987). Serious games are software-based games that simulate reality with audio-visual support. They stimulate various instincts in the players, and certain tasks can be mastered effectively and efficiently. In distinction to this, entertainment games have a different approach: Problem-solving and learning are not the top priority in entertainment games (Susi et al., 2007; Teuteberg et al., 2017).

Areas of application of serious games are especially schools and universities. Serious games make it easier to learn new lessons and consolidate already learned knowledge (Liarokapis et al., 2010). Serious games are used, for example, in training doctors, who can learn to perform successful operations in a virtual operating room, and the focus is on learning the procedures (Sabri et al., 2010). For a detailed discussion of serious games, see Teuteberg et al. (2017).

Business games are widely used in education and business. They represent an application of serious games and serve for training, further education, and evaluation (Greco et al., 2013). Business games have been continuously developed since the 1950s (Teuteberg et al., 2017). For details, see Teuteberg et al. (2017). Unquestionably, simulation games for managers play a "significant role in the education of future business professionals because, through analytical methods and their logic, they prepare them for decision-making in the real business world" (Pejić Bach et al., 2017).

Gamification

A uniform definition of the term gamification does not yet exist. The prevailing opinion in the literature (e.g., evaluation of 119 papers by Caponetto et al., 2014) describes gamification as using game elements in non-game contexts. However, the potential of gamification goes further than this definition, and gamification makes it possible to increase learners' motivation and participation in learning processes (Stieglitz, 2015).

Elements considered here include points, leaderboards, contests, virtual currencies, awards, and notifications with feedback (Fischer et al., 2017, citing further papers).

Gamification has been known since the 1980s. At that time, computer games were analyzed to gain insights into how learning processes could be improved. Gamification applications target the human play instinct. The focus is on elements that can also be found in computer games. The aim is to increase concentration and commitment to a task (Deterding et al., 2011; Anderson et al., 2012). This leads to better learning outcomes and increased motivation. The task could be solved more successfully (Huotari et al., 2012).

Due to growing digitalization and the widespread use of mobile devices nowadays, the possibilities have become more extensive. Gamification applications serve, for example, to acquire knowledge in education, influence employee behaviour, and interact with customers. It is easy to activate a large number of people and let them, for example, compete against each other to improve their performance. Achievements can thus be compared (Teuteberg et al., 2017).

It is important to note that serious games aim to impart knowledge and learn about systems' interactions, and they help to experience and simulate reality via games. Gamification applications, on the other hand, serve to explain, learn, and influence social behaviour (Herranz et al., 2013). This is achieved using elements also applied in serious games (Perrotta et al., 2013; Teuteberg et al., 2017).

Gamification at secondary schools and universities

Progressive digitization and changes in job requirements have an important impact on teaching at schools and universities. New dynamics and trends have emerged, one of which is gamification in teaching. Evaluations show that in 2010, almost no scientific papers were published on this topic. A few years later, there are already thousands of papers in Google Scholar and Scopus (Hamari et al., 2014). Gamification will probably not be a short-term trend but an integral part of educational practice in schools and universities (Fischer et al., 2017).

Gamification at schools and universities focuses on students' behaviour in the learning process, especially the search for solutions, communicating with other students, and presenting the results. For example, points, badges, leaderboards, levels, and ranks act as game elements (Fischer et al., 2017).

Certain game mechanics are the basis of the games, i.e., mechanics through which individual needs are addressed, and motives are activated. The Octalysis Framework includes an overview of game mechanics that serve as core drives. According to Chou (2014), these include:

- "epic meaning and calling
- development and accomplishment
- empowerment of creativity and feedback
- social influence and relatedness
- ownership and possession
- scarcity and impatience
- unpredictability and curiosity
- loss and avoidance."

There are important aspects of the design of gamification applications. Design must be based on pedagogical principles. Furthermore, learning objectives have to be defined. The prerequisites for this are the four freedoms of play. For details on the core drives and the four freedoms of play, see Chou (2014); Fischer et al. (2017).

It is important to consider that student motivation is not only increased through scoring systems, levels, and rankings. Rather, an open student-centred culture of learning and teaching is required (Fischer et al., 2017).

Comparison of Gamification and game-based learning

Sometimes gamification and game-based learning are confused because there are some similarities. However, important differences also exist. Table 1 compares the terms gamification and game-based learning.

Table 1
Comparison of Game-based Learning and Gamification

Point of Comparison	Gamification	Game-based learning
Concept and Characteristics	• adding game elements to a non-game situation • users get a reward for certain behaviours • attract and hold the student's attention • combining fun and learning • increase student motivation through challenges and rewards • the active role of the student • continuous feedback from the system	• knowledge transfer with the support through learning games • improve learning • games have defined learning objectives • combining fun and learning • increase student motivation through challenges and rewards • the active role of the student • continuous feedback from the system
Elements/Design	• e.g. progress bars, points lists, levels, badge-system • intrinsically rewards	• e.g. simulations, quizzes
Benefits	• better learning experience • better learning environment • instant feedback • prompting behavioural change • can be applied to most learning needs	• improves strategic thinking and problem-solving • increases the memory capacity • computer fluency, simulation fluency • develops hand-eye coordination • skill-building (e.g. map reading)
Key Question	Is it effective? (business: Does it improve profits?)	Is it effective?
Examples	• Starbucks: Reward App • Microsoft: Ribbon Hero • Moodle: LevelUp!, Stash	• SimCity • World of Warcraft • Minecraft

Source: Al-Azawi et al. (2016); Becker (2022); RUBeL (2022)

General attitudes about digital technologies in education

The advantages and disadvantages of digital technologies, gamification and game-based learning in teaching at schools and universities have been widely discussed in the literature. Although motivation and participation can be increased through the use, major challenges arise for educators, students, and administrators (Fischer et al., 2017). These will be discussed below.

Advantages of the application of digital technologies in the teaching process

The use of digital technologies in the teaching process includes some advantages, which are now considered. The advantages are dependent on the concept used. Not all of the advantages mentioned have empirical evidence yet; some of them follow plausibility considerations.

- Fun learning and more motivation for students: Digital technologies can increase the fun of learning. More fun in learning often leads to a higher level of personal engagement and increases attention. The learning content can thus be internalized more effectively (RUBeL, 2022). Even a "flow" is often created while playing, and the "flow" can increase concentration and motivation. This effect also supports knowledge transfer (Eckardt et al., 2017).
- Immediate feedback: Gamification applications often give the student immediate feedback. So, he learns from his actions. This also applies to small learning units for which the student receives immediate feedback (RUBeL, 2022). This allows him to correct his actions to complete the whole task and achieve it faster and with better results.
- Improved learning experiences: The student perceives his learning success more positively, and Digital applications encourage him to continue learning (RUBeL, 2022) without the need for the educator to motivate him repeatedly. Furthermore, the student can compare his results with those of his "competitors" and thus better assess himself.
- Self-directed learning: Gamification applications allows the division of complex learning objectives into small learning units. The student can complete these at his own pace. Repetitions are also possible (RUBeL, 2022). Higher-performing students can move ahead more quickly, while lower-performing students repeat tasks multiple times. Partial successes already achieved maintain and increase their motivation (RUBeL, 2022). The student becomes more independent from the educator and the lessons.
- More and/or new fun and motivation for educators: New opportunities open up for educators. They can get more and/or new motivation by using digital technologies. Those who have been teaching the same subject for a long time and are experiencing signs of fatigue and boredom especially benefit from this. They get a reason to question and improve their long-standing teaching - especially if they have already exhausted the possibilities of traditional teaching. Students benefit from this.
- Motivation cycle: Due to the increased motivation and concentration of students, their higher willingness to discuss and their increased interest, positive effects may arise for educators. They are more motivated, enjoy teaching more (or again), improve their concepts further and then pass this on to the students. A cycle of increased motivation is created: students – educators – students – and so on.
- Better compatibility of studies and other commitments/activities: Using digital technologies creates more flexibility and brings new learning opportunities. Depending on the concept, the student can learn (partially) independently of course times. Moreover, easy access to information and the non-existence of fixed terms for learning makes studying more compatible with other commitments (Požgaj et al., 2007). This applies, for example, to students who have care responsibilities for other people – such as their children. In addition, students who have to work for a living in addition to their studies can better

combine these jobs with their studies. Hobbies, sports at a professional level or voluntary work also become compatible with studies.

- Support for students with disabilities and restricted mobility: Digital technologies can help people with disabilities in their studies and provide additional support. Their chances of successfully mastering the course content depend on the concept. Also, it is recognized as an advantage for students with restricted mobility (Požgaj et al., 2007).
- Active participation of all students, even in large groups: Digital technologies enable all students to participate – even in large groups. All students can be included using digital tools and contribute solutions and answers. Assuming anonymity, even shy or lower-performing students are encouraged to participate. Successes can make them more confident so that in other learning situations (e.g. smaller groups), they dare to speak up and advance the course with their answers.
- Stimulation of teamwork: Gamification applications can encourage students to work together. This can also be a requirement in gamification applications. Teamwork improves students' social skills (RUBeL, 2022).
- Important preparation for later professional life: Nowadays, almost no profession is still unaffected by digitization. Companies expect graduates to be able to handle digital technologies. Therefore, using digital technologies at school and university is important preparation for later professional life.
- Easier and faster revision of teaching materials: Educators can often update their teaching materials more easily and quickly using digital tools. This makes it easier for them to keep teaching up to date.

Disadvantages of the application of digital technologies in the teaching process

The following list contains the most important disadvantages of digital technologies in teaching. Like the advantages, the disadvantages also depend on the concept used. Empirical studies prove some disadvantages; others are based on plausibility considerations. Where possible, solutions are presented to reduce or prevent the disadvantages.

- Student heterogeneity in digital and technical knowledge and talent: Students have different starting points and diverse conditions. Students generally interested in the technology may already have been working with digital tools and games in their free time for years. For others, however, familiarisation is a major obstacle that distracts them from learning. You need a lot of time to learn the technical basics. Traditional lessons would be easier for them and would lead to faster success. Even if they are at the same level of knowledge as technically gifted or have prior knowledge, they achieve poorer results because of the technical hurdle. Thus, digital technologies skew outcomes and grades. It would be helpful to offer additional courses to learn how to use digital technologies. However, it should be considered that this represents an additional time burden for the participants.
- Student heterogeneity in financial capabilities: Another important aspect is the financial possibilities. They determine the technical equipment of the students. Students who have an extensive financial budget can buy state-of-the-art high-end equipment. On the other hand, poorer students often own outdated and slow devices. In addition, there may be students who cannot afford a device. The same applies to a fast Internet connection. If gamification applications include a fast result input, this can disadvantage the poorer-equipped students.

They feel unfairly treated and can become demotivated, even though their performance is just as good as the performance of others.
Result: Students have different prerequisites influencing their learning success when using gamification applications. Examples of this are different technical equipment, various level of knowledge and different preferences in learning or gaming styles. Therefore, students' individual prerequisites and expectations must be considered in planning (Fischer et al., 2017). Funds from the school or university that support poorer students with money or loaners may be of help.

- Need for financial, technical and administrative support for educators: Educators also need support from the school or university. For one thing, they need to be funded for state-of-the-art technology. Further, they need advanced training and administrative support in using e-learning tools and creating educational materials by programmers and multimedia experts.
- Need for financial support for schools and universities: A crucial prerequisite for using digital technologies is the financial budget of schools and universities. In addition to digital devices for educators (and maybe students), modern infrastructure is required. Without a fast-wireless network in the school or university, most digital applications will not work. The costs of initial installation and regular maintenance must be considered.
- Distraction from learning: Challenges can arise when the focus is not on the pedagogical and educational objectives but on the game itself. It is, therefore, important to focus on the learning content when using gamification applications. Otherwise, the game may strongly distract from learning (Fischer et al., 2017).
- Interference and clutter: Many concepts involve bringing mobile devices into the classroom. This can create interference, causing students to disrupt each other's learning. In these cases, the educator has to create a silent working atmosphere. All this causes distraction and loss of time. One way to avoid this is to introduce rules when using digital technologies. This gives students a fixed framework.
- Gamification often turns fellow students into competitors: Schools and universities attach importance to acquiring social skills, including the ability to work in a team. In gamification applications, however, students often become competitors. There are winners and losers. In some cases, performance is displayed on score lists, and this can cause negative effects on lower-performing students and create a defensive attitude and demotivation. However, this can be avoided by, for example, anonymized score lists. Further, applications based on student collaboration or group work can be preferred.
- Data protection and personal rights: When using gamification applications, it should be considered that digital traces are created. These are, for example, status displays or score lists, and they can violate the students' data protection and personal rights. Careful handling of personal data is, therefore, an indispensable prerequisite. Students have also become increasingly sensitive recently (Fischer et al., 2017).

Interim conclusion

Gamification has become increasingly important in schools and universities since the 1980s. The increasing digitization and the spread of mobile devices drive this development, and the pandemic has boosted further. Increased gamification of academic education can be expected in the future. Gamification makes it possible to increase learners' motivation and participation in learning processes (Stieglitz, 2015).

It is important to note that gamification applications have to be designed in such a way that they increase student motivation and participation.
Furthermore, cultural differences must be considered in the design. Empirical studies are very important (Fischer et al., 2017). The results of the present study of the project "Challenges and practices of teaching economic disciplines in the era of digitalization – DIGI4Teach" can also contribute to this.

Methodology

Considering that the questionnaire research should yield the most relevant results in examining respondents' opinions, a questionnaire survey was conducted for this paper. The DIGI4Teach project participants have set a questionnaire based on several similar studies (Požgaj et al., 2007; Babić, 2011; Ferrari, 2013; Žuvić et al., 2016; Elsalem et al., 2021; Nikolopoulou et al., 2021; Sáiz-Manzanares et al., 2021), adding their relevant questions. The questionnaire was divided into five sections for educators and six for students. It started with the demographic characteristics of the respondents. The second section was about the respondents' self-assessment of digital competencies, the third was about digital tools and general attitudes about digital and mobile technologies, the fourth was about e-learning quality, and the last was about e-exams. In addition, students had one more section regarding the influence of acquired knowledge, skills and qualifications through formal education on developing creative businesses, entrepreneurial ideas and/or starting digital ventures in the future. For this paper, in addition to the questions from the first session, the following questions were analyzed: (1) the need for introducing more digital tools into the teaching process, (2) the evaluation of using multimedia materials in e-learning in the context of the learning process, (3) the assessment of the impact of simulation games on improving the outcome of the teaching process and (4) the need for more administrative support when using technologies in the teaching process.

The research sample covered university professors and students from economic universities and faculties and teachers and students from economic secondary schools. In the following text, the term educator will be used for both university professors and secondary school teachers and term student for both university and secondary school students. Since Croatia, Poland, Serbia, and Germany have been involved in the DIGI4Teach project, the research was conducted in these countries. It has included primarily the University of Zagreb – Faculty of Economics and Business, Cracow University of Economics, University of Belgrade – Faculty of Economics, Osnabrück University of Applied Sciences, 1st, 2nd and 3rd School of Economics from Zagreb, and School of Economics, Trade and Hospitality from Samobor, Croatia, but also other universities, faculties and economic secondary schools from the mentioned countries. The research was conducted from November 2021 until January 2022 for students and from December 2021 until January 2022 for educators. The questionnaires were emailed to educators and distributed through the classes to students using digital teaching platforms or emails. During this period, 2,474 responses from students and 424 from educators were collected.

Demographic questions referred to the institution/country, main interest area, and years of employment/study. All the questions were closed-ended questions set as multiple-choice questions where the respondents could choose one answer. Table 2 gives an overview of respondents' demographic characteristics. The distribution of the countries in which most respondents work does not differ from the order of the institutions most students attend. Most of the respondents, regarding educators, are interested in trade, followed by accounting and finance, tourism, and other areas. Most educators of those who responded from Croatia and Serbia are primarily

interested in accounting, from Poland in trade, and from Germany in accounting and finance.

On the other hand, most students are interested in finance, followed by trade, accounting, tourism, and other areas. In addition, those from Croatia are primarily interested in tourism, from Poland in trade, and those from Serbia and Germany in finance. Educators who responded mainly teach from 16 to 25 years, while most students who responded attend the third year/class of the faculty/secondary school.

Table 2
Demographic Characteristics of the Respondents' Distribution

Characteristic	Number of respondents	Structure by countries in %			
		Croatia	Poland	Serbia	Germany
Educators					
Major of study					
Accounting	82	20.2	13.9	22.4	40.0
Finance	82	12.7	27.7	16.3	40.0
Trade	98	9.8	48.9	12.2	13.3
Tourism	50	18.5	9.5	4.1	6.7
Other	111	38.7	0.0	44.9	0.0
Years of teaching					
up to 5 years	66	22.0	8.0	10.2	46.7
6 – 15 years	134	41.0	20.4	31.6	26.7
16 – 25 years	144	26.6	48.9	28.6	20.0
over 25 years	79	10.4	22.6	29.6	6.7
Students					
Major of study					
Accounting	489	21.3	18.0	18.5	13.3
Finance	627	19.6	25.2	41.0	42.2
Trade	521	17.0	32.2	14.4	28.9
Tourism	382	25.3	3.4	6.3	4.4
Other	455	16.6	21.2	19.9	11.1
Class/year					
1st year	535	15.9	33.0	22.0	4.4
2nd year	637	34.0	13.0	22.9	13.3
3rd year	747	23.0	43.5	26.6	66.7
4th year	425	23.2	2.6	24.3	2.2
5th year	130	3.9	7.9	4.2	13.3

Source: Authors' work

Table 3
Statements employed to answer the RQs

Statements	Code	Likert scale	
		1	5
I believe that it is necessary to introduce more digital tools into the teaching process.	Q1	I completely disagree	I completely agree
Assess the impact of simulation games, as a form of e-learning, on improving the outcome of the teaching process.	Q2	Insignificant impact	Extremely strong impact
Evaluate the degree of advantages and disadvantages of e-learning through the following statement: Multimedia materials (audio and video materials, games, etc.) that can be used in e-learning make the learning process more fun.	Q3	I completely disagree	I completely agree
Providing better administrative support to educators/students using e-learning tools is necessary.	Q4	I completely disagree	I completely agree

Source: Authors' work

Statements employed to answer the RQs were set in the form of the Likert scale questions with five levels of answers. The authors used statements presented in Table 3, with an explanation of the Likert scale's lowest and highest values.

