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Student's digital competences in Belgium and Romania: A comparative analysis

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This research explores students' digital competences level in three major universities from Belgium and Romania, based on a combination of seven core skills: communication and collaboration skills, creativity skills, critical thinking skills, information skills, problem-solving skills and technological skills. We applied a quantitative design based on an online survey, applied during March 2021–May 2022 using Confirmatory Factor Analysis. The study focuses on examining the qualifications and implementation of students' digital abilities in Romania and Belgium, looking for similarities and differences. The results indicate that students from Belgium have higher average scores for communication and collaboration, information, and problem-solving digital skills than the other skills, while, in the case of students from Romania, creativity and technological skills have the highest average scores compared to the other digital skills. In addition, significant differences between countries regarding the average scores of critical thinking digital skills were not found. Although having a basic understanding of digital competences is advised, improved policies are required to promote the development of these skills as the skill sets needed for information and communication technology employees are more demanding.

KEYWORDS

digital competences, communication and collaboration, creativity, critical thinking, information, problem-solving, technological skills

Introduction

Nearly every aspect of our life is impacted by the digital world, and this trend is only continuing. Technology has produced occupations over the last decades that we could never have envisioned years ago. The modern digital revolution is being driven by the transition from analogue to digital electronic technologies. 99.2% of the storage capacity in the globe in 1986 was analogue, while 94% of the world's information storage capacity had been converted to digital by 2007 (Owens and Padilla, 2021). Based on the phenomenon of

transforming analogue data into binary data (or "digitization"), digitalization represents a major trend shaping society and business at large (Reis et al., 2020; Schallmo and Tidd, 2021). Digitalization improves business relationships between customer and companies, offers new prospects for generating income and value and brings added value to the whole economy and society (Annarelli et al., 2021). To comprehend and manage the changes brought on by the evolution of information and communication technology (ICT) as a person passes through the different periods of life, digital skills are required. A new emphasis is placed on the significance of the comparative studies as an increasing number of young adults enter the employment stage. While everyone has to have a basic understanding of digital competences, ICT professionals have more extensive skill requirements. Without these abilities, there is a chance of exclusion. People must possess the knowledge on how to utilize technology securely and safely to fully activate all the opportunities of digitalization. Digital skills boost young people's self-assurance in using technology for daily tasks, education, employment, or entertainment. Having access to digital devices is necessary but not sufficient for skill development, there are other factors that affect students' ability levels. Also, although there have been benefits to using technology in education, this does not necessarily indicate that teachers can successfully integrate it into their lessons (Farjon et al., 2019).

As of 2014, the Digital Economy and Society Index (DESI) reports have been used by the European Commission to track the digital development of its member countries. Explanatory chapters in DESI provide a European-level assessment across important digital domains, which is crucial for supporting policy decisions. Country profiles in DESI assist the Member States in pinpointing areas which require urgent action. Two nations that are disposed differently in relation to this index are Belgium and Romania. Belgium is positioned in the middle of the scale, while Romania is at the bottom (European Commission. Digital Economy and Society Index (DESI), 2021a). This positioning represents a significant reason in order to compare the digital condition of these two countries. Thus, the discussion and correlation of the six factors that make up the digital skills measured by the Index and the development of both Romania and Belgium in this area are the main objectives of this article. Moreover, the discussions of the indicators that measure digital skills are studied among students to have a better understanding of their employability potential in the modern dynamic market. We will also investigate the situation in Belgium to extract and examine the methods that might serve as models for Romanian policies.

Thus, this paper aims to analyze the students' level and use of the digital skills in Romania and Belgium, with specific emphasis on the elements taken into consideration by DESI. The investigation of similarities and differences between these two countries in a specific targeted public is required in order to have a better and realistic perspective on how digital skills are structured and distributed. The paper situates the analysis into a distinct social framework and with the right methodological design it tries to fill the gap in the literature by adding necessary empirical and comparative studies.

The article is organized as follows: in the next section, the state of the art on digital skills is concisely described, then the subsequent parts depict the methodology and data. The last sections present the results of the analysis, conclusions and directions for further research.

Literature review

Digital skills in pandemic times

The coronavirus pandemic reminds us of the importance of digital skills in helping workers and entire organizations to adapt during a time of physical distancing (Xie et al., 2020). When physical distancing mandates started being implemented, we witness to an increase in digital skills demand in many occupations, especially non-IT sectors (European Commission, 2021a). Many businesses that were lagging in incorporating IT technologies have faced many problems. For instance, in sectors such as leisure and hospitality the impact of the COVID-19 crises was high, particularly on financially fragile firms (Lu et al., 2021). Due to government-imposed lockdowns and social distancing many hospitality businesses were forced to temporary close or limit their operations to only take-outs. Similarly, the mobility restrictions determined a sharp decline in hotel occupancies and revenues (Gursoy and Chi, 2020). In the retail and service sectors, where delivering products and services may prove a challenging option, workers' acquired and owned abilities to operate digital technologies proved to be helpful in avoiding lay-offs and bankruptcies (Xiang et al., 2021). The COVID-19 pandemic has also severely affected the healthcare system by creating a tragic imbalance between needs and resources, which determined a sharp increase in the negative effects of disparities with respect to the social determinants of health. Studies show that patients in minority groups registered a higher mortality rate than the rest of the population and a significantly lower prospect of accessing high quality medical care (Badalov et al., 2022). In terms of digitalization this sector actively moved many activities toward telemedicine and telehealth solutions which allowed a more effectively use of the scars resources and limited the physical contact between medical personnel and patients (Tran et al., 2020).

In many private and public businesses to assure continuity and to build resilience to future crises numerous jobs were fully or partially transformed in digital jobs. This digital economy required different digital skills that may differ from one country to another, according to their level of development and their technological progress. Also, in terms of age, younger generations have a digital advantage relative to other generations, at least in countries where access to technologies is granted (International Labour Organisation, 2020a). Other studies reveal that older workers who were working from home during the COVID-19 pandemic (aged 50 years and above) were "digital pushed" to acquire new computer

skills for work or social interactions (Gallistl et al., 2021; König and Seifert, 2022).

Digital skills: Needs and opportunities

The employment market has been significantly impacted by digitalization, which has altered working circumstances, workplace dynamics, and the necessary knowledge and skills. It shaped employment rates, bringing about both possibilities and threats. Numerous studies predict the creation of hundreds of potential professions, however many of those jobs face extinction due to digitalization. Without sufficient digital competences, it is impossible to engage in the economy and the digital society, especially in light of the digital change that the workplace is through in terms of both the composition and the management. In addition to the changes that digitalization brings into the workplace, the prevalence of digital skills has an impact on how individuals interact, develop themselves and live their daily lives.

