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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).

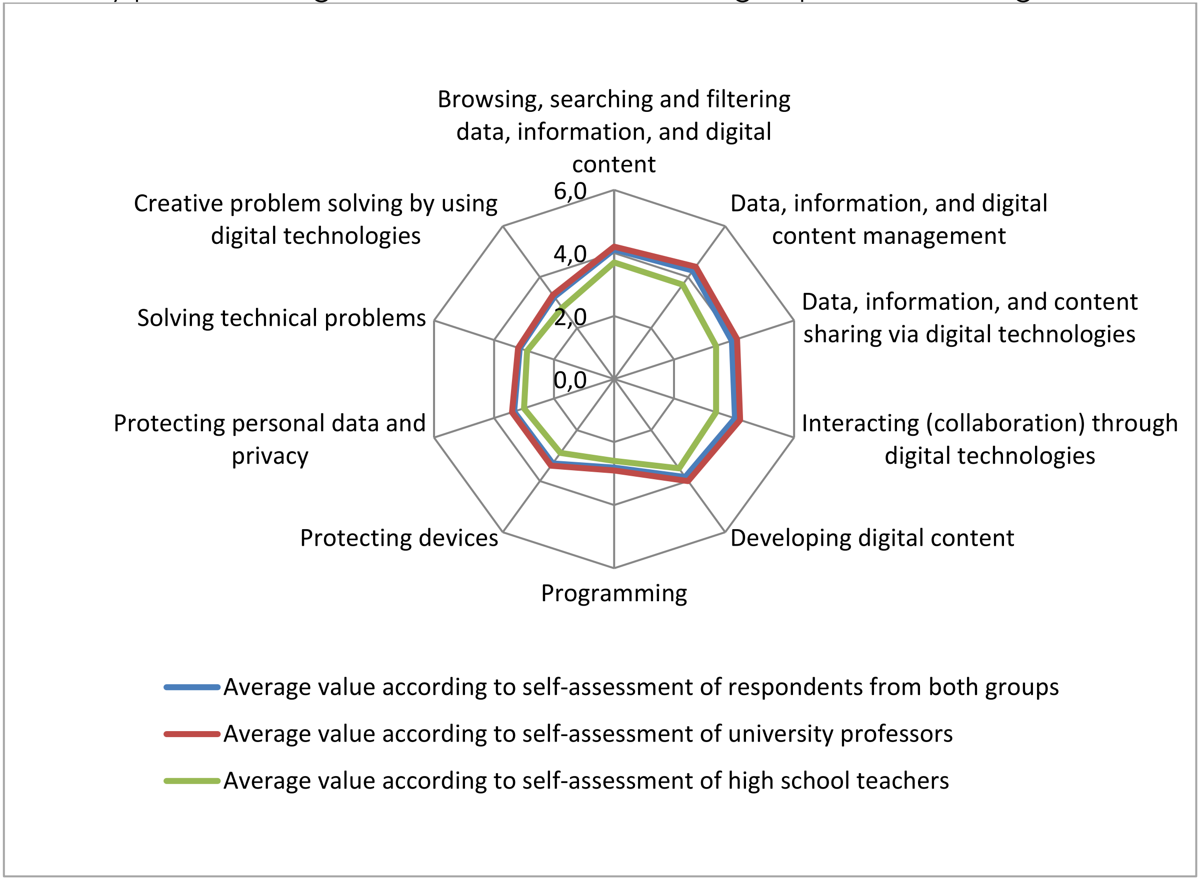
Table 7
Self-assessment of the knowledge and skills possessed by high school teachers and university professors regarding digitised instruments and technologies according to the length of teaching experience

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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