Initially, descriptive statistics were run to present overall results regarding the respondents' attitudes. To answer the RQs set in the introduction, a statistical test of means, the z-test, was employed. For each sample in each of the four testings, the variances of samples were calculated. After that, the authors ran the two-tailed z-test for each RQ, comparing the attitudes of students and educators.

Results

Descriptive Statistics

Before testing the statistical significance between sample means differences, the descriptive statistics values were calculated and analyzed (Table 4).

Table 4
Descriptive Statistics of the Responses

Statement	Respondents	Mean	Mode	St. Dev.
Q1	Educators	3,85	5	1,102
	Students	3,79	5	1,240
Q2	Educators	3,78	4	1,069
	Students	3,64	5	1,234
Q3	Educators	3,54	3	1,020
	Students	3,28	3	1,261
Q4	Educators	4,27	5	0,907
	Students	4,05	5	1,123

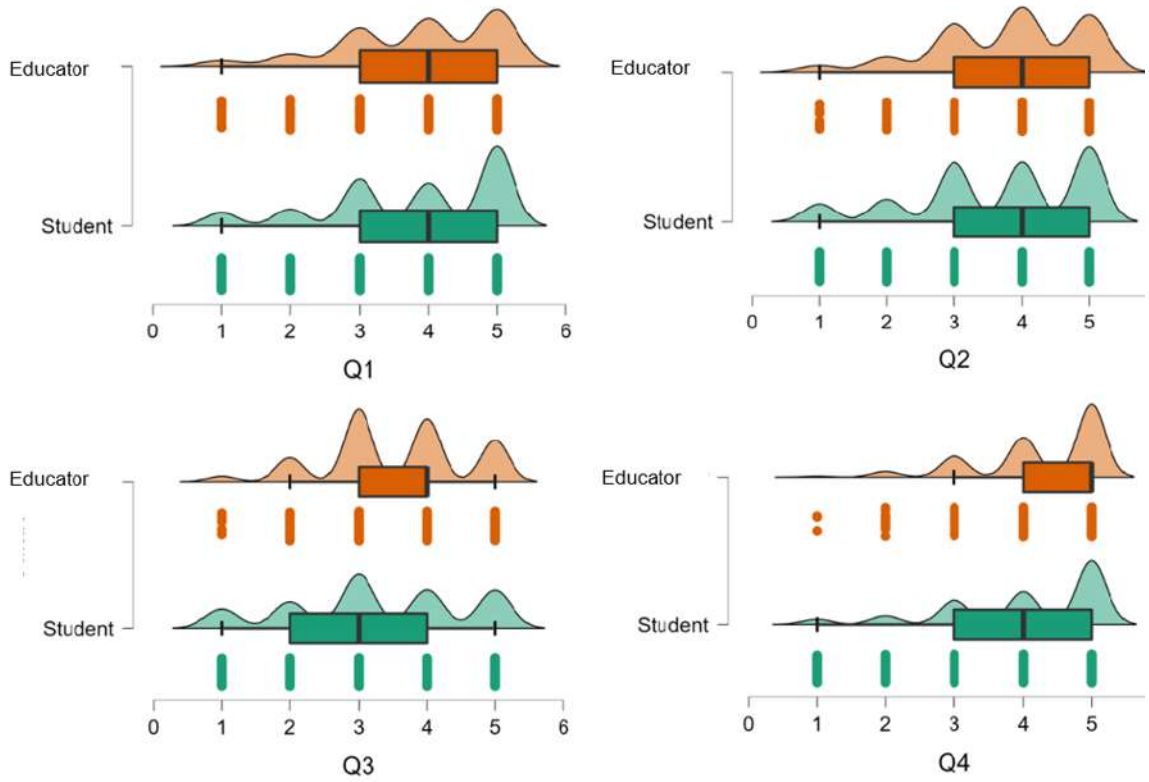
Source: Authors' work

According to the results presented in Table 4, it can be observed that the mean values of educator responses for all four statements are higher than the students' mean values per each statement. By observing mean values, one could conclude that educators are more willing to introduce more digital tools into the teaching process compared to students, that educators believe that the impact of simulation games on improving the outcome of the teaching process is major, that educators think that multimedia materials (audio and video materials, games, etc.), which can be used in e-learning, make the learning process more fun, and that educators are more aware of the need for additional administrative and infrastructure support, compared to students attitudes. On the other hand, mode values refute some of these conclusions based on the mean values. For instance, most educators and students said that they completely agree that they believe it is necessary to introduce more digital tools into the teaching process and that providing better administrative support is necessary when using e-learning tools. Also, most educators and students cannot decide whether it is an advantage or disadvantage that multimedia materials (audio and video materials, games, etc.), which can be used in e-learning, can make the learning process more fun.

Contrary to the mean values, most educators assessed the major impact (4 on a scale of 5) of simulation games, as a form of e-learning, on improving the outcome of the teaching process. In contrast, most students assessed the extremely strong impact (5 on a scale of 5), although the mean value was lower than that of educators. Standard deviation values confirm these differences because all of them are higher than 1 (on a scale of 5). The only one that differs and is below zero is the standard

deviation for the mean value of educators' responses to the question regarding the necessity for more administrative support, which also has the highest mean value among analyzed responses. To answer the RQs the two-tailed z-test for each RQ was conducted. Figure 1 compares the variable distributions according to the educators and students.

Figure 1
The comparison of the variable distributions according to the educators and students



Source: Authors' work

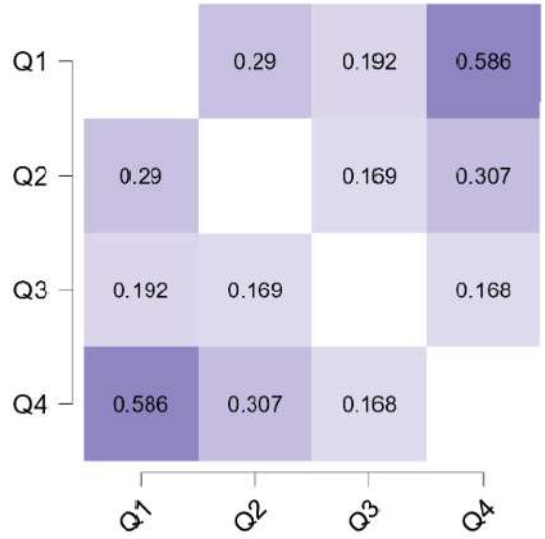
Table 5 presents Spearman's rho correlation analysis of the observed variables related to digitalization, while Figure 2 shows the matrix graph of the same analysis. The strongest correlation (54.3%) is between the statements Q1 (I believe that it is necessary to introduce more digital tools into the teaching process) and Q4 (Providing better administrative support to educators/students in using e-learning tools is necessary), indicating that the digital tools could be more implemented in case of stronger administrative support. Both students and educators would likely prefer the e-learning mode of using digital tools and gamification over on-site.

Table 5
Spearman's rho correlation analysis of the observed variables related to the digitalization

	Q1	Q2	Q3	Q4
1. Q1	1.000			
2. Q2	0.290**	1.000		
3. Q3	0.192**	0.169**	1.000	
4. Q4	0.586**	0.307**	0.168**	1.000

Note: ** statistically significant at 1%
Source: Authors' work

Figure 2
Matrix graph of the Spearman's rho correlation analysis of the observed variables related to digitalization



Source: Authors' work

Comparison of students and educators

The statistical software EViews was used to calculate the results based on which the authors made the conclusions with a significance level of 95%. As explained in the methodology, the two-tail z-test was employed.

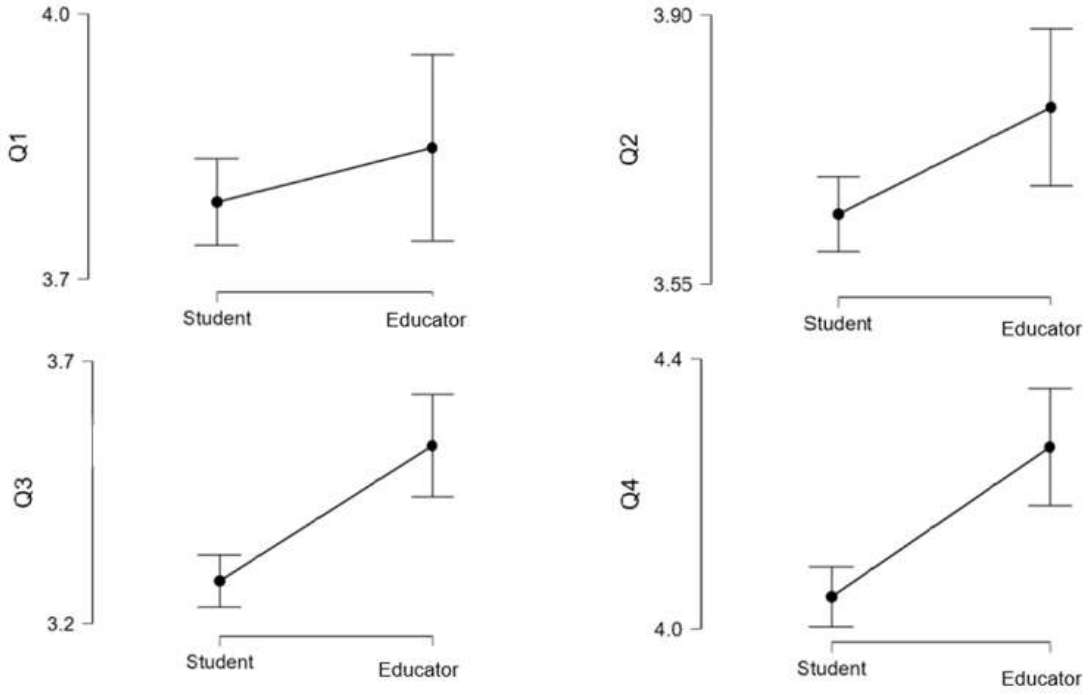
In the first RQ, the authors wanted to answer whether there is a difference between the attitudes of educators and students about the introduction of more digital tools into the teaching process. In addition, in the second RQ, the authors wanted to answer whether the perception of educators and students regarding the impact of simulation games on improving the outcome of the teaching process differs. Afterwards, in the third RQ, the authors wanted to answer whether educators and students think that multimedia materials (audio and video materials, games, etc.), which can be used in e-learning, make learning more fun. Finally, in the fourth RQ, the authors wanted to answer whether educators' perception of the necessity for greater administrative support while using e-learning tools in the teaching process differs from the perception of students' need for such support. The results are presented in Table 6. Figure 3 presents the interaction plots of the variables for educators and students, with a 95% error margin.

Table 6
Z-test Results

	Q1		Q2		Q3		Q4	
	Edu.	Stu.	Edu.	Stu.	Edu.	Stu.	Edu.	Stu.
Mean	3,849	3,787	3,780	3,641	3,539	3,281	4,270	4,048
Known Variance	1,214	1,538	1,143	1,523	1,041	1,589	0,823	1,262
Observations	423	2,474	423	2,474	2,474	423	423	2,474
z	1.038		2.414		4.626		4.476	
p-value	0.299		0.016*		<0.001**		<0.001**	
z Critical	1.96		1.96		1.96		1.96	

*Note: * statistically significant at 5%; ** 1%*
Source: Authors' work

Figure 3
The interaction plots of the variables for educators and students, with the 95% error margin



Source: Authors' work

Observing the results, we can see they differ between the RQs. For the first RQ, the empirical z-score is lower than the critical z-score (1.038 < 1.96), while the p-value is 0.299. Accordingly, it can be concluded that there is no difference between the attitudes of educators and students about introducing more digital tools into the teaching process. Both educators and students, on average, agree that more digital tools should be introduced into the teaching process. Such results go in favour of implementing more gamification in the teaching process.

Regarding the results for the second RQ, the empirical z-score is higher than the critical z-score (2.414 > 1.96), while the p-value is 0.016, which is lower than 0.05. Based on the results, it can be concluded that there is a statistically significant difference with a nce level of 95%. In other words, t eption of educators and students regarding the impact of simulation games on improving the outcome of the teaching process statistically significantly differs with a confidence level of 95%.

Finally, the results for the third and fourth RQs show that the empirical z-score is higher than the critical z-score (4.626 > 1.96; 4.476 > 1.96), while the p-values are less than 0.001. It brings to the conclusion that the attitudes of educators and students regarding making the learning process more fun by using multimedia materials (audio and video materials, games, etc.) statistically significantly differ with a confidence level of 95%. Besides, the attitudes of educators and students statistically significantly differ regarding the necessity of providing better administrative support in using e-learning tools. The same result came after testing both questions at a significance level of 0.01 or, in other words, with a confidence level of 99%.

Discussion

Adapting the teaching process by applying a more interactive approach, e.g. by implementing gamification, requires a personal engagement of educators and students and the support of the administrative staff and infrastructure. A survey has been conducted to evaluate the need and willingness of educators and students to implement more digital tools and gamification into the teaching process. The authors set several research questions and tested them using statistical techniques. To begin with, the authors have assumed that it is important to research the respondents' views on the necessity of introducing more digital tools into the teaching process. After analyzing the answers from educators and students, it was concluded that both educators and students have positive views on introducing more digital tools into the teaching process, and their opinions do not differ significantly. However, educators have more preferences regarding it. Afterwards, it was assumed that it is important to check their perception of simulation games' impact on improving the teaching process's outcome. Analyzing the results, the authors found a statistically significant difference between their answers, where educators perceived a greater impact of simulation games on improving the outcome of the teaching process. Furthermore, research results showed that the attitude of educators and students regarding making the learning process more fun by using multimedia materials (audio and video materials, games, etc.) statistically significantly differs where, again, educators perceive a more significant impact. Finally, as expected, educators showed they need a higher level of administrative support when they use e-learning tools in the teaching process compared to students' needs for such support.

The presented research results slightly exceeded the authors' expectations since educators showed enthusiasm for introducing more gamification supported by the use of digital tools into the teaching process. This can be seen from the perspective of their increased self-confidence after using various digital tools during the COVID-19 pandemic and lockdowns when they performed their lectures in a hybrid mode or even entirely online. They have learned how to use additional digital tools to motivate and encourage students to learn, while, from the students' perspective who were listening to lectures from several educators, who probably used different digital tools, it could be concluded that they encountered too many new digital tools in a short time, which caused them difficulties in navigating and using them. In addition, students were forced to listen to lectures from their homes, which was unfamiliar to them and probably caused an additional overload. Furthermore, implementing more digital tools and gamification in teaching requires administrative and infrastructure support. In that context, educators and students expressed needing better administrative support while using e-learning tools. In addition, the mean values for that question for both groups of respondents resulted in the highest values, which means there was a lack of administrative support during the COVID-19 pandemic since everything had been changing rapidly. Existing capacities were not sufficient to cover all the not expected needs that occurred. Finally, the general conclusion is that educators and students are willing to introduce gamification supported by the use of digital technologies into the teaching process with additional administrative support and adequate infrastructure in educational institutions.

Conclusion

Continuous and up-to-date monitoring of modern teaching methods and development of technological achievements is a necessary prerequisite for sustainable education, which means innovating, updating and adapting the

teaching process to the requirements of the profession, end-users and technology, regardless of the education level. This study considered the application of digital and mobile technologies as supporting tools for implementing gamification in the field of education of future economists, as well as their willingness and readiness for the wider application of digitalized technologies in the teaching process. The research was conducted on a sample of educators and students of economic faculties/universities and secondary economic schools in four countries (Croatia, Poland, Serbia and Germany), primarily interested in accounting, finance, trade and tourism.

Results show that educators and students are willing to have more digital tools introduced in the teaching process. Also, the results confirm that educators are aware of students' motivation to use digital tools more in the teaching process since they are of thinking that simulation games have a moderate to a significant impact on improving the outcome of the teaching process and agree that multimedia materials would make the learning process more fun. The previously mentioned results are consistent with the results of the study by Buzzard et al. (2011) and confirm that both educators and students are eager to teach/learn with the support of various digital technologies. Furthermore, this research recognized the importance of infrastructural and administrative support in implementing gamification and digital tools in the educational process, as in previous studies (Dicheva et al., 2015; Rabah et al., 2018). Regarding infrastructural and administrative support, the results indicate a higher awareness of educators' need for support.

Scientific research should be considered in light of some limitations, so this study is no exception. This study refers only to economics, while further studies could also cover other areas. In addition, considering the uneven distribution of responses between some countries, it is impossible to generalize the conclusions. To address the challenges in existing research, further research studies could include more countries with different levels of digitalization. Also, the results would possibly differ if the two levels of education (higher and secondary education) were considered separately.

Finally, it should be noted that the results of this study confirm that the most relevant stakeholders, educators and students, are willing to introduce gamification supported by digital and mobile technologies into the teaching process with additional administrative support from their educational institutions.

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References

1. Abt, C. C. (1987), Serious games, New York, University Press of America.
2. Al-Azawi, R., Al-Faliti, F., Al-Blushi, M. (2016), "Educational Gamification vs. Game Based Learning: Comparative Study", International Journal of Innovation, Management and Technology, Vol. 7, No. 4, pp. 132-136.
3. Anderson J, Rainie L. (2012), "Gamification and the Internet: Experts Expect Game Layers to Expand in the Future, with Positive and Negative Results", Games Health Journal, Vol. 1, No.4, pp. 299-302.
4. Babić, S. (2011), "Factors that Influence Academic Teacher's Acceptance of E-Learning Technology in Blended Learning Environment", in Pontes, E. et al. (Ed.), E-Learning – Organizational Infrastructure and Tools for Specific Areas, London, IntechOpen, pp. 3-18.