In this vein, the *2030 Digital Compass: The European Way for the Digital Decade Communication* was approved by the European Commission on the 9th of March, 2021 (European Commission, 2021b). The *Communication* outlined a clear vision, optimal strategies, and tactics for the European Union's effective digitalization by 2030. In order to achieve the shift to cleaner energy, a sustainable, and tenacious economy, such transformation is essential. In an increasingly connected world, the EU aspires to be digitally independent and promote digital policies that enable individuals and organisations to seize a human-centred, environmentally friendly, and economically productive digital future. This entails addressing the current weaknesses as well as quickening the development of the investment. In particular, by giving young people access to educational and training opportunities, allowing them to interact and make connections, they become aware of cultural differences, and exchange information, thoughts, and emotions, ICT has the potential to improve their human, social, and cultural capital (McLoughlin, 2018; Vodă and Florea, 2019). The government's perspectives on youth work should adapt as young people's needs and interests change. To effectively interact with young people and comprehend the problems they encounter online, young workers must strengthen their digital abilities.

Basic and advanced digital skills will be crucial in the near future to maintain society's collective resilience since only citizens who are capable of using technology and a highly trained digital workforce will be truly in control of their own fate and be confident and assertive about their options. However, technology proficiency cannot be linked only to exposure to digital devices. According to research, not all young people are tech-savvy or interested in learning more. For instance, a recent study by Erdin and Uzun (2022) clearly stated that "being a digital native or digitally competent does not necessarily mean that teachers can integrate technology into their classes easily."

It is useful to define the term "digitally literate" while discussing digital skills. Recent models and frameworks have outlined the knowledge, abilities, and characteristics associated with being digitally literate. One such element is the European Commission's Digital Competence Framework 2.1 (Carretero et al., 2018), which is dimensionally structured and includes five components of digital competence: "information and data literacy, communication and collaboration, digital content creation, safety, and problem-solving." The strategic priorities stated by the highest levels of governance, both nationally and internationally, demonstrate the urgent necessity for developing digital competences in education systems. As one of eight major qualifications for "Lifelong Learning" adopted by the European Parliament and Council in 2006, "digital competence" was described as "the confident, critical and creative use of information and communications technology (ICT) to achieve goals related to work, employability, learning, leisure, inclusion and/or participation in society" (Ferrari, 2012). Throughout this work, we will consider the competences above as well as variables such as critical thinking, creativity, informational and technical skills.

Moreover, it is explicit from the *Communication* that the Union institutions and the Member States must work together to meet the aim of a population with strong digital skills and highly trained digital professions by 2030. Accordingly, at least 20 million jobs-openings for specialists in the field of ICT are to be expected, with a convergence of women and men, and at least 80% of those aged 16 to 74 should have at least basic digital abilities. The objectives seem relevant, having in mind the current situation, as Eurostat highlights that only 54% of EU citizens between the ages of 16 and 74 in 2021 have at least fundamental digital skills (Eurostat, 2022). Even while the proportion of people in the European Union who have digital abilities has increased by 3% over the past 6 years, many still lack the essential knowledge and abilities. For instance, 84% of people with a high educational qualification, 80% of the youth (aged 16 to 24), and 87% of students have at least fundamental digital abilities. In comparison, only 33% of those between the ages of 55 and 74 as well as 28% of those who are retired or inactive have at least rudimentary computer skills (European Commission. Digital Economy and Society Index (DESI), 2021a). In another survey (European Commission, 2016), 60,000 eighth graders from 21 different educational systems throughout the world had their computer and information literacy skills evaluated. It was discovered that, on average, 17% of students do not perform at the lowest level on their scale, and that just 2% of students achieve the maximum level, necessitating the use of critical thinking when looking for information online. According to their findings, it would be naive to assume that young people will naturally pick up the digital abilities they require in performing their activities.

As technology is becoming increasingly mobile, literacy practices and the development of digital skills are becoming more crucial (Vodă et al., 2022). Children and teenagers in Europe still lack acceptable levels of digital competence. This tendency is particularly serious for critical and participatory literacy, when

students are required to actively engage with the material and develop their own responses in addition to reading it (European Commission, 2016).

In order to establish a comparable situation, we shall examine the situation in Belgium, the Member State that is situated in the centre of the current index of the digital economy and society. Belgium is the second-best performer in the EU when it comes to firms educating their employees in ICT for digital skills, coming in at number 12 out of the 27 member states, with a performance rate of 33% compared to the average of 20% across the EU (European Commission. Digital Economy and Society Index (DESI), 2021c). The Belgian government has also increased its efforts to address the need for students to have improved digital skills as well as to reskill and upskill the labour force. In addition, the Dutch-speaking part of Belgium, Flanders, has just recently introduced a brand-new comprehensive digital schooling approach.

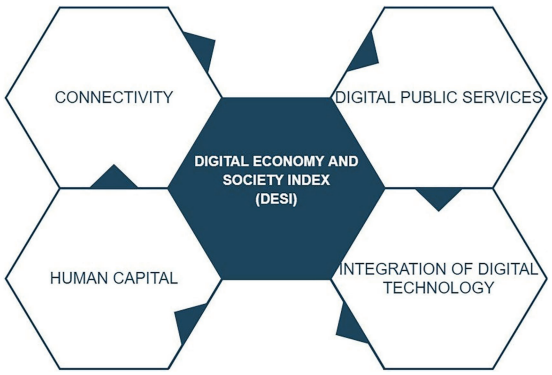

FIGURE 1
Digital Economy and Society Index. Source: authors' representation based on data provided by the European Commission (2020).

Digital progress and performance measurements

The European Commission introduced within the Europe 2020 strategy a performance measurement index to track the digital competitiveness of the European Member states. This analytical tool became one of the main instruments in assessing Europe's digital progress and performance in terms of digital competitiveness. As digitalization disrupts society even more profoundly, countries like Romania must find adequate ways to improve citizens digital skills and cities infrastructures (Vodă and Radu, 2018; Voda and Radu, 2019; Radu and Voda, 2022). According to PwC's Workforce Disruption Index (PwC's Workforce Disruption Index, 2019), in the next 10 years, more than half million jobs in Romania will be affected by the digital transformation generated by new technologies such as automation and artificial intelligence, which will gradually eliminate repetitive activities. The Digital Economy and Society Index (DESI) comprises relevant indicators, grouped in four dimensions/areas (see Figure 1).

- *connectivity* (fixed broadband take-up and coverage, mobile broadband and prices). This dimension is crucial in terms of providing the necessary coverage for online delivery of societal and economic services.
- *human capital - digital skills* (internet user skills and advanced skills). The second dimension underlines the importance of citizens digital skills, which are essential attributes for the effective use of online learning solutions.
- *integration of digital technology by businesses* (business digitalization and e-commerce). In the COVID-19 pandemic situation, governments worldwide had to take actions in order to reduce the spread of the virus. Some measures imposed include: physical distancing, restrictions on the freedom of movement and the closure of non-essential companies (International Labour Organisation, 2020b; Neștian et al., 2021). Given this situation, businesses had to rapidly adapt and make contingency plans to respond to the new measures as they arise. Given the pandemic evolution many companies were forced to embrace technology to move online, complemented by their capacity to explore alternative or temporary working arrangements (e.g., working-from-home; Turnea et al., 2020). However, in European companies the integration of digital technologies had different outcomes that differed according to the size of the enterprises: e.g., Small and Medium Size Enterprises exhibit a lower capacity of integration in comparison with large companies (European Commission, 2020).
- *digital public services* (e-government). Digitizing public services is an imperative action that needs to be considered, as it helps governments meet public expectations and become more efficient and resilient. Digital interactions are also less time consuming for individuals and help significantly reduce transaction costs for the public sector (Daub et al., 2020). Also, unlike the physical office, the delivery of 24/7 public services are likely to produce high benefits for both public administrations and users.