5. Becker, K. (2022), "Games vs Game-based Learning vs Gamification", available at http://minkhollow.ca/beckerblog (2 January 2022)
6. Breuer, J., Bente, G. (2010), "Why so serious? On the relation of serious games and learning", ComputGame Cult, Vol. 4, No. 1, pp. 7-24.
7. Buzzard, C., Crittenden, V. L., Crittenden, W.F., Paulette McCarty, P. (2011), "The Use of Digital Technologies in the Classroom: A Teaching and Learning Perspective", Journal of Marketing Education, Vol. 33, No. 2, pp. 131-139.
8. Caponetto, I., Earp, J., Ott, M. (2014), "Gamification and education: a literature review", in Busch, C. (Ed.), Proceedings of the 8th European Conference on Game Based Learning - ECGBL 2014, Academic Conferences and Publishing International Limited, Reading, pp. 50-57.
9. Chou, Y.-K. (2014), "Octalysis: complete gamification framework", available at http://www.yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/#.U7KSWPb9BTI (2 January 2022)
10. Davison, C. B., Lazaros, E. J. (2015), "Adopting Mobile Technology in the Higher Education Classroom", The Journal of Technology Studies, Vol. 41, No. 1, pp. 30-39.
11. DeBurr, D. (2013), "Build Gamified Websites with PHP and jQuer, Packt Publishing", available at https://www.perlego.com/book/390167/build-gamified-websites-with-php-and-jquery-pdf (24 February 2022)
12. Deterding, S., Dixon, D., Khaled, R., Nacke, L. (2011), "From game design elements to gamefulness. Defining Gamification", in Lugmayr, A., Franssila, H., Safran, C., Hammouda, I. (Eds.), Proceedings of the 15th International Academic MindTrek 2011, ACM Press New York, pp. 9-15.
13. Dicheva D., Dichev, C., Agre, G., Angelova, G. (2015), "Gamification in Education: A Systematic Mapping Study", Educational Technology & Society, Vol. 18, No. 3, pp. 75-88.
14. Eckardt, L., Körber, S., Becht, E. J, Plath, A., Al Falah, S., Robra-Bissantz, S. (2017), "Führen Serious Games zu Lernerfolg – Ein Vergleich zum Frontalunterricht" ("Do Serious Games Lead to Learning Success - A Comparison to Frontal Teaching"), in: Strahringer, S., Leyh, C. (Eds.), Gamification und Serious Games – Grundlagen, Vorgehen und Anwendungen (Gamification and serious games – basics, methods and applications), Springer, Wiesbaden, pp. 139-150.
15. Elsalem, L.; Al-Azzam, N.Z.; Jum'ah, A.A.; Obeidat, N. (2021), "Remote E-exams during Covid-19 pandemic: A cross-sectional study of students' preferences and academic dishonesty in faculties of medical sciences", Annals of Medicine and Surgery, Vol. 62, No. 10, pp. 326-333.
16. Feil, J. H., Scattergood, M. (2005), Beginning game level design, Stamford, Thomson Learning.
17. Ferrari, A. (2013), "DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe", in: Punie, Y., Brečko, B.(Eds.), Joint Research Centre, Institute for Prospective Technological Studies, Publications Office, available at https://data.europa.eu/doi/10.2788/52966 (20 September 2021)
18. Fischer, H., Heinz, M., Schlenker, L., Münster, S., Follert F., Köhler, T. (2017), "Die Gamifizierung der Hochschullehre – Potenziale und Herausforderungen" ("The gamification of university teaching – potentials and challenges"), in: Strahringer, S., Leyh, C. (Eds.): Gamification und Serious Games – Grundlagen, Vorgehen und Anwendungen (Gamification and serious games – basics, methods and applications), Springer, Wiesbaden, pp. 113-125.
19. Greco, M., Baldissin, N., Nonino, F. (2013), "An exploratory taxonomy of business games", Simul Gaming, Vol. 44, No. 5, pp. 645-682.
20. Hamari, J., Koivisto, J., Sarsa, H. (2014), "Does gamification work? – A literature review of empirical studies on gamification", in Proceedings of the 47th Hawaii International Conference on System, IEEE Computer Society, Unites States, pp. 3025-3034.
21. Herranz, E., Colomo-Palacios, R., Amescua-Seco, A. (2013), "Towards a new approach to supporting top managers in SPI organizational change management", in Cruz-Cunha, M. M., Varajão, J., Krcmar, H., Martinho, R. (Eds.), Procedia Technology 9 - CENTERIS 2013 - Conference on ENTERprise Information Systems, Elsevier Ltd., pp.129-138.

22. Huotari, K., Hamari, J. (2012), "Defining gamification – A service marketing perspective", in Lugmayr, A., Franssila, H., Paavilainen, J., Kärkkäinen, H. (Eds.), Proceedings of the 16th international academic mindtrek conference, ACM Press, Tampere, pp. 17-22.
23. Kiryakova, G., Angelova, N., Yordanova, L. (2014), "Gamification in education", In Proceedings of 9th International Balkan Education and Science Conference. Edirne: Trakya University
24. Liarokapis, F., Anderson, E. F., Oikonomou, A. (2010), "Serious games for use in a higher education environment", in Proceedings of CGAMES 2010 USA - 15th International Conference on Computer Games: AI, Animation, Mobile, Interactive Multimedia, Educational and Serious Games, Louisville, pp. 69–77.
25. Llorens-Largo, F., Gallego-Duran, F. J., Villagra-Arnedo, C. J., Compan-Rosique, P., Satorre-Cuerda, R., Molina-Carmona, R. (2016), "Gamification of the Learning Process: Lessons Learned", IEEE Revista Iberoamericana de Technologias del Aprendizaje, Vol. 11, No. 4, pp. 227-234.
26. Majuri, J., Koivisto, J., Hamari, J. (2018), "Gamification of education and leraning: A review of empirical literature", Proceedings of the 2nd International GamiFIN conference, (Pori, Finland, May 21-23, 2018) (2018), pp. 11-19
27. Nah, F. F. H., Zeng Q., Telaprolu V. R., Ayyappa A. P., Eschenbrenner B. (2014), "Gamification of Education: A Review of Literature", In: Nah, F.FH. (eds) HCI in Business. HCIB Lecture Notes in Computer Science, vol 8527. Springer, Cham. https://doi.org/10.1007/978-3-319-07293-7_39
28. Nikolopoulou, K.; Gialamas, V.; Lavidas, K.; Komis, V. (2021), "Teachers' Readiness to Adopt Mobile Learning in Classrooms: A Study in Greece", Technology, Knowledge and Learning, Vol. 26, No. 1, pp. 53-77.
29. Parra-González, M. E., López-Belmonte, J., Segura-Robles, A., Moreno-Guerrero, A. J. (2021), "Gamification and flipped learning and their influence on aspects related to the teaching-learning process", Heliyon, Vol. 7, No. 2,
30. Pejić Bach, M., Zoroja, J., Fašnik, M. (2017), "Teaching Business Simulation Games: Preliminary Current Practice Overview", in Proceedings of the International Conference Theory and Applications in the Knowledge Economy, 12-14 July 2017, Zagreb, Croatia, pp. 432-443.
31. Perrotta, C., Featherstone, G., Aston, H., Houghton, E. (2013), "Game based learning: Latest evidence and future directions", Slough, England: National Foundation for Educational Research.
32. Požgaj, Ž., Knežević, B. (2007), "E-Learning: Survey on Students' Opinions", in Proceedings of the ITI 2007 29th Int. Conf. on Information Technology Interfaces, Cavtat, Croatia, pp. 381-386.
33. Qureshi, M. I., Khan, N., Raza, H., Imran, A., Ismail, F. (2021), "Digital Technologies in Education 4.0. Does it Enhance the Effectiveness of Learning? A Systematic Literature Review." International Journal of Interactive Mobile Technologies (iJIM), Vol. 15, No. 4, pp. 31-47.
34. Rabah, J., Cassidy, R., Beauchemin, R. (2018), "Gamification in education: Real benefits or edutainment?", In Proceedings of European Conference on E-Learning, Academic Conferences and Publishing International, Greece, pp. 1-12.
35. RUBeL – Zentrum für Wissenschaftsdidaktik der Ruhr-Universität Bochum (2022), "Game Based Learning und Gamification – spielerisch zum Lernerfolg" ("Game based learning and gamification – playfully to learning success"), available at https://dbs-lin.ruhr-uni-bochum.de/lehreladen/e-learning-technik-in-der-lehre/game-based-learning/ (2 January 2022)
36. Sabri, H., Cowan, B., Kapralos, B., Cristancho, S., Moussa, F., Dubrowski, A. (2010), "Off-pump coronary artery bypass surgery procedure training meets serious games", in Proceedings of the IEEE international symposium on haptic audio-visual environments and games, IEEE, Phoenix, pp. 1-5.
37. Sáiz-Manzanares, M.C.; Marticorena-Sánchez, R.; Ochoa-Orihuel, J. (2021), "Using Advanced Learning Technologies with University Students: An Analysis with Machine Learning Techniques", Electronics, Vol. 10, No. 2620, pp. 1-16.

38. Smiderle, R., Rigo, S. J., Marques, L. B., de Miranda Coelho, J. A. P., Jaques, P. A. et al. (2020), "The impact of gamification on students' learning, engagement and behavior based on their personality traits", Smart Learning Environments, Vol. 7, No. 3, pp. 1-11,
39. Stegmann, K. (2020), "Effekte digitalen Lernens auf den Wissens- und Kompetenzerwerb in der Schule: Eine Integration metaanalytischer Befunde" ["Effects of digital learning on knowledge and competence development in school: A integration of meta-analytic evidences"], Zeitschrift für Padagogik, Vol. 66, No. 2, pp.174-190, in Sailer, M., Murböck, J., Fischer, F. (2021), "Digital learning in schools: What does it take beyond digital technology?", Teaching and Teacher Education, Vol. 103. No. 2021, pp. 1-13.
40. Stieglitz, S. (2015), "Gamification – Vorgehen und Anwendung" ("Gamification – Methods and application"), HMD Praxis der Wirtschaftsinformatik, Vol. 52 No. 6, pp. 816-825.
41. Stott, A., Neustaedter, C. (2013), "Analysis of Gamification in Education", 2013-0422-01, Connections Lab, Simon Fraser University, Surrey, BC, Canada, April
42. Strahringer, S., Leyh, C. (2017), "Vorwort" ("Preface"), in Strahringer, S., Leyh, C. (Ed.), Gamification und Serious Games – Grundlagen, Vorgehen und Anwendungen (Gamification and serious games – basics, methods and applications), Springer, Wiesbaden, pp. V-VI.
43. Susi, T., Johannesson, M., Backlund, P. (2007), "Serious games – An overview", Technical report, Institutionen f¨or kommunikation och information
44. Swacha, J. (2021), "State of Research on Gamification in Education: A Bibliometric Survey", Education Sciences, Vol. 11, No. 69, pp. 1-15.
45. Teuteberg, F., Jacob, A. (2017), "Game-Based Learning, Serious Games, Business Games und Gamification – Lernförderliche Anwendungsszenarien, gewonnene Erkenntnisse und Handlungsempfehlungen" ("Game based learning, serious games, business games and gamification - Application scenarios conducive to learning, lessons learned and recommendations for action"), in Strahringer, S., Leyh, C. (Eds.), Gamification und Serious Games – Grundlagen, Vorgehen und Anwendungen (Gamification and serious games – basics, methods and applications), Springer, Wiesbaden, pp. 97-112.
46. Žuvić, M.; Brečko, B.; Krelja Kurelović, E.; Galošević, D.; Pintarić, N. (2016), "Priručnik za korištenje Okvira za digitalnu kompetenciju korisnika u školi: učitelja/nastavnika i stručnih suradnika, ravnatelja i administrativnog osoblja" ("Handbook for Digital Competence Framework at School: Teachers and Associates, Principals and Administrative staff"), Zagber, CARNet, available at https://www.bib.irb.hr/967761 (20 September 2021)

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Which Digital Tools dominate Secondary and Higher Education in Economics: Google, Microsoft or Zoom?

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Abstract

Background: Due to the Covid 19 pandemic, in many countries, higher, secondary and even primary education experienced the unannounced shift from traditional classroom lessons to distance teaching using different technologies. **Objectives:** The main objective of the research was to identify the most important digital tools applied by educators and students during the pandemic and evaluate their satisfaction with applying these tools in four countries; Croatia, Germany, Poland and Serbia. **Methods/Approach:** The questionnaires were sent via emails to educators and distributed through the classes to students using digital teaching platforms or emails. The answers were analysed by descriptive statistics. **Results:** Research showed that Google tools most commonly used by students and educators are; YouTube, Gmail, Google Translate, Google Maps and Google Drive. Microsoft digital tools most commonly used by educators and students in observed countries are; Word, PowerPoint and Excel. Other digital tools most commonly used by educators are Zoom and Moodle, while students mostly use Zoom and Kahoot. Moreover, this paper identifies the main reasons for educators' insufficient use of digital tools. **Conclusions:** Google, Microsoft and Zoom dominate their specific domains: Google for networks, Microsoft for documents, and Zoom for online meetings.

Keywords: digital tools; Google; Microsoft; Zoom; education; learning; students

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Introduction

The implementation of digital tools in education at all levels of studying has become necessary in modern society (Harasim, 2012; Lau, 2014; Drijvers, 2015; Camilleri et al., 2016), especially in the context of the Covid-19 pandemic (Curcic et al., 2021; Jobirovich, 2021; Rawashdeh et al., 2021). Developing digital competencies of educators and students is an important segment of lifelong learning, both personal and professional development (Rawashdeh et al., 2021; Kallimulina et al., 2021; Bader et al., 2021). Previous research points to all the advantages and disadvantages of using information and communication technologies in education (Harasim, 2012; Lau, 2014; Drijvers, 2015; Camilleri et al., 2016; Minasyan, 2016; Cruz et al., 2017; Neufeld, 2018). There is a clear indication that maximising advantages and minimising disadvantages is directly conditioned by the high correlation between the digital competencies of educators and generating creativity and student engagement. This study analyses in more detail the level of digital competencies of educators and students and their satisfaction level with implementing digital tools in practice. This research aimed to identify the most important digital tools applied by educators and students from economic universities and faculties and educators and students from economic secondary schools during the pandemic. Moreover, the paper evaluates their satisfaction with applying different digital tools. The research sample includes educators and students from economic universities and faculties and educators and students from economic secondary schools from 4 countries; Croatia, Germany, Poland and Serbia. Four research questions were formed:

- *RQ1 - What Google digital tools do students and educators use in their education and learning in general, and how are they satisfied with them*
- *RQ2 - What Microsoft digital tools do students and educators use in their education and learning in general, and how are they satisfied with them*
- *RQ3 - Which of the other digital tools do students and educators use in their education and learning in general, and how are they satisfied with them*
- *RQ4 – What are the main reasons that educators do not use enough digital tools in their lectures*

The first part of the paper analyses the previous research on this topic, after which the methodology and structure of the survey and sample are presented. By discussing the research results, conclusions on the most important digital tools for educators and students were presented.

Literature Review

The Covid-19 pandemic has affected all social, political and economic spheres, including the global education system. Digital tools have proven to be a good way to monitor and evaluate students in online teaching during the pandemic. The use of the digital tool has been the subject of research by a large number of studies over the last ten years (Harasim, 2012; Lau, 2014; Drijvers, 2015; Camilleri et al., 2016; Minasyan, 2016; Cruz et al., 2017; Neufeld, 2018), but the comparison of the advantages and disadvantages of the implementation of digital tools and online learning, compared to traditional methods, has come to the fore from the start of the Covid-19 pandemic to the present day (Garcia-Martinez et al., 2020; Kalimullina et al., 2021; Bader et al., 2021). One of the most trending topics in the field of education and many research areas are different ideas and experiences in the field of modernisation of teaching, with a focus on the use of digital technologies (Hillmayr et al., 2020; Beardsley et al., 2021, Cetin, 2021; Oliveira et al., 2021).

Harasim (2012) highlighted the benefits of developing a learning theory with a framework that considers the Internet's potential. He pointed out that continuous work should be done to find ways to innovate learning methods, and cooperation between educators and students is essential for successfully implementing any digital method of science based on the use of the potential of the Internet. Vanwynsberghe and Verdegem (2013) confirmed the conclusions made by Harasim, pointing to the potential of social networks in the exchange of learning materials and communication among students regarding all learning-related problems. Vanwynsberghe et al. (2013) emphasise the advantage of implementing social networks in educator-student communication because students are more open to this type of communication and very similar interaction can be achieved in classrooms - face to face. Drijvers (2015) dealt more detail with implementing digital technologies in education, with special reference to mathematics education. This author concluded that the design of digital tools, the role of educators in implementing teaching through digital tools and the educational context are key predictors of the success of digital technology in mathematics education.

Minasyan (2016) analysed the advantages and disadvantages of implementing digital tools in the educational process, pointing out that the 21st century should be viewed as a period of active learning and autonomy of students that takes place in parallel with the growing need to learn, develop and improve skills. Information and communication technology is the main catalyst in this process. It is the basis for the development of access to education where the focus is on students, their autonomy, and endless opportunities for continuous development and improvement in all spheres. Analysing the implementation of digital tools in education, based on examples from practice, several authors concluded that the key advantages of this approach are: technology as a teaching tool raises the level of knowledge and experience in the educator-student relationship, students are provided with quick access data, and a higher level of participation and commitment and creativity of students leads to the realisation of personal development and improvement (Danko, 2010; Makosa, 2013; Lau, 2014; Minasyan, 2016; Cruz et al., 2017; Neufeld, 2018). The negative aspects of the implementation of digital technologies in teaching were (Makosa, 2013; Minasyan, 2016; Otterborn et al., 2019): interfering with students with a large number of external factors that online educators can not follow, poor quality of activities preparing students for the realisation of online classes, cheating /copying work tasks and degradation of critical and analytical skills in the field of student thinking (debate on various topics in the classroom more effectively encourages the exchange of opinions among students, which significantly improves these skills). Cruz et al. (2017) confirmed Minasyan's conclusions, pointing to the excellent results of combining traditional and online teaching, which will generate the best results in the field of education: autonomy and independence in learning, critical thinking and solving complex problems, effective communication and exchange knowledge and experience. Camilleri et al. (2016) proved that the successful implementation of information and communication technologies and the realisation of its previously listed benefits predominantly depend on the digital literacy of students and the level of technological annexation of professors.