We analyzed the students' level and use of the digital skills in Romania and Belgium, with specific emphasis on the following skills: Communication and Collaboration digital skills, Creativity digital skills, Critical digital skills, Information digital skills, Problem-solving digital skills and Technical digital skills.

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Communication and collaboration

The ability to effectively use ICT to transfer information to others is the emphasis of the communication variable we are referring to in this study. Internet communication skills were defined by Van Dijk and Van Deursen (2014) as the capacity to encode and decode data in order to create, comprehend, and exchange meaning with other individuals utilising message systems like e-mail, chat rooms, or instant messaging. The major elements of this variable, according to Siddiq et al. (2016), are transferring information—using ICT to successfully communicate information and ideas to diverse audiences utilising a range of media and online formats. Moreover, the ability to attract online attention, the ability to experiment online for improving the decision-making process, the ability to pool knowledge and exchange meaning with others in peer-to-peer networking, and the ability to exchange meaning to reach decisions and realise transactions while understanding the meanings of others are all part of this skill. The ability to use ICT to create a social network and operate as a team to share information, reach agreements, and make choices while maintaining respect for one another is related to the collaboration variable. According to Helsper and Eynon (2013), involvement in debates and interactive communication are the two main elements of the ITC's collaborative dimension. Users should generate meaning through exchanges with the help of a variety of modern ICT tools, such as online platforms.

The digital tools provide young people with faster access to information as well as basic assistance, an immersive solution that may be available at all times, and a level of daily services, regardless of a person's location or willingness to reveal their identity. These benefits are seen from the perspective of communication and collaboration. Moreover, despite the fact that young people are exposed to harmful content online, technology-powered solutions can open up new possibilities by detecting, discouraging, and preventing online hate speech by warning users about the possible harm that their activity may create. For example, *Watwat.be* is a youth-focused online information platform in Belgium coordinated by the NGO *De Ambrassade* with assistance from the Flemish Government. The platform's goal is to educate and advise internet consumers to improve their online experience and to better collaborate with other users. In Romania, we can observe that numerous organisations, like the NGO *Digital Citizens Romania*, organise activities for kids, teachers, and parents as part of the EU's mission to enhance the population's digital abilities The events point out the development of basic online communication skills and fundamental coding abilities through the use of free online platforms like *Scratch* or *Code.org* and take place in different settings, from face-to-face activities to online meetings.

Creativity

The creative aspect of digital skills is concerned with using ICT to develop new or previously undiscovered ideas, or to handle traditional views in a novel way and turn them into products, services, or procedures that are considered innovative in a given domain. According to Hinrichsen and Coombs (2013), the creation of content – using ICT to come up with new ideas or find innovative ways to do things – is the most crucial element of the creative digital capability. Due to their frequent use of technological resources, young people are accustomed to the internet and new technologies. Of course, being "digitally native" does not automatically mean "digitally literate" (ICDL Europe, 2014). Having an early exposure to technology and using it naturally and easy (Tapscott, 2008) do not equate to the mastering of the entire range of digital skills (collaborative, creative or critical evaluation skills). Though these new tools give young people new opportunities, they are not simply consumers but also creators. For example, blogging and vlogging have grown to be quite popular for presenting various concerns to a broader audience and for creating a community around relevant topics of discussion.

The digital world offers a vast array of possibilities, from the ability to acquire knowledge and educational resources to the chance to express themselves, help shape their identities and interact with others. Van Dijk and Van Deursen (2014) define content production competence as the ability to produce content of a standard that is suitable for publication online. Moreover, the creative dimension comprises elements such as developing digital content from existing online material and interactive ways of keeping in touch with other users.

To better understand the creative skills Romanians and Belgians pose, we can look at the social media stats reported by Statcounter. The social media market share suggests that 78.05% of Belgian online users prefer Facebook to other social networks (Statcounter, 2022a), while 96.97% of Romanians use this platform (Statcounter, 2022b). Though Facebook is a relatively easy-to-use social network, we can see its great potential for generating creative content. On the other hand, the use of Pinterest – the image-based social media network – is more prevalent in Belgium, with 9.51% of the social media market share, whereas in Romania it only covers 0.75%. While the documented benefits of using Pinterest as a professional resource are typically focused on business, the platform has also been deliberately employed in educational settings to foster the development of creative skills. This is due to Pinterest's visual and organising features (Teach Thought Staff, 2012).

Critical thinking

The ability to think critically on the digital platforms suggests that the users should see the ICT as a tool to make informed decisions about online information using reflective analysis and sufficient proof to substantiate the findings. Sharing opinions and networking are two of the main purposes of digital media, but they can also increase the risk of social isolation offline and prejudice against people with different opinions. *The Digital Education Action Plan* (European Commission, 2018) emphasises

the risks associated with exposure to enormous amounts of data that are mostly driven by algorithms. These risks call for critical thinking and a complete approach to digital social inclusion. Disinformation does not only happen in the online environment, but it has so far been able to effectively take advantage of both the flaws in the digital world and the weaknesses in humankind as a whole. Disinformation operations frequently deftly sidestep or quietly hinder rational thought in favour of preying on people's emotions rather than their reason or critical thinking. Individual users who express their ideas online often go beyond the role of merely information consumers and instead become co-authors of the original message. The most vulnerable demographic in the face of the problem of disinformation is young people, who are the primary users and producers of content through social media.

The essential elements for defining the critical thinking dimension, according to Lee et al. (2016), are clarification – the employment of ICT to ask and respond to inquiries clarifications; assessment – the use of ICT to evaluate a source's applicability to a specific issue; and justification – a user can utilize ITC tools in order to find credible arguments to support assertions with relying heavily on their congruence with other knowledge claims. Moreover, digital users could benefit from developing digital critical thinking skills to connect facts, issues and problems to that they can propose insight for dialogue. The result of the combined and coordinated efforts of all relevant and targeted agents, including national governments, European institutions, academic organizations, media and, last but not least, individual consumers of virtual content, should be in the fight against disinformation in the social media era and could certainly benefit from the improvement of digital and critical thinking abilities.

Information

An individual who is "capable of recognising when information is needed and has the capacity to search, assess, and apply the necessary information successfully" is said to be information literate by Van Dijk and Van Deursen (2014). Users who perform well in the informational dimension find it simple to conduct online searches for information, are adept at using a variety of search-related tactics, find it simple to choose the right keywords to use when conducting online searches, and feel comfortable selecting search results after considering more than the top three results pages. Additionally, users frequently examine material from many websites to determine its veracity and rely on their assessment of a website's credibility. Above all, information literate users carefully analyse the data they obtain online and make sure to use their critical thinking abilities in order to evaluate the search inquiries results. Information skills are the aptitude for finding, choosing, and assessing data from the digital environment.

As we can see from the definition above, this digital skill's essential elements are accessibility, evaluation, and management. Accessibility is the use of ICT to locate and extract information from various online sources, evaluation is the use of ICT to determine whether or not the information is significant for a given purpose, and management is the use of ICT to organise information so that it can be found later. In terms of accessibility, Bulgaria has the lowest rate of internet access among the EU Member States (84%). However, between 2016 and 2021, Bulgaria, along with Cyprus, Romania, Greece, Slovenia, and Lithuania, saw substantial growth in the percentage of households with internet connections. These increases ranged from 15 to 20 percentage points (European Commission. Digital Economy and Society Index (DESI), 2021a). Romania ranks 10th on connectivity, while Belgium is suffering delays in the implementation of 5G networks, mostly because of the delay in allocating 5G pioneer regions and ranks 16th (European Commission. Digital Economy and Society Index (DESI), 2021c).

Romania's coverage increased in 2020, but overall take-up remained unchanged. Reaching the EU average, fast broadband coverage grew to 87%. The fixed very high-capacity network indicator in Romania is 76%, which is significantly higher than the EU average of 59%. This indicates that infrastructure-based competition is fierce in Romania, particularly in urban regions (European Commission. Digital Economy and Society Index (DESI), 2021b). More studies are required in order to assess the evaluation and management dimensions of the information skill. Information is not always of the same quality, making the assessment of information sources crucial. This requires users to possess certain skills that allow them to verify the accuracy of the data and the validity of the sources.

Problem-solving

The ability to use ICT to conceptually process and comprehend a problem situation in connection with the active transfer of skills to solve a problem defines the problem-solving abilities (Laar et al., 2017). For development, economic expansion, employment, and prosperity in both the national and international contexts, a robust digital economy is essential. The labour force and the categories of skill sets in business and society are significantly impacted by the growth of digital technology. With the automation of repetitive tasks and the resulting demand for new and varied sorts of professions, including more skilled digital technology professionals across all economic sectors, the landscape of employment is changing.

The problem-solving abilities are affected as well by the evolution of digital technologies. In almost all jobs where digital technologies complement existing talents, this transformation is driving the need for digital skills. The demand for a high level of digital proficiency is highlighted once again.

Nevertheless, young people should be encouraged to develop this skill in order to better perform in their professional life, as well as in their personal life, as more and more solutions to household problems can be found in the online environment.

Technic

In the digital environment, technical skills refer to the ability to use (mobile) devices and applications to carry out daily duties and to identify specific online environments to navigate them and uphold orientation. The technical variable, according to Van Deursen et al. (2016), involves navigation as well as ICT knowledge and usage. ICT usage refers to users who can run fundamental (mobile) application operations and access resources for daily use, whereas ICT knowledge refers to users who are informed about the features of devices or apps. Last but not least, the navigation dimension emphasises how simple it is for consumers to maintain their sense of direction while surfing online.

The operational internet skills, such as using mobile Internet, were addressed by the researchers in addition to assessing the technical proficiency (the ability to connect to WIFI networks or to download and install apps on a mobile device). To have a better understanding of the operational internet abilities, additional factors relevant to using the online environment and search engines were also measured.

Data and methods

Study design and data analysis

The paper focuses on analyzing the students' level and use of the digital skills in Romania and Belgium, seeking to identify the similarities and differences between the two countries. This investigation will highlight a better and realistic perspective on how digital skills are structured and distributed in accordance to the specificity of each country. There are evaluated perceptions regarding six digital skills: communication and collaboration digital skills, creativity digital skills, critical-thinking digital skills, information digital skills, problem-solving digital skills, and technical digital skills.

We applied a quantitative design based on an online survey administrated in three major universities from Belgium (Catholic University of Louvain, University of Namur) and Romania ("Alexandru Ioan Cuza" University of Iasi) using different educational platforms (e.g., Microsoft Teams, Zoom) during March 2021–May 2022. Although investment in education and training, as well as their modernisation and adjustment represent a mandatory condition for both economic and social process, several member states have diminished their education and training expenditure (European Commission, 2021b). For instance, even if in the past years the public expenditure on education in both countries was fairly steady, variations between them were considerable (around 6% of GDP in Belgium and around 3% of GDP in Romania). Moreover, in Belgium, there was set up a knowledge and support center for digital school education. In addition, in both countries, in higher education, significant investments were planned for the development of digital infrastructure and digital teaching resources, the adaptation of study courses and digital training for academic staff (European Commission, 2021b).

The questionnaire included three sets of questions: the first one focused on evaluating the students' perceptions regarding their digital skills, the second one referred to questions used for finding the students' perceptions on several directions of action that need to be taken into consideration in obtaining a development strategy in education, and the third one captured both the students' social and demographic particularities and the sources for their digital skills accumulation. In the present paper, we used only the first and the third sets of questions in order to create our constructs measuring the digital skills and to characterize the sample, as presented in Table 1.

A short description of the study goals and the participants' right to quit the survey at any time were included on the first page of the questionnaire. Also, it was mentioned that the anonymity of the respondents will be assured and that there will not be any repercussions in the case of withdrawing from the survey.

Statistical methods

In order to analyze if there are significant differences between Belgium and Romania regarding the sources of digital skills accumulation (i.e., digital education courses and levels of education) and the distributions of the six digital skills, we performed the following test: Pearson Chi-Square, Continuity Correction and Independent T Test. The first two tests are included in the Chi-Square Tests category and refer to testing of the significance of associations between two categorical variables, in our case, variable Country associated, by turn, with the digital education courses enrolment and education. The Independent T test was used in the case of comparing the mean of each digital skill score from Belgium with the corresponding mean from Romania in order to understand whether the scores of digital skills differ based on country (Field, 2005).

In addition, for checking if digital education courses enrolment and education have significant influences on the digital skills, depending on the number of the independent variables' categories, we applied Independent T Test (in the case of digital education courses) and One-way ANOVA (in the case of education). Unlike Independent T Test which is used for comparing two means, One-way ANOVA is a parametric test that compares three or more independent groups in order to identify whether there is statistical evidence that the associated population means are significantly different (Kent State University Libraries, 2021).

Finally, the correlations among the six digital skills at the level of each country were identified by using Principal Components Analysis (PCA). It is a multivariate statistical process which is applied as a data reduction technique in order to identify variables that account for a large proportion of variance in a large data set (Dugger et al., 2022). Particularly,

TABLE 1 Description of the variables.