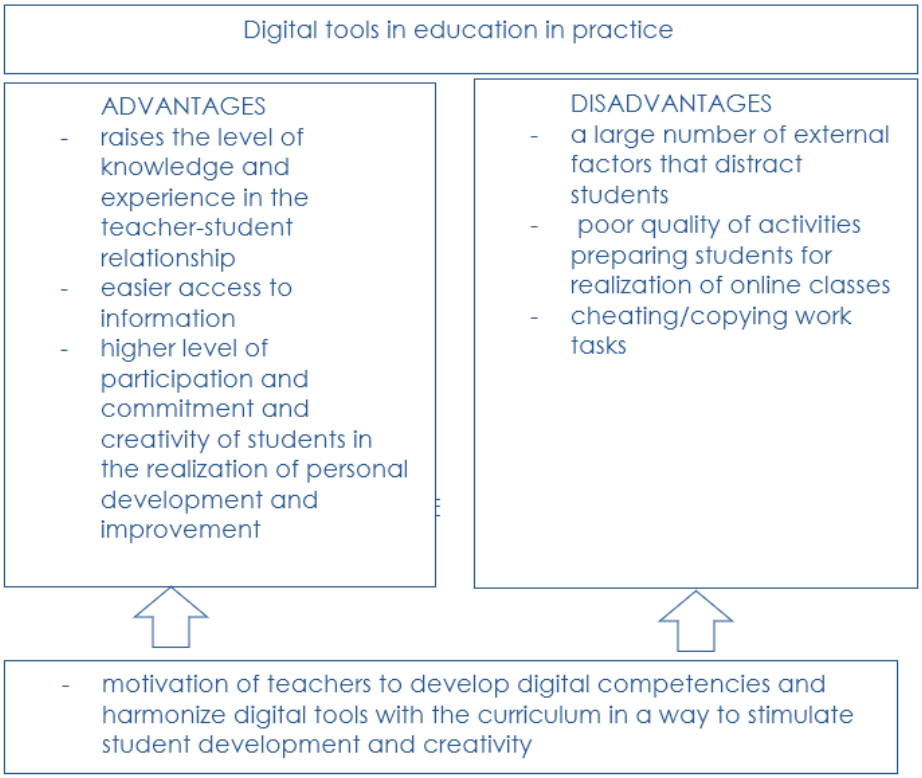
In the conditions of the Covid-19 pandemic, it is necessary to keep up with the times and use all the facilities offered by implementing information and communication technologies in the field of education (Gjud et al., 2020) to the fore. Many authors point out that at the very beginning of the pandemic, there was a gap between professors who considered textbooks the best way to master the material, with moderate use of digital tools, and students for whom the use of technology in

teaching creates additional interest, fun and dynamism (Vurusic, 2019; Gjud et al., 2020; Dragun, 2021). The period of temporary suspension of regular teaching processes, sampled by the pandemic, has led to a significant change in the way of learning in the education system at the global level. The epidemiological situation has imposed distance learning tools as an alternative to classroom teaching. The predominantly combined teaching system (traditional and online) was applied in the primary and secondary education systems. In contrast, higher education institutions made the most of the advantages of digital tools in education (Curcic et al., 2021). The main advantages of the implementation of distance learning tools in the field of higher education (Curcic et al., 2021; Jobirovich, 2021; Rawashdeh et al., 2021):

- Possibility of easy access to teaching from any place that has an Internet connection;
- Lower costs of teaching;
- Fast and efficient exchange of teaching materials between professors-students and student-student is enabled;
- It is possible to test students' knowledge based on precisely defined criteria by the professor;
- Influence on the development of digital competencies of professors/students, which are very important in modern society.

Figure 1 summarizes the advantages and disadvantages of digital tools usage in education-practice.

Figure 1
Advantages and disadvantages of digital tools in education-practice



Source: Author's work, based on relevant literature

Garzia-Martines et al. (2020) researched the advantages and disadvantages of digital tools and personal education in higher education. They concluded that implementing digital tools in education is effective only if it stimulates students'

creativity, engagement and teamwork, making maximum use of Internet potential and data. Research has shown that, otherwise, students are discouraged from giving their best in using the potential of digital tools for personal and professional development. Kalimullina et al. (2021) agree with these conclusions, adding that it is very important to work intensively on the digital competence of educators because without it, there is no complete integration of digital technology in education, and thus no successful impact on students in the field of development creativity, commitment and maximum use of the potential of information and communication technologies for the development of critical thinking.

Bader et al. (2021) analysed in detail the attitudes of English students about the use of digital tools in education and concluded that it is discouraging that students are unaware of the opportunities offered by the implementation of digital tools (development of creativity, critical thinking available data and independence), but only positively assess the ease of use. This is why the question arises about the type of digital tools used in teaching these students because they should be aimed at stimulating student development in all domains. Hillmayr et al. (2020), analysing the implementation of digital tools in teaching in mathematics studies, concluded that the student positively evaluated only dynamic digital tools in teaching, which stimulate logical thinking and effective drawing of conclusions. It is very important to motivate educators to develop their digital competencies because it will generate their improvement in the application of digital tools in education in a way that corresponds to the curriculum, with a focus on stimulating the creativity and engagement of students (Beardsley et al., 2021; Cetin, 2021). Digital skills and educator competencies are the basis of the digital transformation of education (Guillen-Gamez et al., 2021; Hamalainen et al., 2021; Oliveira et al., 2021; Yilmaz, 2021; Zhao et al., 2021).

It can be concluded that implementing digital tools is necessary for the era of rapid development of information and communication technologies, but that their potential is not maximised, either by professors or students. The fact is that the use of digital tools in teaching has both positive and negative sides, with undeniable potential that can be used only through teamwork in the educator-student relationship, with the motivation of educators to develop digital competencies and motivate students to improve in all domains, a key predictor of the efficiency and effectiveness of this teamwork, and thus the success of the digital transformation of education. Creating digital tools for the educational sphere in the years to come should stimulate lifelong learning for students and educators.

Methodology

Sample characteristics

This paper is the result of the cooperation of educators from Croatia, Poland, Serbia, and Germany who have been involved in the DIGI4Teach project. Therefore, the research was conducted in these countries. Respondents from the following institutions were included in the research; the University of Zagreb – Faculty of Economics and Business, Osnabrück University of Applied Sciences, Cracow University of Economics, University of Belgrade – Faculty of Economics,1st, 2nd and 3rd School of Economics from Zagreb, and School of Economics, Trade and Hospitality from Samobor, Croatia, but also other universities, faculties and economic secondary schools from those four countries were included. The data was collected from November 2021 until January 2022 for students and from December 2021 until January 2022 for educators. The questionnaires were sent via emails to educators and

distributed through the classes to students using digital teaching platforms or emails. The results presented in this paper are part of wider research structured as part of the DIGI4Teach project. In other words, the questionnaire sent to educators and students contains more questions than those analysed in this paper.

The research sample includes educators and students from economic universities and faculties and educators and students from economic secondary schools. Empirical research was conducted on two groups of respondents, professors and students. The sample related to professors includes professors from secondary schools of economics and university professors. The sample related to students includes students from secondary schools of economics and university students. In this research, 423 educators, of which 77.54% were university educators and 22.46% were educators of secondary schools of economics (table 1). The survey includes answers from 2,474 students, most of whom come from universities, 67.87%, while the remaining students come from secondary schools of economics (table 1).

Table 1
Educational level – educators and *students*

Educational level	# of educators	% educators	# of students	% students
Faculty (university)	328	77.54%	1,679	67.87%
Secondary school of economics	95	22.46%	795	32.13%
Total	423	100.00%	2,474	100.00%

Source: Author's work

This study's respondents come from Croatia, Germany, Poland and Serbia. The largest number of educator respondents comes from Croatia (40,90%), followed by Poland (32.39%), Serbia (23.17%) and Germany (3.55%). The situation is similar with student respondents, most of whom are from Croatia, followed by Poland, Serbia and Germany. The structure of respondents by country is shown in table 2.

Table 2
Country where educator's and student's school/faculty/university is located

Country	# of educators	% educators	# of students	% students
Croatia	173	40.90%	1,298	52.47%
Germany	15	3.55%	45	1.82%
Poland	137	32.39%	699	28.25%
Serbia	98	23.17%	432	17.46%
Total	423	100.00%	2,474	100.00%

Source: Author's work

According to the number of years of teaching, most educators are engaged in lectures between 16 and 25 years old (34.04%), which indicates a high level of respondents' experience in the teaching process. Slightly fewer respondents teach between 6 and 15 years (31.68%), followed by respondents with more than 25 years of teaching experience (18.68%), while the smallest number of respondents have less than 5 years of teaching experience (15.60%).

Among students, the largest number of students at the time of the survey was in the third year of study (30.19%), followed by students in the second year of study (25.75%), the first year of study (21.62%), the fourth year of study (17.18%) and fifth years of study (5.25%).

The largest number of educators cite trade (23.17%) as their main area of interest, followed by accounting (19.39%), finance (19.39%) and tourism (11.82%). According to the area of interest, the remaining respondents were classified in the category other (26.24%). The structure of educators and students according to the main interest area is presented in table 3. The main area of interest for the largest number of students is finance (25.34%), followed by trade (21.06%), accounting (19.77%) and tourism (15.44%). Other areas of interest include the same areas for educators and are related to 18,39% of students. Among them, management (5.94%) and marketing (5.50%) are the most important areas of interest.

Table 3
Structure of educators and students according to the main interest area

Major	# of educators	% educators	# of students	% students
Accounting	82	19.39%	489	19.77%
Finance	82	19.39%	627	25.34%
Tourism	50	11.82%	382	15.44%
Trade	98	23.16%	521	21.06%
Other	111	26.24%	455	18.39%
Total	423	100.00%	2,474	100.00%

Source: Author's work

Research questions

In this research, four research questions were defined. Two groups of respondents answered the first three research questions; educators and students using a Likert scale of 1-5 (possible answers are: 0 - I do not use; 1 - I am extremely dissatisfied; 5 - I am extremely satisfied):

- "What Google digital tools do you use in your education and learning, and how satisfied are you with them?" (RQ1)
- "What Microsoft digital tools do you use in your education and learning, and how satisfied are you with them?" (RQ2)
- "Which of the other digital tools do you use in your education and learning in general, and how satisfied are you with them?" (RQ3)

The answers to these questions were analysed by applying descriptive statistics where average values were calculated for each answer of the respondents. The fourth research question is as follows:

- "If you think that you do not use enough digital tools in your lectures, please select the main reason/s for this" (RQ4)

Six answers were offered to this question, and the respondents were able to mark several answers. Respondents were also allowed to state other reasons in an open form.

Results

Google tools

Table 4 shows the percentage of respondents who do not use a particular Google digital tool and the mean value of educators' and students' satisfaction.

According to research results, the first five Google tools used by most educators in education are YouTube (91.49%), Gmail (90.31%), Google Translate (85.58%), Google Maps (84.63%) and Google Drive (78.49%). Similar research results are found for students. Most students use YouTube (96.28%), Gmail (95.55%), Google Translate (93.09%), Google Maps (88.32%) and Google Drive (73.52%). It can be concluded that

Google tools most commonly used by students and educators are; YouTube, Gmail, Google Translate, Google Maps and Google Drive. Those digital tools are used by more than 70% of educators and students. In addition to the Google mentioned above tools, more than 60% of educators use Google Docs, Google Forms, and Google Sites in the teaching process. In addition to the most commonly used Google digital tools mentioned above, more than 60% of students use Google Classroom, Google Docs and Google Meet in their education.

Educators expressed the greatest satisfaction with using Google Maps, for which the average grade is 4.29, Gmail with an average grade of 4.19 and Google Drive and Google Calendar, with an average grade of 4.01. On the other hand, students expressed their greatest satisfaction with using YouTube, which has an average grade of 4.28; Gmail, with an average grade of 4.27; and Google Maps, with an average grade of 4.24.

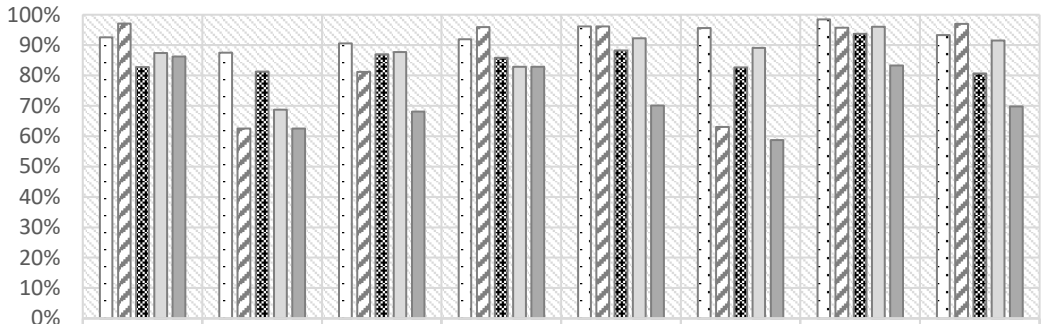
Table 4
Mean values of educators 'and students' answers about the application of Google digital tools in education and learning

Google Tools	Educators (Average)	Educators (% not using the tool)	Students (Average)	Students (% not using the tool)
YouTube	3.99	8.51%	4.28	3.72%
Gmail	4.19	9.69%	4.27	4.45%
Google Maps	4.29	15.37%	4.24	11.68%
Google Translate	3.87	14.42%	3.81	6.91%
Google Drive	4.01	21.51%	3.82	26.48%
Google Classroom	3.90	53.90%	3.92	34.92%
Google Docs	3.73	35.22%	3.71	32.58%
Google Meet	3.67	46.81%	3.75	39.37%
Google Forms	3.88	37.59%	3.67	45.35%
Google Calendar	4.01	41.84%	3.61	55.09%
Google Earth	3.68	55.79%	3.60	59.14%
Google Sheets	3.81	56.03%	3.49	60.99%
Google Sites	3.59	37.59%	3.43	62.69%
Google Slides	3.46	69.03%	3.44	63.62%
Google Contacts	3.83	52.25%	3.36	68.31%
Google News	3.16	73.52%	3.25	68.15%
Google Ads	3.15	75.65%	2.77	65.56%
Google Cloud Search	3.49	75.41%	3.21	70.86%
Google Chat	3.42	74.23%	3.27	72.55%
Google Groups	3.30	74.47%	3.21	74.09%
Google Hangouts	3.19	78.49%	3.04	74.05%
Google Travel	3.35	79.67%	3.20	77.24%
Google Print	3.17	84.63%	3.15	76.80%
Google Jamboard	3.32	85.11%	3.06	78.05%
Google Keep	3.30	85.82%	3.12	78.74%
Google Vault	2.94	87.71%	3.04	79.26%
Google Podcasts	3.14	85.11%	3.04	79.63%
Google Currents	2.97	89.13%	3.02	79.30%
Google Collections	3.26	88.42%	2.93	80.36%

Note: Possible answers are: 0 - I do not use; 1 - I am extremely dissatisfied; 5 - I am extremely satisfied
Source: Author's work

Figure 2 shows the most commonly used Google digital tools by educators and students in Croatia, Germany, Poland and Serbia, where the respondents come from. In Croatia and Serbia, Google digital tool most commonly used by educators is Gmail, while in Germany and Poland, the most used Google digital tool is YouTube.

Figure 2
The most common Google digital tools used by educators and students in observed countries (% of educators and students using the tool)



	Educator				Student			
	Croatia	Germany	Poland	Serbia	Croatia	Germany	Poland	Serbia
Youtube	93%	88%	91%	92%	96%	96%	98%	93%
Gmail	97%	63%	81%	96%	96%	63%	96%	97%
Google Maps	83%	81%	87%	86%	88%	83%	94%	81%
Google Translate	87%	69%	88%	83%	92%	89%	96%	91%
Google Drive	86%	63%	68%	83%	70%	59%	83%	70%

Source: Author's work

Microsoft tools

Table 5 shows the percentage of respondents who do not use a particular Microsoft digital tool in education and learning.

Table 5
Mean values of educators 'and students' answers about the application of Microsoft digital tools in education and learning

Microsoft tools	Educators (Average)	Educators (% not using the tool)	Students (Average)	Students (% not using the tool)
Word	4.55	1.18%	4.42	1.33%
PowerPoint	4.54	1.18%	4.39	1.78%
Excel	4.44	3.31%	4.21	5.78%
Teams	3.69	31.91%	3.66	42.04%
Outlook	4.04	35.46%	3.66	59.50%
OneNote	3.46	67.85%	3.40	66.65%
MS Forms	3.59	67.85%	3.40	68.63%
Movie Maker	3.06	83.69%	3.07	73.24%
Publisher	3.09	82.51%	3.12	78.78%
Flipgrid	2.72	91.49%	2.91	83.23%

Note: Possible answers are: 0 - I do not use; 1 - I am extremely dissatisfied; 5 - I am extremely satisfied
Source: Author's work

The research results show that more than 95% of educators and 94% of students use Word, PowerPoint and Excel in education and learning.