Variables	Description	Items	Sources
Communication and collaboration digital skills	• The students' ability to transmit information using digital environments and to share online content and media made by them or others and to collaborate with peers. • Number of items: 6	1. "I can communicate with others using Skype, WhatsApp, Messenger, etc. or using basic features (e.g., voice messaging, SMS, text exchange)." 2. "I can use advanced features of several communication tools (e.g., using Skype and sharing files)." 3. "I actively use a wide range of communication tools (e-mail, SMS, instant messaging, blogs, and social networks) for online communication." 4. "I can use collaboration tools (e.g., project management software, online spreadsheets) and help edit documents / files created and shared by others (One Drive, Google Drive, Dropbox, etc.)." 5. "I know I can use online services (e.g., e-banking, e-governments, e-hospitals, online payment etc.)." 6. "I pass on or share knowledge with others online (e.g., *via* social networking tools or in online communities)."	Al Khateeb (2017)
Creativity digital skills	• The students' ability to create content by converting information into new knowledge. • Number of items: 6	1. "I know how to create/edit something new from existing online images, music or video." 2. "I can create digital content (e.g., text, tables, images, audio, video files) in at least one format using digital tools." *3. *"I am confident about writing/ create content on a blog, website or forum."* *4. *"I would feel confident putting writing/video/image content I have created online".* *5 *"I can use tools for creating webpages or blogs".* *6. *"I can create complex, multimedia content in different formats, using a variety of digital tools and environments".*	Van Deursen and van Dijk, 2014 Al Khateeb (2017)
Critical thinking digital skills	• The students' ability to think reflectively and judge skillfully the incoming online information and provide them with a safe, permanent and an easily accessible tool as well as a physical environment and, also, to formulate their own point of view. • Number of items: 5	1. "I know when I should and should not share information online and which kind of information." 2. "I am aware that my credentials (username/password) can be stolen. I know I should not reveal private information online." *3. *"I know how to extract/highlight fundamental concepts and references in the text".* *4. *"I know how to identify and extract specific information in sources like social media".* *5. *"I know that on internet not all information is reliable and I know how to check different sources and evaluated online content".*	Van Deursen and van Dijk, 2014 and Al Khateeb (2017)
Information digital skills	• The students' ability to search, evaluate and organize digital information. • Number of items: 6	1. "I can use advanced search strategies to find reliable information on the internet (such as using web feeds (like RSS))." 2. "I use some filters when searching to compare and assess the reliability of the information I find". 3. "I can assess the validity and credibility of information using a range of criteria". 4. "I can save or store files or content and retrieve them once saved or stored". 5. "I classify the information in a methodical way using folders. I make backups of information or files I have stored". 6. "I can save information found on the internet indifferent formats. I can use cloud information storage services".	Al Khateeb (2017)
Problem-solving digital skills	• The students' ability to find solutions for the problems or to formulate strategies to determine the best solutions for them. • Number of items: 5	1. "I can take basic steps to protect my devices (e.g., using anti-viruses and passwords)." 2. "I have installed security programmes on the device(s) that I use to access the Internet (e.g., antivirus, firewall)." 3. "I know how to react if my computer is infected by a virus. I can configure or modify the firewall and security settings of my digital devices". 4. "I find support when a technical problem occurs or when using a new program". 5. "I can solve most of the more frequent problems that arise when using digital technologies".	Al Khateeb (2017)

(Continued)

TABLE 1 (Continued)

Variables	Description	Items	Sources
Technical digital skills	• The students' ability to continuously adapt to new technologies. • Number of items: 9	1. "I can bookmark a website and I can download/upload files." 2. "I can complete online forms." 3. "I can apply basic formatting (e.g., insert footnotes, charts, tables) to the content I or others have produced." 4. "I know how to reference and reuse content covered by copyright." *5. *"I know how to import data into a specific programs and tools* (e.g., *STATA, SPSS, Eviews, MonkeyLearn, Aylien, Google Cloud NLP API, Amazon Comprehend, Brandwatch, RapidMiner, MeaningCloud)."* *6. *"I know how to do simple data processing in specific programs and tools* (e.g., *STATA, SPSS, Eviews, MonkeyLearn, Aylien, Google Cloud NLPAPI, Amazon Comprehend, Brandwatch, RapidMiner, MeaningCloud)".* *7. *"I can choose the right tool, device, application, software or service to solve (non-technical) problems".* *8. *"I am aware of new technological developments. I understand how new tools work".* *9. *"I regularly update my technical digital skills. I am aware of my limits and try to fill my gaps".*	Van Deursen and van Dijk, 2014 Al Khateeb (2017)

Each variable was defined based on several items (i.e., the higher score the higher skill) with answers evaluated on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree). * indicates that the items were developed by the authors.

PCA transforms the coordinate system of the original data into composites so that the largest variance is along the first coordinate (i.e., Component 1), and the second largest variation in the data is along the second coordinate (i.e., Component 2), and thus these coordinates are called the principal components (Hochreiter, 2013).

Digital skills measures

As mentioned previously, the first section of the questionnaire focused on evaluating the students' perceptions regarding their digital skills. It consisted of 38 items which were created based on the Laar et al. (2017) and van Laar et al. (2020) meta-analysis on digital skills. The reference study focused on seven core skills supported by the use of ICT: communication digital skills, collaboration digital skills, creativity digital skills, critical-thinking skills, information digital skills, problem-solving digital skills, and technical digital skills. Each of these digital skills was evaluated through several items (see Table 1) using a five-point Likert scale in which 1 represents "strongly disagree" and 5 "strongly agree." Most of the questions included in the study for measuring each of the digital skills defined by Laar et al. (2017) and van Laar et al. (2020), were adapted starting from the methodologies applied by Al Khateeb (2017) and Van Deursen and van Dijk (2014).

The constructs for each of the six digital skills were determined by averaging the responses for the items referring to them. However, before creating the constructs, we focused on the analyzing in detail the items and we checked the reliability of the multi-item scales, the convergent and divergent validity.

The reliability of the multi-item scales was verified through Cronbach's Alpha Test and McDonald's Omega Test. Although, the usual range of variation for the results of these two test is [0–1], for exploratory studies, the acceptable values must be situated between 0.60 and 0.70 (Hair et al., 2014). The results presented in Table 2 reveal that, in the two samples (Belgium and Romania), each of the six constructs reflecting digital skills register values of the tests higher than 0.65, offering, in this way, a good reliability of the scales.

Furthermore, for measuring the convergent and discriminant validity, Average Variance Extracted (AVE) and its square-root were calculated at the level of each construct. The convergence of the constructs is assured if the AVE values are higher than 0.50, while the discriminant validity is validated if the values for square-roots of AVE are higher than the ones on the corresponding column and row of the correlation matrix. Taking into consideration these criteria, we can observe from results included in Table 2 that both convergent and discriminant validity are achieved.

Sample and data

The Romanian participants in the study were asked to complete the questionnaire in their mother language. For the respondents from Belgium, the questionnaire was available in English. In this way, we assured that the questions were thoroughly understood by the participants so that eventual errors will not appear. A pilot study involving 20 respondents from each country, excluded from the final study database, was carried out to eliminate any potential issues or concerns. The results from the

TABLE 2 Results of reliability and validity tests.

Variable	Cronbach's alpha	McDonald's omega	Average variance extracted	Correlations between variables					
				1	2	3	4	5	6
Belgium									
1. Communication and Collaboration digital skills	0.736	0.742	0.597	[0.772][a]					
2. Creativity digital skills	0.790	0.794	0.558	0.516***	[0.746]				
3. Critical digital skills	0.690	0.719	0.549	0.557***	0.362***	[0.740]			
4. Information digital skills	0.705	0.703	0.593	0.570***	0.366***	0.516***	[0.770]		
5. Problem solving digital skills	0.682	0.678	0.519	0.496***	0.562***	0.485***	0.514***	[0.720]	
6. Technical digital skills	0.772	0.687	0.541	0.617***	0.643***	0.609***	0.533***	0.645***	[0.735]
Romania									
1. Communication and Collaboration digital skills	0.827	0.832	0.520	[0.721]					
2. Creativity digital skills	0.830	0.826	0.561	0.646***	[0.748]				
3. Critical digital skills	0.821	0.837	0.548	0.592***	0.463***	[0.740]			
4. Information digital skills	0.718	0.717	0.539	0.545***	0.502***	0.649***	[0.734]		
5. Problem solving digital skills	0.809	0.754	0.655	0.468***	0.498***	0.600***	0.496 ***	[0.809]	
6. Technical digital skills	0.786	0.739	0.513	0.608***	0.580***	0.643***	0.604***	0.669***	[0.716]

*** denotes the statistical significance at 0.05 level; [a]The data in the diagonal square brackets are the square root of the A Variance Explained value for each variable.

pilot study were used to ensure that the questionnaire was fit to be used after slight modifications.

A random sample of 300 students is selected from each university, by using the organization database. In order to assure the comparability and validity of the responses in the sample were included only students that had compatible specializations, which determined significant reduction of the selection base. In Belgium, out of the 300 students selected, 127 were willing to participate in the survey, which gave us a total of 89 valid responses In Romania, from the total students that were selected, only 116 accepted to respond to the questionnaire, and 109 successfully completed the survey. Thus, the percentage of the valid responses were 70.08% for Belgium and 93.96% for Romania. The total sample consisted of 207 respondents (89 coming from Belgium universities and 109 from the Romanian university).

Results

Descriptive statistics

This section includes the descriptive statistics for the variables considered in the study. Also, it reveals the results of the comparison between Belgium and Romania regarding the six digital skills and the sources of their accumulation. The digital competences studied in the case of students from both countries were correlated to the age of the students and their educational level as we have focused our statistic on youth from the university background.

Table 3 presents the frequency distributions of the variables Age, Gender, Digital courses enrolment and Education in the case of each country.

In Belgium most of the students were aged between 21 and 24 years old (42.7%) or 25 and higher (38.2%), while the vast majority of Romanian students were aged between 18 and 20 years old (50.5%) or 21 and 24 years old (42.5%). In the total sample, female respondents were preponderant in both countries (68.5% in Belgium and 91.7% in Romania). As we mention, our research is focused on analyzing young university students' digital skills, meaning that age is an important determinant factor. Developed as such, the study will allow us to advance a clear picture of the employability potential of young people from the two countries studied, as the ability of an individual to fulfill their career potential depends on attributes and skills that are developed during their lifetime.

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TABLE 3 Characteristics of students' samples from Belgium and Romania (n=89 for Belgium and n=109 for Romania).

Variable	Category	Frequency	Percentage (%)
Belgium			
1. Age	18–20	17	19.1
	21–24	38	42.7
	25+	34	38.2
2. Gender	Female	61	68.5
	Male	28	31.5
3. Digital courses enrolment	No	60	67.4
	Yes	29	32.6
4. Education	Level 1 (Primary)	4	4.5
	Level 2 (Secondary)	7	7.9
	Level 3 (Tertiary)	36	40.4
	Level 4 (Primary & Secondary)	6	6.7
	Level 5 (Secondary & Tertiary)	14	15.7
	Level 6 (Primary, Secondary & Tertiary)	22	24.7
Romania			
1. Age	18–20	55	50.5
	21–24	46	42.2
	25+	8	7.3
2. Gender	Female	100	91.7
	Male	9	8.3
	No	98	89.9
3. Digital courses enrolment	Yes	11	10.1
4. Education	Level 1 (Primary)	5	5.6
	Level 2 (Secondary)	38	34.9
	Level 3 (Tertiary)	10	9.2
	Level 4 (Primary & Secondary)	15	13.8
	Level 5 (Secondary & Tertiary)	25	22.9
	Level 6 (Primary, Secondary & Tertiary)	16	14.7

Source: authors' calculations based on the Stata statistical analysis software.

The accumulation of digital skills is based on the theory learned and practice completed in the years of schooling and in other courses which are not a part of the scholar curriculum. In both countries, the levels of enrolment in digital courses are low (Table 3), 32.6% for the students from Belgium and only 10.1% from Romania declaring that they followed these type of training in order to enhance their knowledge and practice of the digital skills. This high difference between the two countries can be validated also through the results of the Chi-Square tests applied (Table 4), the p-values corresponding to the calculated values of the test being lower than a significance level of 0.01. According to the results presented in Table 3, the students from Belgium mentioned that, in the years of schooling, the role of the education in achieving the digital skills was mostly preponderant in the third level (i.e., university; 40.4%), while in the Romanian students' case, the second level (i.e., high school) was most relevant (34.9%). Among the students, 24.7% Belgians and 14.7% Romanians said that the digital skills were accumulated in all of their levels of education. The results of Pearson Chi-Square and Continuity Correction for the variable education (Table 4) show that there are significant differences between countries concerning the levels of education in which the students learned the digital skills (p-values lower than a risk of 0.01).

Digital skills in Belgium and Romania

The graphic representation from Figure 2 indicates the mean scores obtained for each of the six digital skills in the case of each country (blue representation for Belgium and green representation for Romania). The digital skills for which were identified the higher scores were Communication and Collaboration and Critical thinking ones, with levels above 4.2 points, but with no significant differences between the two countries. The first type of skills was found to be more predominant in the case of students from Belgium (4.48 points), while the second type was more prevalent in the case of students from Romania (4.39 points) In Belgium, the other digital skills registered average scores between 3.75 and 3.45 points, with Creativity and Technical ones being at the bottom of the list (3.47 and 3.45 points). In Romania,

TABLE 4 Results of testing the differences between Belgium and Romania regarding digital courses enrolment and education.

Chi-square tests	Digital courses enrolment		Education	
	Value of the statistic	*p*-Value	Value of the statistic	*p*-Value
Pearson Chi-square	42.483	0.000	15.376	0.000
Continuity Correction	45.251	0.000	14.012	0.000

Source: authors' calculations based on the Stata statistical analysis software.

Creativity and Technical skills registered not only the same average score (3.48 point), but also the lowest levels In general, the average scores for Information and Problem-solving skills were near 4 points, thus indicating that students from both countries have a high levels of competencies regarding the gathering and using information and solving difficult tasks. Comparing the results for the two countries, Communication and Collaboration digital skills and Information digital skills registered higher mean values in Belgium (4.48 points and 4.05 points) than in Romania (4.29 points and 3.75 points). Contrary, in the case of Critical thinking digital skills, Romanian students had, in average, higher scores (4.39 points) than the ones from Belgium (4.22 points). Finally, Creativity digital skills, Problem-solving digital skills and Technical digital skills do not defer significantly, in average, from