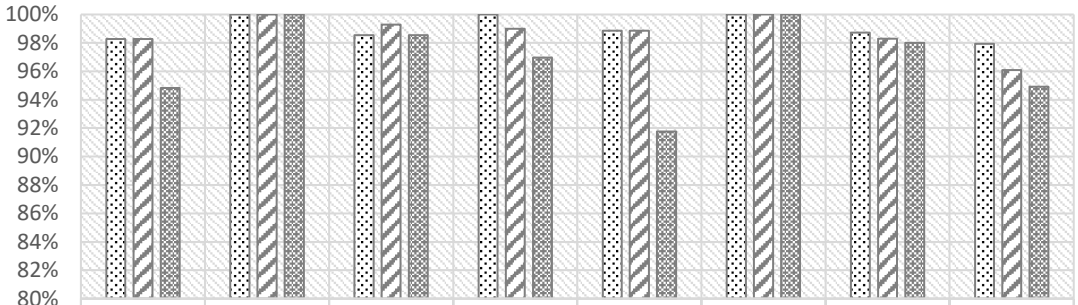
More than 60% of educators in education use the Microsoft digital tools Teams (68.09%) and Outlook (64.54%). Students use these tools to a lesser extent; Teams (57.98%) and Outlook (40.50%). Educators express the greatest satisfaction with the use of Word (average grade 4.55), PowerPoint (average grade 4.54), Excel (average grade 4.44) and Outlook (average grade 4.04). Students show a slightly lower level of

satisfaction with the use of these digital tools; however, those tools still have high average grades; Word (4.42), PowerPoint (4.39) and Teams (4.21).

Figure 3 shows the most common Microsoft digital tools educators and students use in observed countries. In all observed countries, more than 98% of educators use Word and PowerPoint and more than 94% use Excel in education. Moreover, in all observed countries, more than 98% of students use Word, more than 96% of students use PowerPoint, and more than 91% of students use Excel in learning.

According to the research results, it is evident that educators and students in Croatia use Excel to a lesser extent in education and learning than in other countries.

Figure 3
The most common Microsoft digital tools used by educators and students in observed countries

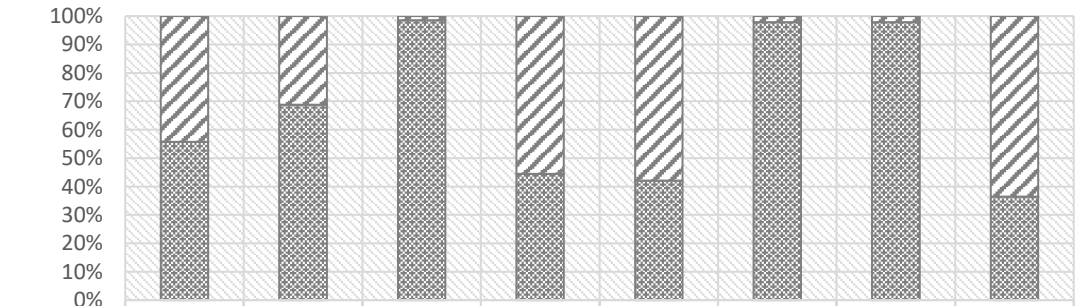


	Educator				Student			
	Croatia	Germany	Poland	Serbia	Croatia	Germany	Poland	Serbia
Word	98%	100%	99%	100%	99%	100%	99%	98%
Power point	98%	100%	99%	99%	99%	100%	98%	96%
Excel	95%	100%	99%	97%	92%	100%	98%	95%

Source: Author's work

Table 5 identified a difference in the use of Teams between educators (68.09% of educators use the tool) and students (57.96% use the tool). Because this digital tool was very important in online teaching, the use of this Microsoft digital tool by country was analysed below in Figure 4.

Figure 4
The use of Microsoft Teams by educators and students in analysed countries



	Teachers				Students			
	Croatia	Germany	Poland	Serbia	Croatia	Poland	Germany	Serbia
Do not use Teams	44,26%	31,25%	1,45%	55,56%	57,89%	2,15%	2,18%	63,51%
Do use Teams	55,74%	68,75%	98,55%	44,44%	42,11%	97,85%	97,82%	36,49%

Source: Author's work

Other Tools

The goal of the third research question, "Which of the other digital tools do you use in your education and learning in general and how satisfied are you with them?" was to identify other digital tools used in the education process (Table 6).

Table 6

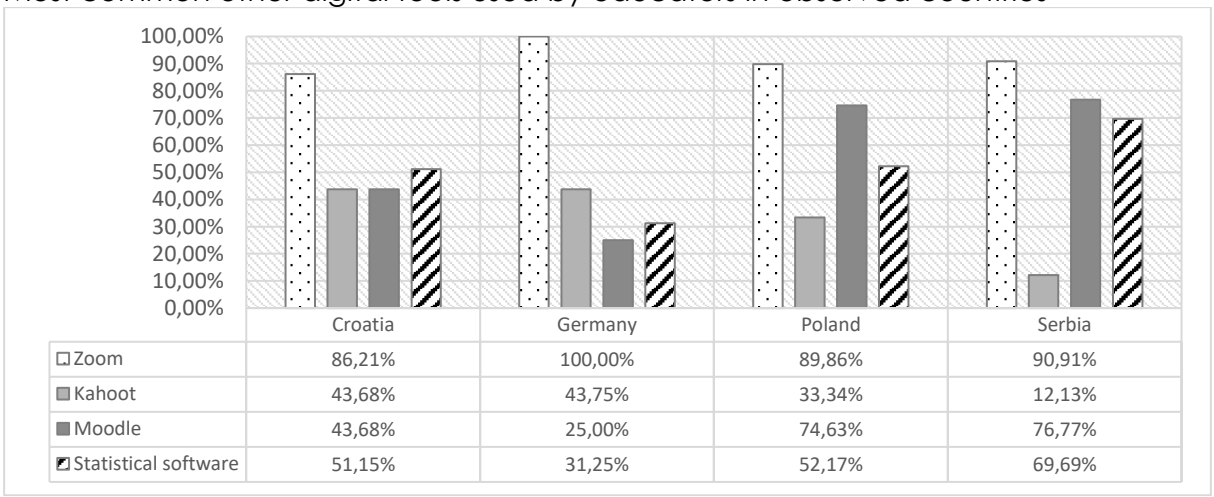
Mean values of educators 'and students' answers about the application of the other digital tools they use in your education and learning

Other tools	Educators (Average)	Educators (% not using the tool)	Students (Average)	Students (% not using the tool)
Zoom	4.33	11.11%	3.95	25.26%
Kahoot	3.73	63.59%	4.04	28.66%
Canva	3.74	76.36%	3.81	57.15%
Worldwall	3.66	84.87%	3.33	73.16%
Mentimeter	3.57	81.80%	3.21	82.13%
Geogebra	3.14	90.07%	3.32	77.93%
Bookwidgets	3.03	93.14%	2.93	87.67%
Genially	3.08	91.25%	3.03	87.19%
Merlin	3.54	83.69%	3.14	77.77%
Quizizz	3.65	79.91%	3.51	66.09%
Mindmapping	3.27	86.76%	3.06	83.19%
Wizer.me	3.09	92.43%	2.93	85.89%
ClickMeeting	3.07	80.38%	2.99	82.22%
WordPress	3,32	79.20%	3.24	78.50%
Inforgapia	2,69	93.85%	2.95	87.71%
Book Creator	3,07	92.91%	2.94	86.70%
Yammer	3,52	83.69%	3.33	77.61%
Lumen	3,12	83.92%	3.08	79.30%
QR code generation software	3,60	76.60%	3.23	80.40%
Moodle	3,74	41.61%	3.67	56.51%
Lucidpress	2,81	93.85%	2.93	87.95%
Powtoon	2,94	91.96%	3.02	87.23%
Lucidchart Diagrams	3,00	92.20%	3.06	86.62%
Statistical software	3,79	45.39%	3.15	79.14%
Diagrams.net	3,22	93.62%	3.02	87.31%
Accounting software	3,36	81.56%	3.04	80.36%
Piktochart	3,09	91.96%	3.03	85.77%

Note: Possible answers are: 0 - I do not use; 1 - I am extremely dissatisfied; 5 - I am extremely satisfied; Source: Author's work

Figure 5

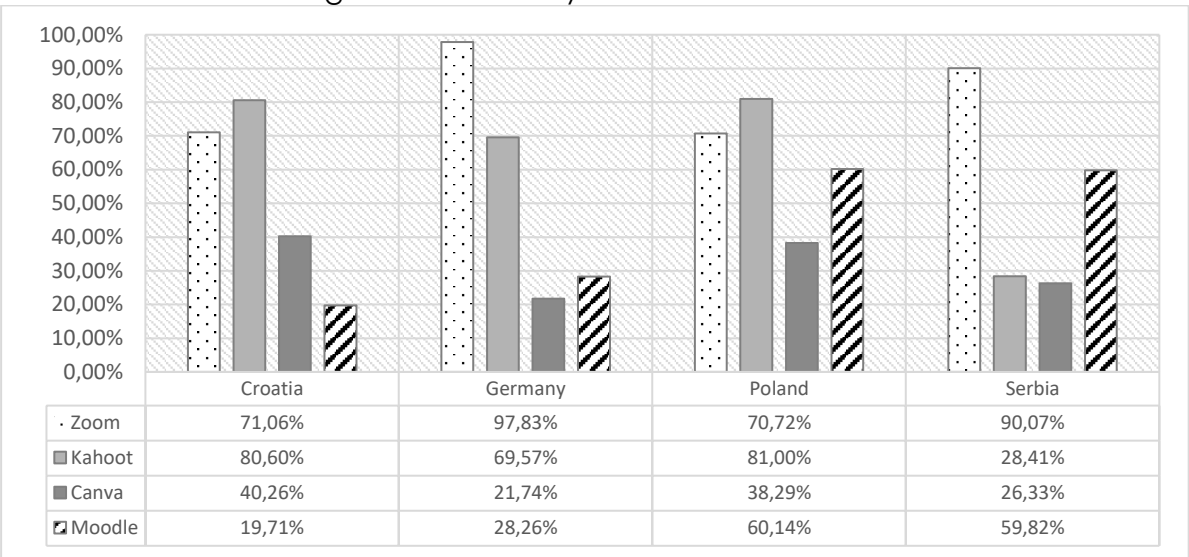
Most common other digital tools used by educators in observed countries



	Croatia	Germany	Poland	Serbia
Zoom	86,21%	100,00%	89,86%	90,91%
Kahoot	43,68%	43,75%	33,34%	12,13%
Moodle	43,68%	25,00%	74,63%	76,77%
Statistical software	51,15%	31,25%	52,17%	69,69%

Source: Author's work

Figure 6
Most common other digital tools used by students in observed countries



	Croatia	Germany	Poland	Serbia
Zoom	71,06%	97,83%	70,72%	90,07%
Kahoot	80,60%	69,57%	81,00%	28,41%
Canva	40,26%	21,74%	38,29%	26,33%
Moodle	19,71%	28,26%	60,14%	59,82%

Source: Author's work

Reasons for not using enough digital tools

The last research question was asked only to educators; " If you think that you do not use enough digital tools in your lectures, please select the main reason/s for this". Educators were able to mark multiple answers. As can be seen in Table 7, most respondents cite the main reason for insufficient use of digital tools in lectures; (1) Overload of existing teaching materials (lack of time for additional application of digital tools) – 48% and (2) Lack of time for preparing new materials (47%). Lack of financial resources seems to be the least significant reason for the insufficient use of digital tools (11%).

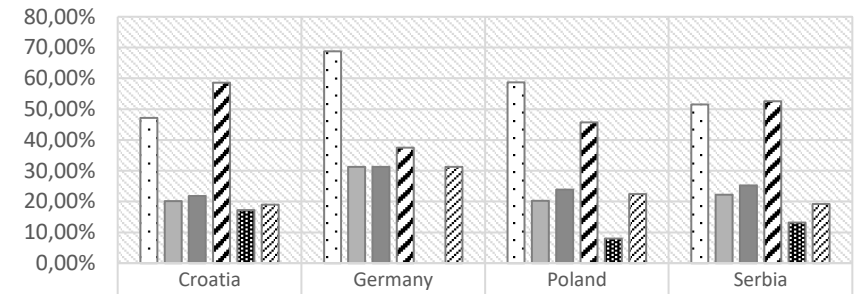
Respondents had the opportunity to state other reasons for the insufficient use of digital tools and stated some of the reasons; (1) lack of support from specialists to implement new digital tools, (2) some tools are similar to others, so it makes no sense to use them all, (3) tools should match the content of the course and learning outcomes, (4) it is not an obligatory action at university, (5) data protection regulations, (6) data privacy etc.

Table 7
Reasons for not using enough digital tools in teaching practice

If you think that you do not use enough digital tools in your lectures, please select the main reason/s for this	# educators	% educators
Lack of time for preparing new materials	200	47.29%
Inability to participate in workshops regarding digital tools	84	19.86%
Insufficient knowledge of terms and rights of using applications available via web	72	17.03%
Overload of existing teaching materials (lack of time for additional application of digital tools)	203	47.99%
Impossibility of independently changing the existing curriculum	77	18.21%
Lack of financial resources	47	11.12%

Source: Author's work

Figure 7
The main reasons for not using enough digital tools in teaching practice



	Croatia	Germany	Poland	Serbia
Lack of time for preparing new materials	47,13%	68,75%	58,70%	51,52%
Inability to participate in workshops regarding digital tools	20,12%	31,25%	20,29%	22,23%
Insufficient knowledge on terms and rights of using applications available via web	21,84%	31,25%	23,92%	25,26%
Overload of existing teaching materials (lack of time for additional application of digital tools)	58,62%	37,50%	45,66%	52,53%
Impossibility to independently change the existing curriculum	17,25%	0,00%	7,98%	13,14%
Lack of financial resources	18,97%	31,25%	22,47%	19,20%

Source: Author's work

Figure 7 shows the main reasons for not using enough digital tools in teaching practice by country. The main reason is the overload of existing teaching materials (lack of time for additional application of digital tools) in Croatia and Serbia, followed by a lack of time for preparing new materials. In Germany and Poland, the main reason is the lack of time for preparing new materials, followed by the overload of existing teaching materials (lack of time for additional digital tools).

Discussion

Until the Corona crisis, teaching at higher education institutions was held almost exclusively in classrooms. A small number of courses were held as online courses. High education lately experienced the unannounced shift from traditional lessons held in classrooms to distance teaching using different technologies. Due to those specific circumstances, educators are forced to change how they observe the process of learning, teaching and assessment in the digital environment. On the other hand, students also had to adapt to a new way of learning, applying new digital technologies in a short period. According to Toquero (2020), there is a stronger need for academic organisations to improve their curriculum, and the usage of new instructional methods and strategies should be of utmost significance. According to Toquero (2020), in the future, we can expect changes in the curriculum of courses at different universities globally and the introduction of a hybrid way of teaching permanently; a mix of traditional teaching in classrooms at universities and online teaching using different digital technologies. This research aimed to identify which digital tools educators and students use the most in teaching and learning and to what extent they are satisfied with them. To achieve the goal of the research, four research questions were asked to educators and students; (RQ1) "What Google digital tools do you use in your education and learning in general and how satisfied are you with them?", (RQ2) "What Microsoft digital tools do you use in your education and learning in general, and how satisfied are you with them?", (RQ3) "Which of the

other digital tools do you use in your education and learning in general, and how satisfied are you with them?" and the fourth research question (RQ4) was asked only to educators and was: "If you think that you do not use enough digital tools in your lectures, please select the main reason/s for this". Six answers were offered to this question, and the respondents were able to mark several statements. Respondents were also allowed to state other reasons in an open form. The survey included respondents from 4 countries; Croatia, Germany, Poland and Serbia. A total of 423 educators and 2,474 students answered the research questions. The limitation of this research can be identified in the relatively small share of respondents from Germany. Therefore, research on a larger sample of educators and students should be further examined to obtain more relevant conclusions on the application of digital technologies in Germany.

Answers to research questions of this research are presented below:

- *RQ1 - What Google digital tools do students and educators use in their education and learning in general, and how are they satisfied with them*

According to research results, the first five Google tools used by most educators in education are YouTube (91.49%), Gmail (90.31%), Google Translate (85.58%), Google Maps (84.63%) and Google Drive (78.49%). Similar research results are found among students. Most students use YouTube (96.28%), Gmail (95.55%), Google Translate (93.09%), Google Maps (88.32%) and Google Drive (73.52%). It can be concluded that Google tools most commonly used by students and educators are; YouTube, Gmail, Google Translate, Google Maps and Google Drive. Those digital tools are used by more than 70% of educators and students. Educators expressed the greatest satisfaction with using Google Maps, for which the average grade is 4.29, Gmail with an average grade of 4.19 and Google Drive and Google Calendar, with an average grade of 4.01. On the other hand, students expressed their greatest satisfaction with using YouTube, which has an average rating of 4.28; Gmail, with an average rating of 4.27; and Google Maps, with an average rating of 4.24.

- *RQ2 - What Microsoft digital tools do students and educators use in their education and learning in general, and how are they satisfied with them*

The research results show that more than 95% of educators and 94% of students use Word, PowerPoint and Excel in education and learning. Educators express the greatest satisfaction with the use of Word (average grade 4.55), PowerPoint (average grade 4.54), Excel (average grade 4.44) and Outlook (average grade 4.04). Students show a slightly lower level of satisfaction with the use of these digital tools; however, those tools still have high average grades; Word (4.42), PowerPoint (4.39) and Teams (4.21).

- *RQ3 - Which of the other digital tools do students and educators use in their education and learning in general, and how are they satisfied with them*

The research results showed that among other digital tools that educators use in teaching, Zoom is the most important, and 89% of educators apply it; Moodle is used by 58% of educators, Statistical software by 55% of educators and Kahoot by 36% of educators. Students, on the other hand, mostly use Zoom (74%), Kahoot (71%), Moodle (43%) and Canva (43%). In this category, educators rated the digital tool Zoom with the highest average grade (4.33), while students expressed the highest satisfaction with Kahoot (4.04).

- *RQ4 – What are the main reasons that educators do not use enough digital tools in their lectures*

Educators were able to mark multiple answers. Most respondents cite the main reason for insufficient use of digital tools in lectures site; (1) Overload of existing teaching materials (lack of time for additional application of digital tools) – 48% and

(2) Lack of time for preparing new materials (47%). Other important reasons are; Inability to participate in workshops regarding digital tools (20%), the Impossibility of independently changing the existing curriculum (18%), and Insufficient knowledge of terms and rights of using applications available via the web (17%). Lack of financial resources seems to be the least significant reason for the insufficient use of digital tools (11%).

Conclusion

Research papers published before the Covid-19 health crises showed how these crises accelerated the digital transformation in higher education. Digital transformation changes how educational material is published and distributed to learners. Moreover, digital technologies are also changing the nature of lectures. Digital transformation in higher education is inevitable. The unannounced need for accelerated digital transformation in higher education will have permanent consequences in teaching. A complete return to the classic way of teaching seems not to be expected. Covid-19 strongly influences all aspects of our lives and, thus, higher education institutions. Transfer to online learning was one of the most significant changes in delivering lectures in 2020-2021. Transferring from traditional learning to online learning happened quickly and unexpectedly.

The main objective of this research was to identify key digital tools used by educators and students and their satisfaction with them in four countries; Croatia, Germany, Poland and Serbia. The research sample includes educators and students from economic universities and faculties and educators and students from economic secondary schools. A total of 423 responses from educators and 2,474 responses from students from the 4 countries were collected. Most of the surveyed educators and students come from Croatia, followed by Poland and Serbia, while the least is from Germany, a kind of research limitation. To get a more accurate picture of the application of digital technologies in Germany, it is necessary to expand the research to a larger number of respondents. According to the years of work experience, the largest number of educators (respondents) have between 16 and 25 years of experience in teaching, followed by educators with between 6 and 15 years of experience. The largest number of students is in the third year of study, followed by students in the second year of study.

Regarding Google digital tools, research results showed that Google tools most commonly used by both students and educators are; YouTube, Gmail, Google Translate, Google Maps and Google Drive. Moreover, educators expressed the greatest satisfaction with the use of Google Maps (average grade 4,29), Gmail (4,19) and Google Drive and Google Calendar (4.01). On the other hand, students expressed their greatest satisfaction with the use of YouTube (4,28), Gmail (4.27), and Google Maps (4.24). Regarding Microsoft digital tools, research results showed that the Microsoft tools most commonly used by educators and students in observed countries are; Word, PowerPoint and Excel. Educators and students rated their satisfaction with using these digital tools with high average grades. The research results showed that among other digital tools that educators use in teaching, Zoom and Moodle are the most important, followed by Statistical software and Kahoot.

On the other hand, students mostly use Zoom, Kahoot, Moodle and Canva. In this category, educators rated the digital tool Zoom with the highest average grade (4.33), while students expressed the highest satisfaction with Kahoot (4.04). The paper also analyses the application of the most important Google, Microsoft and other digital tools by country. The aim of the research was also to identify the main reasons for the insufficient use of digital tools by educators, and two main reasons were

identified; (1) Overload of existing teaching materials (lack of time for additional application of digital tools) and (2) Lack of time for preparing new materials. For future research, we recommend including educators and students from other countries in the sample to identify the most important digital tools for educators and students in transitional and economically developed countries.

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References

1. Bader, M., Iversen, S. H., Burner, T. (2021), "Students' perceptions and use of a new digital tool in educator education", Nordic Journal of Digital Literacy, Vol. 16, No. 1, pp. 21-33.
2. Beardsley, M., Albo, A., Davinia, H., Aragon, P. (2021), "Emergency education effects on educator abilities and motivation to use digital technologies", British Journal of Educational Technology, Vol. 52, No. 2, pp. 1455-1477.
3. Camilleri, M., Camilleri, A. (2016), "Digital Learning Resources and Ubiquitous Technologies in Education", Tech Know Learn, Vol. 8, pp. 65-82.
4. Cetin, E. (2021), "Digital storytelling in educator education and its effect on the digital literacy of pre-service educators", Thinking Skills and Creativity, Vol. 39, article 100760.
5. Cruz, R., Martins, J., Sousa, M. (2017), "Digital learning methodologies and tools-a literature review", Edulearn17 Proceedings, pp. 5185-5192.
6. Curcic, J., Vasic, S., Delic, M., Gracanin, D., Ciric, D. (2021), "Unapredjenje zadovoljstva korisnika u primeni alata za ucenje na daljinu u institucijama visokog obrazovanja", available at http://www.trend.uns.ac.rs/stskup/sadrzaj-2021.html (5 February 2022)
7. Danko, O. (2010), "Development of language competences of students in non-core schools using the methods and means of informatics", Informatics and Education, No. 11, pp. 119-121.
8. Dragun, M. (2021), Uporaba digitalnih alata u nastavi na daljinu, Sveučilište u Splitu, Filozofski fakultet, Split.
9. Drijvers, P. (2015), "Digital Technology in Mathematics Education: Why It Works (Or Doesn't)", Springer - Selected Regular Lectures from the 12th International Congress on Mathematical Education, pp. 135-151.
10. Garcia-Martinez, J., Rosa-Nepal, F., Romero-Tabeayo, I., Lopez-Salvo, S., Fuentes-Abeldo, E. (2020), "Tools and Personal Learning Environments: An Analysis in Higher Education", Sustainability, Vol. 12, No. 19, pp. 1-11.
11. Gjud, M., Popcevic, I. (2020), "Digitalizacija nastave u skolskom obrazovanju", Polytechnic and design, Vol. 8, No. 3, pp. 154-162.
12. Guillen-Gamez, F., Mayorga-Fernandez, M., Contreras-Rosado, J. (2021), "Incidence of Gender in the Digital Competence of Higher Education Educators in Research Work: Analysis with Descriptive and Comparative Methods", Journal of Education Sciences, Vol. 11, No. 3, pp. 1-14.
13. Hamalainen, R., Nissinen, K., Mannonen, J., Lamsa, J., Leino, K., Taajamo, M. (2021), "Understanding teaching professionals' digital competence: What do PIAAC and TALIS reveal about technology-related skills, attitudes, and knowledge?", Computers in Human Behavior, Vol. 117, pp. 1-15.
14. Harasim, L. (2012), Learning Theory and Online Technology: How New Technologies are Transforming Learning Opportunities, Routledge.

15. Hillmayr, D., Ziernwald, L., Reinhold, F., Hofer, S., Reiss, K. 2020), "The potential of digital tools to enhance mathematics and science learning in secondary schools: A context-specific meta-analysis", Computers & Education, Vol. 153, pp. 1-25.
16. Jobirovich, M. (2021), "Advantages of the Introduction of Digital Technologies into the Educational Process", Pindus Journal of Culture, Vol. 7, pp. 17-20.
17. Kallimulina, O., Tarman, B., Stepanova, I. (2021), "Education in the Context of Digitalization and Culture: Evolution of the Educator's Role, Pre-pandemic Overview", Journal of Ethnic and Cultural Studies, Vol. 8, No. 1, pp. 226-238.
18. Lau, K. (2014), "Computer-based teaching module design: principles derived from learning theories", Medical Education, Vol. 48, No. 3, pp. 247-254.
19. Makosa, P. (2013), Advantages and disadvantages of digital education, Biuletyn Edukacji Medialnej.
20. Minasyan, E. (2016), "Digital tools implemented in the learning process: more of help or hindrance?", Humanitarian Education at Economic University, Vol. 2., pp. 253-258.
21. Neufeld, D. (2018), "An Exploratory Study of the Impact of Digital Learning Tools on Student Engagement, Self-Efficacy and Ownership of Learning", Faculty of Education, Memorial University of Newfoundland.
22. Oliveira, K., Souza, R. (2022), "Digital Transformation towards Education 4.0", Informatics in Education, Vol. 21 No. 2, pp. 283-309.
23. Otterborn, A., Schonborn, K., Hulten, M. (2018), "Surveying preschool educators' use of digital tablets: general and technology education related findings", International Journal of Technology and Design Education, Vol. 29, pp. 717-737.
24. Rawashdeh, A., Mohammed, E., Arab, A., Alara, M., Al-RAwashdeh, B. (2021), "Advantages and Disadvantages of Using e-Learning in University Education: Analyzing Students' Perspectives", The Electronic Journal of e-Learning, Vol. 19, No. 3, pp. 107-117.
25. Toquero, C. M. (2020), "Challenges and opportunities for higher education amid the COVID-19 pandemic: The Philippine context", Pedagogical Research, Vol. 5, No. 4, pp. 1-5.
26. Vanwynsberghe, H., Verdegem, P. (2013), "Integrating Social Media in Education", Clcweb: Comparative Literature and Culture, Vol. 15, No. 10, pp. 1-11.
27. Vurusic, M. (2019), Digitalni alati u nastavi povijesti u osnovnoj školi, Sveučilište u Rijeci, Filozofski fakultet, Rijeka.
28. Yilmaz, A. (2021), "The Effect of Technology Integration in Education on Prospective Skills and Academic Achievements", Peer Review Academic Journal, Vol. 8, No. 2, pp. 163-199.
29. Zhao, Y., Liorente, A., Gomez, M. (2021), "Digital competence in higher education research: A systematic literature review", Computers & Education, Vol. 168, article 104212.

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Digital Competencies in Selected European Countries among University and High-School Students: Programming is lagging behind

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Abstract

Background: Constant integration of digital technologies in economic and social life is rapidly and significantly shaping and changing our environment and ourselves. To function in such a world, even in daily routines, it is necessary to possess certain digital competencies. **Objectives:** This paper aims to examine how university and high-school students of economic orientations from selected European countries self-assess their digital competencies, and to analyse the identified differences. This will enable further understanding of university and high-school students' digital competencies that can serve as guidance for improving teaching practices and curricula. **Methods/Approach:** A survey was conducted to collect data that were analysed using non-parametric statistic tests (Mann-Whitney U test and Kruskal-Wallis H test) and Spearman Rank-Order Correlation coefficient. **Results:** University and high-school students consider to have below intermediate level of digital competencies. High-school students self-assessed digital competencies at a higher level than university students. University students of higher years of study self-assessed digital competencies at a higher level. There is no universal pattern among high-school students of different years of study. University students in the Accounting module and high-school students in the Tourism module assessed their digital competencies at the lowest level in several areas. There is a consistency in self-assessment of digital knowledge and digital skills. Conclusions: The identified below intermediate level of digital competencies and discovered discrepancies indicated the need for educational process improvements to provide university and high-school students with a higher degree of digital competencies. Programming is the most lagging behind in all the observed groups.

Keywords: economic education; digitalisation; digital knowledge; digital skills; self-perception; programming

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Introduction

The contemporary world is a digital world where it is crucial to demonstrate an appropriate level of digital knowledge and skills to increase the chances for professional and personal development. This statement is based on two indisputable facts. Firstly, information technologies are being broadly implemented in economic and social life. Secondly, information technologies are available to many of the world's population. Due to the wide application of information technology for private and business purposes and in education, there is a growing emphasis on the importance of possessing digital competencies. Digital competencies are of the utmost importance for the progress of society in general, quality of education, employability, successful integration in the labour market and progress in the career. The intense globalisation and the emergence of the COVID-19 pandemic highlighted the necessity for further development of digital knowledge and skills. The relationship between digitalisation and education is two-way.

On the one hand, education has to provide university and high-school students with an adequate level of digital competencies. On the other hand, the digitalisation fostered by the COVID-19 pandemic faced professors and teachers with the challenge of continuing high-quality teaching in new circumstances. The key motivation for our research was to investigate the relationship between digitalisation and education with the objectives to identify the current level of digital competencies among university and high-school students of economic orientation, find out the space for its improvement through innovations in the curricula and continuous advancement in teaching methods, and give a recommendation to education policymakers.

We strive to answer the following research questions:

- *RQ1. What is the level of university and high-school students' digital competencies by their perception, and are there significant differences across these two groups of respondents?*
- *RQ2. Is there a relationship between the self-assessment of digital knowledge and digital skills among university students as well as among high-school students?*
- *RQ3. Are there significant differences in the self-assessment of digital competencies between university students of different years of study and between high-school students of different years of study?*
- *RQ4. Are there significant differences in the self-assessment of digital competencies between university students of different major areas and between high-school students of different major areas?*

In the following part of this introductory section, we present several concepts related to digitalisation and their meaning and specify which particular definitions we are using in the paper. The term digitisation can be assigned a wide range of meanings depending on the context in which it is used. In its initial meaning, the term denotes the process of converting information stored in the form of text, sound, or image into binary code, in which information is presented in a string of only two digits (zero or one). The process of digitalisation began in the period of production of the first computers, in the sixth decade of the last century. From then to nowadays, the term has been used in more and more different fields in which its meaning was constantly broadening. A range of new terms related to the digitalisation concept has emerged: digitalisation of business, digitalisation of governance, digitalisation of communications, digitalisation of education, digital knowledge, digital skills, digital literacy, and so on.

The terms competence, knowledge, skills, digital competence, digital knowledge and digital skills are defined in the existing literature in many different ways. According to the Council of the European Union (2017, p. 20) "competence means the proven ability to use knowledge, skills and personal, social and/or methodological abilities in work or study situations and professional and personal development", while the term skill means "the ability to apply knowledge and use know-how to complete tasks and solve problems". "In the context of the European Qualifications Framework for lifelong learning (EQF), skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments)" (Council of the European Union, 2017, p. 20). The European Parliament and the Council of the European Union (2006, p. 13) define competence as "a combination of knowledge, skills and attitudes appropriate to the context". They recognise "eight key competencies that all individuals need for personal development, active citizenship, social inclusion and employment: 1. communication in the mother tongue, 2. communication in foreign languages, 3. mathematical competence and basic competencies in science and technology, 4. digital competence, 5. learning to learn, 6. social and civic competencies, 7. sense of initiative and entrepreneurship, and 8. cultural awareness and expression" (European Parliament and the Council of the European Union, 2006, p. 13). European Commission (2016, p. 2) considers that the term skills "refers broadly to what a person knows, understands and can do".

A basic definition of the concept of digital competence is that it is the ability to use information and communication technologies (ICTs). However, like the definition of the term competence in general, the meaning and scope of the concept of digital competence vary between authors (such as Ilomäki et al., 2011; Krumsvik, 2011, 2012; Käck et al., 2012). Digital competencies are "the confident, critical and creative use of ICTs to achieve goals related to work, employability, learning, leisure, inclusion and/or participation in society" (Ferrari, 2013, p. 2). Ferrari (2013, p. 2) states that "digital competence is a transversal key competence which, as such, enables us to acquire other key competencies (e.g. language, mathematics, learning to learn, cultural awareness)". According to the European Parliament and the Council of the European Union (2006, p. 15), "digital competence involves the confident and critical use of information society technology for work, leisure, and communication, including basic skills in ICTs: the use of computers to retrieve, assess, store, produce, present and exchange information, and to communicate and participate in collaborative networks via the Internet". In the European Digital Competence Framework for Citizens (DigComp), digital competence is grouped into five areas: "information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving" (Carretero et al., 2017, p. 11).

Spante et al. (2018, p. 1), in a systematic review of higher education research for the period 1997 - 2017, found out there are a lot of definitions for the concept of digital competence depending on whether the concept is defined by policy, by researchers, or both, and whether it is focused on social practices or technical skills. Spante et al. (2018, p. 15) conclude that the perspective of the digital competence concept has been transformed from solely operational and technical-oriented to knowledge and cognitive-oriented. Krumsvik (2011, p. 40) argues that "it is not clear whether the underlying epistemology of digital competencies within education is steered by policymakers or by academics".

In the existing literature, digital competence is mainly used as a comprehensive term that includes both digital knowledge and digital skills. This paper is based on the data obtained in a questionnaire conducted for the project "Challenges and

practices of teaching economic disciplines in the era of digitalisation“ - DIGI4Teach. Particularly, the section “Self-assessment of digital competencies” was the focus of our analysis. All questions are divided into two categories: one refers to digital knowledge (proficiency) and the other to digital skills. Digital knowledge means that participants have some theoretical knowledge, while digital skill means they know how to apply their theoretical knowledge in practice. The most common verb used in the questions about digital knowledge is ‘know’, while the verbs ‘apply’, ‘perform’, and ‘conduct’ are most frequently used in part about digital skills. In the paper, we use these definitions of digital competence, digital knowledge and digital skills.

The remainder of the paper is organised as follows. A literature review follows the introduction. The next section describes the methodology used in the data collection process and analysis of the results. After that, the results are presented and discussed. Concluding remarks are given in the last section.

Literature review

Numerous international studies indicate that a lot of people lack digital competencies despite the fact they need to be digitally competent for education, employment, and lifelong learning (Ferrari, 2013, p. 4). Almost half of the European Union population lacks basic digital skills (European Commission, 2016, p. 7). The COVID-19 pandemic highlighted the lack of digital skills in the labour market (European Commission, 2020, p. 3). Eurostat’s (2020) publication states a significant difference between the two age groups in having basic or above basic digital skills. Namely, in 2019 in the group aged between 16 and 74, 56% of individuals had basic or above basic digital skills, while for the group aged 16 to 24, this number was 80%.

Araiza-Vazquez and Pedraza-Sanchez (2019) study revealed that university students perceive having high ICT competencies. The respondents were university students of business administration, accounting and international business, and the accounting students self-reported to have the highest ICT competencies. Martzoukou et al. (2020, p. 1413) conducted a study where university students from Scotland, Ireland and Greece with library and information science as major areas self-assessed their digital competencies. The authors concluded that students’ digital competencies were low in several areas: “development of information literacy, digital creation, digital research and digital identity management” (Martzoukou et al., 2020, p. 1413). Crawford-Visbal et al. (2020) adopted the European Commission’s Digital Competence Framework 2.0 (2017) to analyse the digital competencies of university students of communication in Argentina, Colombia, Peru, and Venezuela. Questionnaires, focus groups and semi-structured interviews were used to gather the data. The results showed that students have a high internet connectivity level but a low level of information literacy. Also, the study found that students overestimate their digital competencies, although they often do not meet minimum job market standards. The recommendation for education policymakers was to take action to improve students’ digital competencies and ICT skills.