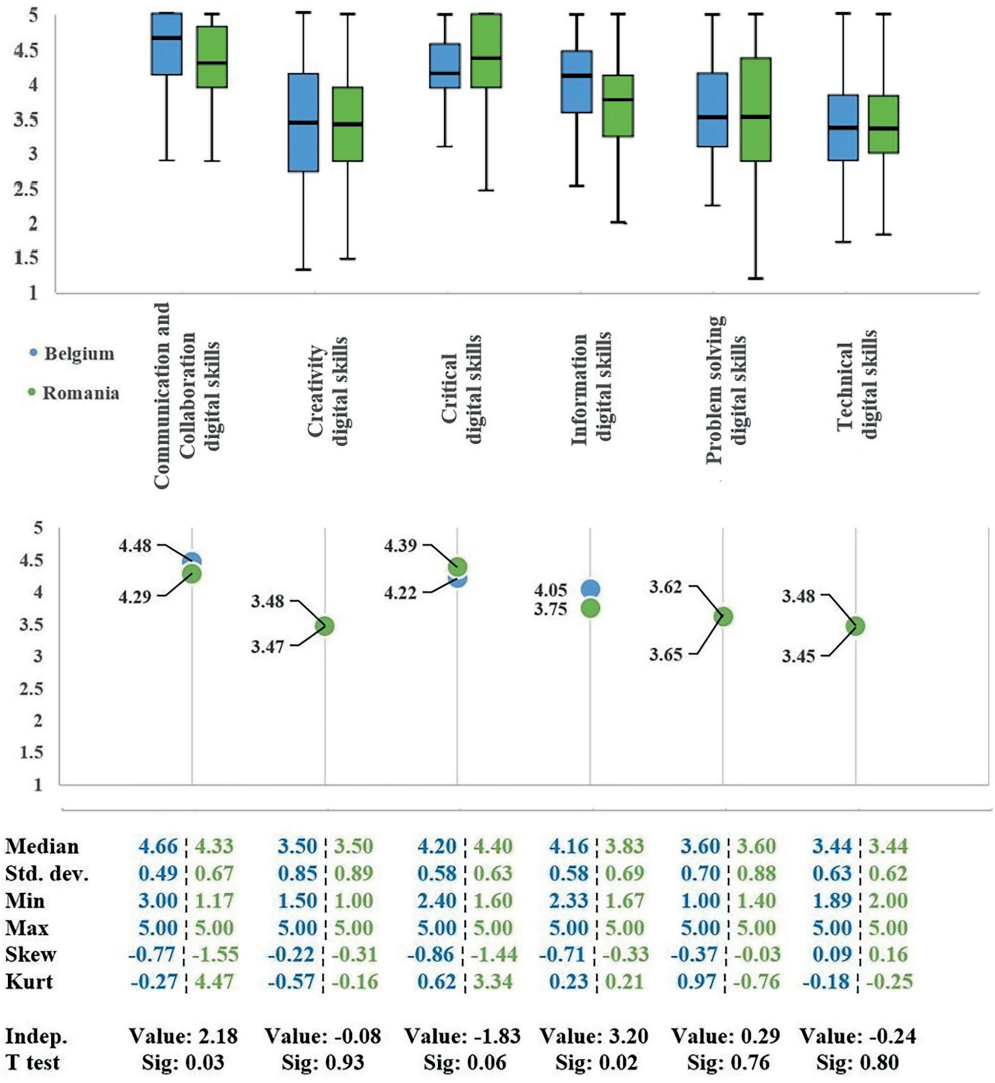

FIGURE 2
Descriptive statistics of the Digital Skills scores for Belgium and Romania. Source: authors' calculations based on the Stata statistical analysis software.

a country to another. Moreover, the Independent T Tests results reveal that, for the last three digital skills mentioned, there is not a statistically significant difference between the means obtained for each of the two countries, *p*-values associated with the T values being higher than a level of significance of 0.10 (value of $p = 0.93$ for Creativity digital skills; value of $p = 0.76$ for Problem-solving digital skills; and value of $p = 0.80$ for Technical digital skills). However, for Communication and Collaboration digital skills, Critical thinking digital skills, and Information digital skills, the results of Independent T Tests indicated statistically significant differences between Belgium and Romania, the *p*-values being close to a risk of 0.05 (value of $p = 0.03$; value of $p = 0.06$; and value of $p = 0.02$).

Other results included in Figure 2 emphasize, in general, negative values for the coefficients of Skewness, meaning that, mostly, the values of the digital skills tend to be in the upper half of the variation range (i.e., 3 and higher). Also, taking into consideration the mean values and their corresponding standard deviations, we calculated the coefficients of variation for each of the digital skills and all of them were lower than 0.50 (i.e., 10.93; 24.42; 13.74; 14.32; 19.33; 18.10 for Belgium; and 15.61; 25.64; 1,435; 18.40; 24.10; 17.97 for Romania), meaning that the distributions are homogenous and the means are representative.

The results presented in Table 5 indicate if the sources of digital skills accumulation (i.e., digital courses enrolment and education) have a statistically significant impact on the scores of the digital skills in Belgium and Romania.

Giving that the variable digital courses enrolment is a binary one, we applied the Independent T Test in order to test if there are significant differences between scores of each digital skill depending on the participation or nonparticipation in trainings. In Belgium, except Communication and Collaboration digital skills and Critical thinking digital skills, all the other types of digital skills are significantly influenced by the enrolment in digital courses: Creativity and Problem-solving digital skill for a 5% level of significance ($t = 2.119$, value of $p = 0.037$ and $t = 2.844$, value of $p = 0.006$); while Information and Technical digital skills for a 0.10 level of significance ($t = 1.795$, value of $p = 0.076$; and $t = 1.894$, value of $p = 0.062$). In the case of Romania, only Information digital skills are significantly influenced by the enrolment in digital courses ($t = 2.190$, value of $p = 0.044$). Taking into consideration the other source of digital skills accumulation, education, the results of the ANOVA test show that in both countries the influence is not statistically significant, the *p*-values corresponding to the F statistics being higher than an acceptable level of significance.

Figure 3 consists of two graphic representations resulted from de PCA analysis presenting the relationships between the six digital skills of the students, the left one for Belgium and the right one for Romania. The solutions identified in the PCA analysis are validated through the results of Bartlett Test of Sphericity and Kaiser-Meyer-Olkin (KMO) Test which verify if the variables are independent (Bartlett, 1954; Kaiser, 1974): the associate probability of the Chi-square test used within the Bartlett Test of Sphericity was lower than the significance level of 0.01 and the value of KMO Test was above 0.6.

In the graphic specific to Belgium, there can be identified two groups of variables around the Ox axis: the above group formed by Critical thinking digital skills, Information digital skills and Communication and Collaboration digital skills; and the below group composed by Technical digital skills, Problem-solving digital skills and Creativity digital skills. In Romania the grouping of the variables around the Ox axis is

TABLE 5 Results of Independent *T* Test and ANOVA test for each type of digital skills.