Colas-Bravo et al. (2017) concluded that non-university students in Spain self-perceive to have an average level of digital skills. The sample consisted of 50.3% of primary school and 49.7% of high-school students.

Studies comparing employers’ expectations and potential employees’ self-perception of digital competence are very important. The study of Torres-Coronas (2015) identified the gap in the perception of digital competencies between university students and employers, which represents a discrepancy between education and labour market needs. The participants in a study by Sicilia et al. (2018) were university students, employers, and representatives of civic institutions from Spain, Poland, the

UK, Ireland and Belgium. The DigComp 2.1. framework was used as a reference for digital competencies to assess the relative importance of digital competencies and the possibilities and best approaches to acquire them. The study pointed out differences in self-perception of digital competencies across examined groups and a gap between the requirements of the labour market and the actual students' competencies.

Methodology

As noted above, the research conducted in this paper is based on the data obtained through a questionnaire prepared by the project members from the University of Zagreb, Faculty of Economics & Business, as the project coordinator. The "Self-assessment of digital competencies" section of the questionnaire is based on the following sources: CARNet (2016), Ferrari (2013) and Ferrari et al. (2014). Following these authors, a three-point Likert scale was used, meaning that respondents could report having a basic, intermediate or advanced level of digital knowledge and skills. The project members who prepared the questionnaire defined respondents as students from universities of economics and high-school students of economics in the fields of Accounting, Finance, Trade and Tourism, coming from Croatia, Germany, Poland and Serbia. The survey participants filled out the questionnaire in November and December 2021 and January 2022. The sample consists of 2482 respondents, where 1679 are university students and 795 are high-school students. All years of studies were represented in the sample.

The distribution of the respondents between countries, years of study and major areas are provided in Table 1.

Table 1
Distribution of University and High-school students between Countries, Years of Study and Major Areas

	University students		High-school students	
	#	%	#	%
Country				
Croatia	656	39.07	642	80.75
Germany	29	1.73	16	2.01
Poland	699	41.63	0	0.00
Serbia	295	17.57	137	17.23
Total	1679	100.00	795	100.00
Year of Study				
1st	411	24.48	124	15.60
2nd	455	27.10	182	22.89
3rd	449	26.74	298	37.48
4th	239	14.23	186	23.40
5th	125	7.44	5	0.63
Major Area				
Accounting	355	21.14	134	16.86
Finance	438	26.09	189	23.77
Trade	404	24.06	117	14.72
Tourism	162	9.65	220	27.67
Other	320	19.06	135	16.98
Total	1679	100.00	795	100.00

Source: Authors' calculation

To investigate whether there are differences in self-assessment of digital competencies between the university and high-school students, we applied the Mann-Whitney U test for two independent samples. To answer whether there are differences in self-assessment of digital competencies between university/high-school students of different years of study and whether there are differences in self-assessment of digital competencies between university/high-school students of different major areas, we used the Kruskal-Wallis H test for five independent samples. We also applied post hoc analysis to identify where the differences came from. We calculated the Spearman Rank-Order Correlation coefficient to investigate if there is a correlation between the self-assessment of digital knowledge and the self-assessment of digital skills.

Results

Comparison between university and high-school students

The average levels of self-assessed digital knowledge and skills for university and high-school students are presented in Table 2.

Table 2
Average values of the self-assessed digital knowledge and skills for university and high-school students

Digital Competence	University students		High-school students	
	Knowledge	Skills	Knowledge	Skills
Browsing, searching and filtering data, information, and digital content	2.01	1.71	2.04	1.77
Data, information, and digital content management	1.85	1.93	1.88	1.76
Data, information, and content sharing via digital technologies	1.92	1.79	1.91	1.79
Interacting (collaboration) through digital technologies	1.86	1.86	1.84	1.81
Developing digital content	1.81	1.86	1.88	1.85
Programming	1.40	1.37	1.51	1.51
Protecting devices	1.70	1.58	1.76	1.58
Protecting personal data and privacy	1.78	1.72	1.86	1.77
Solving technical problems	1.58	1.59	1.61	1.65
Creative problem-solving by using digital technologies	1.57	1.53	1.66	1.64

Note: The level of digital knowledge was estimated with grades: 1-foundation level, 2-intermediate level, 3-advanced level
Source: Authors' work

The average value of self-assessed digital knowledge for university students is 1.75, the minimum value is 1.40, and the maximum value is 2.01. Regarding digital skills for university students, the average value is 1.69, the minimum value is 1.37, and the maximum value is 1.93. In the sample of high-school students, the average value of self-assessed digital knowledge is 1.80, the minimum value is 1.51, and the maximum value is 2.04. High-school students self-assessed their digital skills at an average value of 1.71, with a minimum value of 1.51 and a maximum of 1.85. It can be concluded that, on average, both university and high-school students self-perceive to have below intermediate-level digital competencies. High-school students reported higher levels of digital competencies than university students, while both university and high-school students reported having a lower level of digital skills than digital knowledge.

Such results open space for the analysis of the digital adequacy of teaching methods. Professors, teachers and educational policymakers need to constantly modernise curricula and apply contemporary digital tools in teaching.

In Table 3, standardised Mann-Whitney U test statistics and p-values are reported to examine differences in the self-assessment of digital competencies between students and high-school students.

Table 3
Differences in the self-assessment of digital competencies between university and high-school students

Question	Knowledge		Skills	
	Z	p-value	Z	p-value
Browsing, searching and filtering data, information, and digital content	-0.999	0.318	-1.983	0.047*
Data, information, and digital content management	0.892	0.372	-5.102	<0.001*
Data, information, and content sharing via digital technologies	-0.273	0.785	-0.096	0.924
Interacting (collaboration) through digital technologies	-0.523	0.601	-1.711	0.087
Developing digital content	-2.627	0.009*	-0.210	0.834
Programming	-4.290	<0.001*	-5.848	<0.001*
Protecting devices	-1.700	0.089	-0.261	0.794
Protecting personal data and privacy	-2.035	0.042*	-1.740	0.082
Solving technical problems	-1.252	0.211	-1.955	0.051
Creative problem-solving by using digital technologies	-3.575	<0.001*	-4.367	<0.001*

Note: The asterisk * indicates a 5% significance level. Z shows standardised Mann-Whitney U test statistics.
Source: Authors' work

Based on the results shown in Table 3, we can conclude: university students self-reported lower digital knowledge than high-school students in Developing digital content, Programming, Protecting personal data and privacy, and Creative problem-solving by using digital technologies. Regarding digital skills, university students self-assessed them at a higher level than high-school students in the area of Data, information, and digital content management, while high-school students self-reported higher digital skills than university students in the areas of Browsing, searching and filtering data, information, and digital content, Programming, and Creative problem solving by using digital technologies.

There are no statistically significant differences in digital knowledge between university and high-school students in the following areas: Browsing, searching and filtering data, information, and digital content, Data, information, and digital content management, Data, information, and content sharing via digital technologies, Interacting (collaboration) through digital technologies, Protecting devices, and Solving technical problems. There are no statistically significant differences in digital skills between university and high-school students in the following areas: Data, information, and content sharing via digital technologies, Interacting (collaboration) through digital technologies, Developing digital content, Protecting devices, Protecting personal data and privacy, and Solving technical problems.

Accordingly, there are differences in self-assessment of digital knowledge between university and high-school students in four out of 10 areas, always in favour of high-school students. Concerning digital skills, there are differences in four out of 10 areas:

high-school students self-reported higher levels in three areas, while university students only in one.

Such results may seem a little bit counterintuitive since it is expected that a higher level of education means a higher level of knowledge and skills. However, we analysed a special kind of knowledge and skills – digital ones. Possible factors of observed differences between analysed groups of respondents can be age differences: younger respondents started to be exposed to the digital world and content at an earlier stage of their life; they adapt to the digital world faster; high-school students have more free time than university students. The additional possible explanatory factor that has to be further examined may be higher self-confidence in high-school students compared to university students.

Table 4 contains correlation coefficients and p-values calculated to investigate the association between digital knowledge and skills: the left panel contains results for university students, while the right one is for high-school students.

Table 4
Correlation between digital knowledge and skills among university and high-school students

Digital Competence	*University students*		*High-school students*	
	r	p-value	r	p-value
Browsing, searching and filtering data, information, and digital content	0.456	< 0.001*	0.405	< 0.001*
Data, information, and digital content management	0.462	< 0.001*	0.426	< 0.001*
Data, information, and content sharing via digital technologies	0.539	< 0.001*	0.489	< 0.001*
Interacting (collaboration) through digital technologies	0.563	< 0.001*	0.537	< 0.001*
Developing digital content	0.562	< 0.001*	0.533	< 0.001*
Programming	0.576	< 0.001*	0.542	< 0.001*
Protecting devices	0.512	< 0.001*	0.532	< 0.001*
Protecting personal data and privacy	0.521	< 0.001*	0.519	< 0.001*
Solving technical problems	0.605	< 0.001*	0.485	< 0.001*
Creative problem-solving by using digital technologies	0.621	< 0.001*	0.553	< 0.001*

Note: The asterisk * indicates a 5% significance level. Spearman rank correlation coefficient (r) is reported.
Source: Authors' work

There is a significant positive correlation in the self-assessment of digital competencies (digital knowledge and digital skills) for both groups of respondents (university and high-school students). Further, this means that there is consistency in the self-assessment of digital knowledge, on the one hand, and digital skills, on the other hand, in the same areas.

Comparison according to the year of study of university students

Tables 5 and 6 show the average values of the self-assessed digital knowledge and digital skills, respectively, for university students of different years of study.

Table 5
Average values of the digital knowledge of university students of different years of study

The average level of digital knowledge	1st	2nd	3rd	4th	5th
Browsing, searching and filtering data, information, and digital content	1.82	2.00	2.06	2.17	2.18
Data, information, and digital content management	1.71	1.83	1.92	1.98	1.96
Data, information, and content sharing via digital technologies	1.81	1.89	2.01	1.92	2.02
Interacting (collaboration) through digital technologies	1.65	1.89	1.98	1.85	2.04
Developing digital content	1.72	1.81	1.87	1.80	1.86
Programming	1.37	1.40	1.41	1.36	1.58
Protecting devices	1.64	1.73	1.73	1.67	1.69
Protecting personal data and privacy	1.76	1.78	1.86	1.68	1.80
Solving technical problems	1.55	1.55	1.64	1.55	1.64
Creative problem-solving by using digital technologies	1.51	1.55	1.61	1.59	1.64

Note: Level was estimated with grades: 1-foundation level, 2-intermediate level, 3-advanced level
Source: Authors' work

Table 6
Average values of the digital skills of university students of different years of study

The average level of digital skills	1st	2nd	3rd	4th	5th
Browsing, Searching and filtering data, information, and digital content	1.62	1.63	1.84	1.77	1.76
Data, information, and digital content management	1.73	1.96	2.00	2.01	2.09
Data, information, and content sharing via digital technologies	1.69	1.75	1.87	1.80	1.91
Interacting (collaboration) through digital technologies	1.75	1.89	1.92	1.87	1.92
Developing digital content	1.80	1.82	1.94	1.81	2.02
Programming	1.38	1.33	1.39	1.37	1.44
Protecting devices	1.51	1.56	1.65	1.60	1.65
Protecting personal data and privacy	1.68	1.71	1.76	1.71	1.74
Solving technical problems	1.55	1.53	1.66	1.60	1.70
Creative problem-solving by using digital technologies	1.43	1.53	1.54	1.51	1.66

Note: Level was estimated with grades: 1-foundation level, 2-intermediate level, 3-advanced level
Source: Authors' work

Table 7 presents Kruskal-Wallis H test statistics and p-values, which are calculated to investigate possible differences in the self-assessment of digital competencies between university students of different years of study.

Table 7
Differences in the self-assessment of digital competencies between university students of different years of study

	Knowledge		*Skills*	
Digital competence	**KW**	**p-value**	**KW**	**p-value**
Browsing, searching and filtering data, information, and digital content	54.197	< 0.001*	36.646	< 0.001*
Data, information, and digital content management	37.716	< 0.001*	37.834	< 0.001*
Data, information, and content sharing via digital technologies	21.724	< 0.001*	20.793	< 0.001*
Interacting (collaboration) through digital technologies	45.003	< 0.001*	15.930	0.003*
Developing digital content	11.970	0.018*	16.831	0.002*
Programming	14.090	0.007*	4.551	0.337
Protecting devices	5.062	0.281	11.644	0.020*
Protecting personal data and privacy	11.521	0.021*	2.786	0.594
Solving technical problems	8.858	0.065	14.604	0.006*
Creative problem-solving by using digital technologies	7.176	0.127	15.880	0.003*

Note: The asterisk * indicates a 5% significance level. KW shows Kruskal-Wallis H test statistics.
Source: Authors' work

The results presented in Table 7 reveal that there are statistically significant differences in digital knowledge between university students of different years of study in the following areas: Browsing, searching and filtering data, information, and digital content (between the first and all higher years of study and between the second and fourth year of study), Data, information, and digital content management (between the first year and all higher years of study and between the second and fourth year of study), Data, information and content sharing via digital technologies (between the first and third, and between the first and fifth year of study), Interacting (collaboration) through digital technologies (between the first and all higher years of study), Developing digital content (between the first and third year of study), Programming (between the first and fifth and between the fourth and fifth year of study), and Protecting personal data and privacy (between the third and fourth year of study).

There are statistically significant differences in digital skills between university students of different years of study in the following areas: Browsing, searching and filtering data, information, and digital content (between the first and third; the first and fourth; and the second and third year of study), Data, information, and digital content management (between the first and all higher years of study), Data, information, and content sharing via digital technologies (between the first and third and the first and fifth year of study), Interacting (collaboration) through digital technologies (between the first and second and between the first and third year of study), Developing digital content (between the first and third and between the first and fifth year of study), Protecting devices (between the first and third year of study), Solving technical problems (between the second and third year of study), and Creative problem solving by using digital technologies (between the first and fifth year of study).

There are no statistically significant differences in digital knowledge between university students of different years of study in Protecting devices, Solving technical problems, and Creative problem-solving by using digital technologies. Also, there are no statistically significant differences in digital skills between university students of different years of study in the areas of Programming and Protecting personal data and privacy.

To summarise, there are differences in self-assessment of digital knowledge between university students of different years of study in seven out of 10 areas. In all areas, besides Protecting personal data and privacy, university students of higher years of study self-reported higher digital knowledge. Regarding digital skills, there are differences in self-assessment between university students of different years of study in eight out of 10 areas, where students of higher years of study self-assessed their digital skills at a higher level.

Comparison according to the year of study of high-school students

Average values of the self-assessed digital knowledge and digital skills among high-school students of different years of study are presented in Tables 8 and 9.

Table 8

Average values of the digital knowledge of high school students of different years of study

The average level of digital **knowledge**	1st	2nd	3rd	4th	5th
Browsing, searching and filtering data, information, and digital content	2.02	1.92	2.07	2.13	1.60
Data, information, and digital content management	1.83	1.81	1.94	1.90	1.40
Data, information, and content sharing via digital technologies	1.91	1.85	1.91	1.96	1.80
Interacting (collaboration) through digital technologies	1.75	1.84	1.84	1.90	1.80
Developing digital content	1.85	1.77	1.94	1.93	1.60
Programming	1.61	1.54	1.44	1.54	1.20
Protecting devices	1.72	1.76	1.77	1.76	1.60
Protecting personal data and privacy	1.89	1.81	1.88	1.84	1.60
Solving technical problems	1.58	1.52	1.62	1.72	1.20
Creative problem-solving by using digital technologies	1.69	1.59	1.63	1.76	1.60

Note: Level was estimated with grades: 1-foundation level, 2-intermediate level, 3-advanced level; Source: Authors' work

Table 9

Average values of the digital skills of high school students of different years of study

The average level of digital skills	1st	2nd	3rd	4th	5th
Browsing, searching and filtering data, information, and digital content	1.78	1.75	1.80	1.77	1.40
Data, information, and digital content management	1.62	1.75	1.76	1.86	1.40
Data, information, and content sharing via digital technologies	1.70	1.74	1.81	1.89	1.80
Interacting (collaboration) through digital technologies	1.76	1.71	1.86	1.85	1.60
Developing digital content	1.84	1.77	1.88	1.91	1.20
Programming	1.65	1.55	1.44	1.50	1.00
Protecting devices	1.55	1.57	1.58	1.63	1.40
Protecting personal data and privacy	1.84	1.77	1.73	1.81	1.40
Solving technical problems	1.67	1.65	1.61	1.72	1.20
Creative problem-solving by using digital technologies	1.62	1.60	1.63	1.69	1.40

Note: Level was estimated with grades: 1-foundation level, 2-intermediate level, 3-advanced level; Source: Authors' work

Table 10 contains Kruskal-Wallis H test statistics and p-values for testing if there are differences in the self-assessment of digital competencies between high-school students of different years of study.

Based on the results from Table 10, it can be concluded that there are statistically significant differences in digital knowledge between high-school students in the second and fourth years of study in the areas of Browsing, searching and filtering data, information, and digital content, and Solving technical problems. Fourth-year high-school students self-reported higher digital knowledge in both areas than second-year high-school students. Also, there are differences in digital knowledge between high-school students in the first and fifth year of study in Programming, where, unexpectedly, fifth-year high-school students reported a lower level of digital knowledge than first-year high-school students. This counterintuitive result is because only five high-school students are in their fifth year of study. All fifth-year high-school students come from Germany, which education system has a little bit different structure. In all other areas, there is no statistically significant difference in digital knowledge between high-school students of different years of study. Programming is the only area where high-school students of different years of study self-reported statistically significant differences in digital skills. Unexpectedly, first-year high-school students reported a higher level of digital skills than third-year high-school students.