Variable	Digital courses enrolment Independent *T* Test		Education ANOVA	
	***T* statistic**	***p*-Value**	***F* statistic**	***p*-Value**
Belgium				
Communication and Collaboration digital skills	0.046	0.963	0.733	0.601
Creativity digital skills	2.119**	0.037	0.427	0.829
Critical digital skills	0.059	0.953	1.176	0.328
Information digital skills	1.795*	0.076	0.439	0.820
Problem solving digital skills	2.844***	0.006	1.695	0.145
Technical digital skills	1.894*	0.062	0.531	0.752
Romania				
Communication and Collaboration digital skills	1.117	0.281	0.739	0.596
Creativity digital skills	1.382	0.190	0.821	0.538
Critical digital skills	1.529	0.145	1.439	0.216
Information digital skills	2.190**	0.044	1.453	0.212
Problem solving digital skills	−1.183	0.257	0.746	0.591
Technical digital skills	0.665	0.516	1.108	0.361

***, **, * denote the statistical significance at 0.01, 0.05 and 0.10 level.

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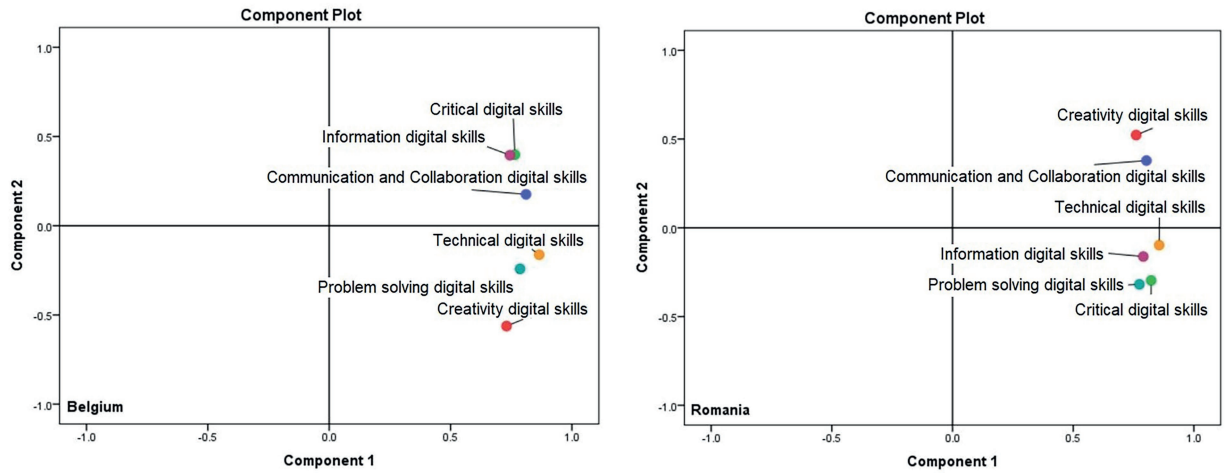

FIGURE 3
Relationships among Digital Skills in Belgium and Romania. Source: authors' calculations based on the Stata statistical analysis software.

different. In the group above the axis are included Creativity digital skills and Communication and Collaboration digital skills; while the other group comprises Technical digital skills, Information digital skills, Problem-solving digital skills and Critical thinking digital skills. The elements from each group are positively correlated (Creativity digital skills with Communication and Collaboration digital skills in the first group; Technical digital skills, Information digital skills, Problem-solving digital skills and Critical thinking digital skills among themselves in the second group), students registering similar scores for them. However, even if correlations were positive at individual level, at group level the results show a negative sign.

Discussion

With more young individuals entering the workforce, there is a renewed focus on the need for comparative studies. Thus, this paper contrasts the digital proficiency of Romanian and Belgian students. These include general abilities like web surfing, email, or instant messaging conversation, as well as the capacity to use online platforms linked to one's field of work and familiarity with digital financial services. Future employment in the online economy will require significantly more sophisticated digital abilities for tens of millions of jobs. By including pertinent empirical and comparative data, the current study also aims to address a gap in the literature.

To determine the similarities and differences between the two countries, the study focuses on examining the students' level and use of digital abilities in Romania and Belgium. The findings indicate that the digital skills of students do not differ considerably from one nation to another. Comparing the results for the two nations, it can be seen that Belgium (4.48 points and 4.05 points) outperformed Romania in terms of mean values for both communication and collaboration digital skills and information digital skills (4.29 points and 3.75 points).

Countries similar to Romania in their digital skills status must develop appropriate solutions to enhance residents' digital competences and city infrastructure as the effects of digitalization on society become increasingly more significant. The communication and collaboration skills that Romanian youth need to develop include the capacity to attract online attention, the capacity to experiment online to enhance decision-making, and the capacity to exchange meaning to deal with different situations and complete transactions while comprehending the meanings of others. The collaboration variable is connected to the capacity to use ICT to build social networks and function as a group to share knowledge, reach decisions, and do so while still showing respect for each other.

On the brighter side, there were no significant differences in average critical thinking digital skills scores between the nations studied. In the first section of the paper, we have stressed the value of acquiring adequate digital competences. It is difficult to participate in the economy and the digital society without a minimum knowledge of digital skills, especially in light of the workplace's ongoing digitalization in terms of management and organizational structure.

Conclusion

Multiple aspects of the human life are always changing due to geopolitical, demographic, and economic factors. Particularly technology is altering the nature of sectors such as education, administration, health, making whole industries and job sectors redundant while also generating entirely new businesses. Governments, company executives, academic institutions, and individuals will need to overcome incentives to focus on the short term and start making plans for a future in which change is the only constant in order to address this supply and demand imbalance.

Young people who are digitally literate can access crucial information and services, conduct online transactions, and explore technology that will enhance their social relationships with friends and family. Additionally, it will present them with more chances to advance in their career or pursue their schooling. The idea behind 21st-century digital skills is that they are necessary for employees to take ownership of their own development and to participate in the knowledge-based workforce. What employees can do with information to boost 21st-century abilities and fully utilise ICT is what matters most (Laar et al., 2017). It is crucial to assist children and teens, especially those who are at risk of exclusion, in developing new skills by offering dependable and approachable assistance as they navigate the complexities of the digital world.

The ability to possess information, skills and attitudes appropriate for a given setting is referred to as digital competence. Consequently, in order to improve digital competence, it is essential to acquire knowledge of technology, practical skills for using digital tools, and a mind-set that encourages critical thinking, operational and informational knowledge, innovation, and creativity. Naturally, a development in the educational system in countries such as Romania and Belgium will result in lower unemployment and a lower danger of poverty, as well as higher living standards and longer life spans (Leiciu and Zafiu, 2021). In this regard, it should be highlighted that raising the digital educational bar in the EU Member States is essential for keeping up with the shifting demands of the corporate world (Tarabasz et al., 2018) and all significant aspects of a contemporary participative citizen (Van Dijk and Van Deursen, 2014).

This research has several limitations that are listed hereby. This study works with data collected at national and international level but includes a limited number of faculties and students from Romania and Belgium, which can cause potential sampling bias. Second, we focused on six digital skills as antecedents of digital competences. Other types of digital skills can be collected to make the analysis more specific. In addition, several factors determining the levels of digital skills among students could provide a more detailed perspective on the specificity of each country and system of education. Third, the study does not take into consideration the modalities through which students are developing the digital skills in each country, a more specific approach being useful to complete the big picture. Finally, the analysis capture student's perception at a given time, and a follow-up study could be conducted to analyze how digital constructs relate to each other from an evolutionary perspective.

Data availability statement

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

Ethics statement

Ethical review and approval were not required for the study on human participants in accordance with the local legislation and institutional requirements. The patients/participants provided their written informed consent to participate in this study.

Author contributions

AV, CG, CC, and GP: conceptualization, validation, investigation, writing—original draft preparation and writing—review and editing. AV, CG, and GP: literature review. AV and CC: methodology, formal analysis and resources. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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