Table 10

Differences in the Self-Assessment of Digital Competencies between High-school students of Different Years of Study

	Knowledge		*Skills*	
Digital comptence	**KW**	**p-value**	**KW**	**p-value**
Browsing, searching and filtering data, information, and digital content	12.141	0.016*	2.644	0.619
Data, information, and digital content management	7.247	0.123	8.652	0.070
Data, information, and content sharing via digital technologies	2.699	0.609	7.054	0.133
Interacting (collaboration) through digital technologies	2.887	0.577	7.005	0.136
Developing digital content	8.499	0.075	8.253	0.083
Programming	9.680	0.046*	12.90	0.012*
Protecting devices	0.649	0.957	1.545	0.819
Protecting personal data and privacy	1.907	0.753	3.884	0.422
Solving technical problems	11.549	0.021*	5.397	0.249
Creative problem-solving by using digital technologies	6.610	0.158	2.631	0.621

Note: The asterisk * indicates a 5% significance level. KW shows Kruskal-Wallis H test statistics.
Source: Authors' work

Comparison according to the major of study of university students

Average values of the self-assessed digital knowledge and digital skills between university students of different major areas are presented in Table 11 and Table 12

Table 11
Average values of the digital knowledge of university students of different major of study

The average level of digital knowledge	Accounting	Finance	Trade	Tourism	Other
Browsing, searching and filtering data, information, and digital content	1.95	2.04	2.00	1.98	2.08
Data, information, and digital content management	1.78	1.89	1.86	1.86	1.87
Data, information, and content sharing via digital technologies	1.81	1.96	1.90	1.97	1.98
Interacting (collaboration) through digital technologies	1.78	1.94	1.84	1.80	1.90
Developing digital content	1.72	1.77	1.84	1.83	1.89
Programming	1.35	1.40	1.40	1.36	1.49
Protecting devices	1.66	1.76	1.66	1.70	1.70
Protecting personal data and privacy	1.76	1.80	1.77	1.78	1.80
Solving technical problems	1.51	1.61	1.57	1.56	1.65
Creative problem-solving by using digital technologies	1.50	1.58	1.57	1.59	1.63

Note: Level was estimated with grades: 1-foundation level, 2-intermediate level, 3-advanced level; Source: Authors' work

Table 12
Average values of the digital skills of university students of different major of study

The average level of digital skills	Accounting	Finance	Trade	Tourism	Other
Browsing, searching and filtering data, information, and digital content	1.66	1.78	1.71	1.69	1.71
Data, information, and digital content management	1.91	1.95	1.88	1.88	2.01
Data, information, and content sharing via digital technologies	1.74	1.79	1.82	1.73	1.82
Interacting (collaboration) through digital technologies	1.78	1.89	1.86	1.89	1.90
Developing digital content	1.78	1.86	1.89	1.83	1.93
Programming	1.30	1.41	1.37	1.33	1.42
Protecting devices	1.51	1.61	1.65	1.54	1.57
Protecting personal data and privacy	1.66	1.75	1.75	1.64	1.73
Solving technical problems	1.55	1.63	1.59	1.56	1.62
Creative problem-solving by using digital technologies	1.43	1.53	1.57	1.48	1.55

Note: Level was estimated with grades: 1-foundation level, 2-intermediate, 3-advanced level Source: Authors' work

The Kruskal-Wallis H test statistics and p-values for testing if there are differences in the self-assessment of digital competencies between university students of different major areas are shown in Table 13.

Table 13
Differences in the Self-Assessment of Digital Competencies between University Students of Different Major of Study

	Knowledge		*Skills*	
Digital competence	**KW**	**p-value**	**KW**	**p-value**
Browsing, searching and filtering data, information, and digital content	7.189	0.126	7.717	0.103
Data, information, and digital content management	6.217	0.184	6.002	0.199
Data, information, and content sharing via digital technologies	14.026	0.007*	4.142	0.387
Interacting (collaboration) through digital technologies	9.279	0.054	6.724	0.151
Developing digital content	11.097	0.026*	7.215	0.125
Programming	8.455	0.076	9.702	0.046*
Protecting devices	5.353	0.253	8.397	0.078
Protecting personal data and privacy	0.688	0.953	5.764	0.217
Solving technical problems	8.919	0.063	2.873	0.579
Creative problem-solving by using digital technologies	5.769	0.217	11.657	0.020*

Note: The asterisk * indicates a 5% significance level. KW shows Kruskal-Wallis H test statistics.
Source: Authors' work

Results from Table 13 indicate that there are statistically significant differences in digital knowledge between university students of different major areas regarding Data, information, and content sharing via digital technologies (between students of Accounting and Finance modules, between students of Accounting and Tourism modules, and between students of Accounting and Other modules), and regarding Developing digital content area (between students of Accounting and Other modules). There are statistically significant differences in digital skills between university students of Accounting and Finance modules in Programming and between students of Accounting and Trade modules in Creative problem-solving, with Accounting students reported a lower level of digital knowledge and skills.

Comparison according to the major of study of high-school students

Average values of the self-assessed digital knowledge and digital skills between high-school students of different major areas are presented in Tables 14 and 15.

Table 14
Average values of the digital knowledge of high-school students of different majors of study

The average level of digital knowledge	**Accounting**	**Finance**	**Trade**	**Tourism**	**Other**
Browsing, searching and filtering data, information, and digital content	2.02	2.05	2.09	1.98	2.10
Data, information, and digital content management	1.84	1.89	1.94	1.83	1.95
Data, information, and content sharing via digital technologies	1.87	1.90	1.99	1.79	2.07
Interacting (collaboration) through digital technologies	1.84	1.81	1.97	1.74	1.91
Developing digital content	1.87	1.86	1.97	1.75	2.07
Programming	1.54	1.53	1.68	1.40	1.50
Protecting devices	1.78	1.75	1.88	1.68	1.76
Protecting personal data and privacy	1.84	1.86	1.98	1.72	1.97
Solving technical problems	1.60	1.63	1.75	1.48	1.67
Creative problem-solving by using digital technologies	1.63	1.70	1.75	1.55	1.75

Note: Level was estimated with grades: 1-foundation level, 2-intermediate, 3-advanced level
Source: Authors' work

Table 15
Average values of the digital skills of high-school students of different majors of study

The average level of digital skills	Accounting	Finance	Trade	Tourism	Other
Browsing, searching and filtering data, information, and digital content	1.81	1.75	1.87	1.71	1.79
Data, information, and digital content management	1.76	1.78	1.85	1.65	1.80
Data, information, and content sharing via digital technologies	1.81	1.80	1.90	1.71	1.81
Interacting (collaboration) through digital technologies	1.81	1.78	1.89	1.72	1.93
Developing digital content	1.90	1.79	1.92	1.73	2.04
Programming	1.56	1.52	1.58	1.44	1.50
Protecting devices	1.60	1.62	1.73	1.46	1.59
Protecting personal data and privacy	1.81	1.80	1.84	1.63	1.88
Solving technical problems	1.62	1.66	1.74	1.59	1.71
Creative problem-solving by using digital technologies	1.65	1.65	1.67	1.54	1.74

Note: Level was estimated with grades: 1-foundation level, 2-intermediate, 3-advanced level
Source: Authors' work

In Table 16, Kruskal-Wallis H test statistics and p-values for testing if there are differences in the self-assessment of digital competencies between high-school students of different major areas are reported.

Table 16
Differences in the self-assessment of digital competencies between high-school students of different majors of study

Digital competence	*Knowledge*		*Skills*	
	KW	**p-value**	**KW**	**p-value**
Browsing, searching and filtering data, information, and digital content	3.400	0.493	5.395	0.249
Data, information, and digital content management	4.484	0.344	6.742	0.150
Data, information, and content sharing via digital technologies	15.888	0.003*	4.963	0.291
Interacting (collaboration) through digital technologies	8.709	0.069	9.324	0.054
Developing digital content	20.940	< 0.001*	16.696	0.002*
Programming	17.400	0.002*	6.319	0.177
Protecting devices	5.747	0.219	14.033	0.007*
Protecting personal data and privacy	13.514	0.009*	14.040	0.007*
Solving technical problems	16.325	0.003*	5.857	0.210
Creative problem-solving by using digital technologies	12.371	0.015*	8.420	0.077

Note: The asterisk * indicates a 5% significance level. KW shows Kruskal-Wallis H test statistics.
Source: Authors' work

High-school students of different majors differ in digital knowledge in the following areas: Data, information, and content sharing via digital technologies (between modules Tourism and Others), Developing digital content (between Tourism and Trade and between Tourism and Others), Programming (between Tourism and Trade), Protecting personal data and privacy (between Tourism and Trade, and between Tourism and Others), Solving technical problems (between Tourism and Trade), and

Creative problem solving by using digital technologies (between Tourism and Trade). In all cases, high-school students of Tourism as their major area self-reported a lower level of digital knowledge.

Statistically significant differences in digital skills between high-school students of different main areas of interest exist in Developing digital content (between Tourism and Others, and between Finance and Others), Protecting devices (between Tourism and Trade), and Protecting personal data and privacy (between Tourism and Others). High-school students in the Tourism module have a lower level of digital skills than high-school students in all other modules. In contrast, in the mentioned pair Finance and Others, high-school students of modules grouped as Others have a higher level of digital skills.

Conclusion

In this paper, we investigated how university and high-school students in economics self-assess their digital competencies. We aimed to identify university and high-school students' current levels of digital knowledge and skills and to propose ways to improve their digital competencies with the ultimate goal of facilitating the learning process and providing a smooth transition and inclusion of university and high-school students in the labour market. Additionally, our goal was to propose ways to improve teaching methods to ensure a high-quality teaching process despite the challenges caused by the COVID-19 pandemic. To this end, we analysed data on self-perception of digital competencies obtained through conducting a questionnaire. Our main findings can be summarised as follows: (1) university and high-school students self-assess their digital competencies at the below intermediate level; (2) high-school students' digital knowledge self-assessment is higher than university students' ones in four out of 10 analysed areas; (3) high-school students' digital skills self-assessment is higher than university students' ones in three out of 10 analysed areas, while the opposite is the case in one out of 10 analysed areas; (4) there is the accordance in the self-assessment of digital knowledge and skills for the same areas, but self-assessment of digital skills is lower than self-assessment of digital knowledge; (5) university students of higher years of study self-assessed digital knowledge at a higher level in six out of 10 areas, while in one out of 10 the direction is the opposite; (6) university students of higher years of study self-assessed digital skills at a higher level in eight out of 10 areas; (7) there is no universal pattern in self-assessment of digital competencies between high-school students of different years of study; and (8) university students of Accounting module and high-school students of Tourism module reported lowest levels of digital competencies .

Like in Eurostat's (2020) study, we discovered differences between the two age groups regarding digital competencies. However, our respondents are much younger (university and high-school students), and there is no large difference in age as in Eurostat's (2020) research.

Contrary to Araiza-Vazquez and Pedraza-Sanchez (2019), our results show that all university students self-report to have below intermediate level of digital competencies, while university students in the Accounting module perceive to have the lowest level of digital competencies. Like Martzoukou et al. (2020), we identified that university students self-reported to have a below-average level of digital competencies in most investigated areas. Contrary to the results of Colas-Bravo et al. (2017), we identified that high-school students self-perceive to have below intermediate level of digital competencies.

The below intermediate level of digital competencies of both university and high-school students suggests that education policymakers must innovate teaching

methods and curricula by including new courses that will allow university and high-school students to improve their digital competencies. Education policymakers should pay special attention to the Accounting module at universities and the Tourism module at high schools of economics due to identified lowest levels of digital competencies for these groups of respondents. The monitoring of the digital aspects of the quality of teaching methods and the quality of teaching outcomes by educational policymakers must be continuous due to the fast-paced digital world.

The reasons why high-school students self-assess their digital competencies at a higher level than university students could be that they belong to the younger cohort of Generation Z that began to be influenced by the fast-changing digital world in early childhood and that they have less intense school assignments and therefore more free time to explore digital contents. The explanation for higher levels of self-reported digital competencies among university students of higher years of study may be that higher-level courses are more specialised and applicative. More digital tools are used at those courses compared to theoretical courses in lower years of study.

Our study contributes to the existing literature in several ways. First, the research conducted during the COVID-19 pandemic emphasised the necessity for digitalisation of the teaching process and the advantage of possessing digital competencies. Second, the study is international, with respondents from four countries. Third, the perceptions of university and high-school students of all years of study and different economic disciplines as majors are analysed. Additionally, digital knowledge and skills as components of digital competencies are analysed separately. There are more studies about the digital competencies of professors and teachers than about the digital competencies of university and high-school students. In this regard, our study is an important addition to the existing literature.

The limitation of the research is that educational systems among analysed countries are not the same. The countries are at different levels of economic development with different abilities to buy access to digital content and tools.

The results of our study opened space for further research directions. Additional groups of respondents need to be included: employers, university and high-school students from all fields of social, natural and technical sciences, and primary school students. The motivation for including employers is the importance of digital competencies for employability and success in the labour market. University and high-school students from all fields of social, natural and technical sciences have to be included since all people need to be digitally competent. Primary school students have to be examined since it is crucial to start acquiring digital competencies correctly in the early stages of education. Additionally, the factors that affected the identified differences in self-assessment of digital competencies, such as the overconfidence of younger respondents, need to be further investigated.

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References

1. Araiza-Vazquez, M. J., Pedraza-Sanchez, E. Y. (2019), "Discernment of digital competences in students of a business school", in Gómez Chova L., López Martínez A., Candel Torres I. (Ed.), EDULEARN19 Proceedings, 11th International Conference on Education and New Learning Technologies, 1-3 July, 2019, Palma, Spain, pp. 4737-4747.
2. CARNet (2016), "Framework for digital competence of users in school: teachers, professional associates, directors and administrative staff" (in Croatian), Hrvatska akademska i istraživačka mreža – CARNet, Zagreb, Croatia.
3. Carretero, S., Vuorikari, R., Punie, Y. (2017), "DigComp 2.1: The Digital Competence Framework for Citizens with eight proficiency levels and examples of use", EUR 28558 EN, Publications Office of the European Union, Luxembourg, available at https://publications.jrc.ec.europa.eu/repository/handle/JRC106281 (02 February 2022)
4. Colas-Bravo, P., Conde-Jimenez, J., Reyes-de Cozar, S. (2017), "Digital competences of non-university students", Revista Latinoamericana de Tecnologia Educativa-Relatec, Vol. 16, No. 1, pp. 7-20.
5. Council of the European Union (2017), "Council recommendation of 22 May 2017 on the European Qualifications Framework for lifelong learning and repealing the recommendation of the European Parliament and of the Council of 23 April 2008 on the establishment of the European Qualifications Framework for lifelong learning" (2017/C 189/03), Official Journal of the European Union, available at https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32017H0615(01)&from=EN#d1e35-15-1 (02 February 2022)
6. Crawford-Visbal, J. L., Crawford-Tirado, L., Ortiz-Záccaro, Z. Z., Abalo, F. (2020), "Assessment of Digital Competences in Communication Students across four Latin American Universities", Education in the Knowledge Society, Vol. 21, No. 20, pp. 1-14.
7. European Commission (2016), "Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions, A New Skills Agenda for Europe, Working together to strengthen human capital, employability and competitiveness, SWD (2016) 195 final", available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52016DC0381&from=EN (02 February 2022)
8. European Commission (2020), "European Skills Agenda for Sustainable Competitiveness, Social Fairness and Resilience", available at https://ec.europa.eu/social/main.jsp?langId=en&catId=89&furtherNews=yes&newsId=9723 (02 February 2022)
9. European Parliament and the Council of the European Union (2006), "Recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning (2006/962/EC)", Official Journal of the European Union, L 394, available at https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2006:394:0010:0018:en:PDF (02 February 2022)
10. Eurostat (2020), "Do young people in the EU have digital skills?", available at https://ec.europa.eu/eurostat/en/web/products-eurostat-news/-/edn-20200715-1 (02 February 2022)
11. Ferrari, A. (2013), "DIGCOMP: a framework for developing and understanding digital competence in Europe", available at https://data.europa.eu/doi/10.2788/52966 (02 February 2022)
12. Ferrari, A., Brečko, B. N., Punie, Y. (2014), "DIGCOMP: A Framework for Developing and Understanding Digital Competence in Europe, Transforming Education through Innovation and Technology", eLearning Papers.
13. Ilomäki, L., Kantosalo, A., Lakkala, M. (2011), "What is digital competence?" European Schoolnet, in Linked Portal, European Schoolnet (EUN), Brussels , pp. 1-12
14. Käck, A., Männikö-Barbutiu, S. (2012), Digital kompetens i lärarutbildningen, Studentliteratur AB, Lund.

15. Krumsvik, R. A. (2011), "Digital competence in Norwegian teacher education and schools", Högre Utbildning, Vol. 1, No. 1, pp. 39-51.
16. Krumsvik, R. A. (2012), "Teacher educators' digital competence", Scandinavian Journal of Educational Research, Vol. 1, No. 12, pp. 269-280.
17. Martzoukou, K., Fulton, C., Kostagiolas, P., Lavranos, C. (2020), "A study of higher education students' self-perceived digital competences for learning and everyday life online participation", Journal of Documentation [online], Vol. 76, No. 6, pp. 1413-1458.
18. Sicilia, M.A., García-Barriocanal, E., Sánchez-Alonso, S., Różewski, P., Kieruzel, M., Lipczyński, T., Royo, C., Uras F., Hamill, S. (2018), "Digital skills training in Higher Education: insights about the perceptions of different stakeholders", in García-Peñalvo, F. J. (Ed.), Proceedings of the 6th International Conference on Technological Ecosystems for Enhancing Multiculturality (TEEM 2018), Salamanca, Spain, October 24-26, 2018, pp. 781-787.
19. Spante, M., Hashemi, S. S., Lundin, M., Algers, A. (2018), "Digital competence and digital literacy in higher education research: Systematic review of concept use", Cogent Education, Vol. 5, No. 1, pp. 1-21.
20. Torres-Coronas, T., Vidal-Blasco, M.-A. (2015), "Students and employers perception about the development of digital skills in higher education", Revista de Educación, No. 367, pp. 63-89.

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