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Article

Digital skills in vocational education and training: Investigating the impact of Erasmus, digital tools, and educational platforms

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Abstract: This study investigates the impact of various educational and social factors on the digital skills of vocational education and training (VET) students, emphasizing the significance of continuous skill development in the digital age. Utilizing structural equation modeling (SEM), the paper analyzes data from 382 adult VET students in Greece, examining the effects of Erasmus program participation, daily computer use, educational platforms, and social network engagement on digital competencies. The findings reveal that participation in Erasmus programs and the use of educational platforms significantly enhance students' digital skills, highlighting the value of international experiences and digital learning tools in VET. Conversely, daily computer use alone does not significantly impact digital skills, suggesting that structured and purposeful digital tool integration is essential for skill development. The study also underscores the positive role of social networks in improving content management skills, advocating for their strategic use in educational settings. These results demonstrate the need for targeted digital literacy initiatives within VET programs to prepare students for modern labor market demands. The research contributes to the theoretical understanding of digital skill acquisition and offers practical insights for educators and policymakers to enhance VET curricula, fostering economic and social progress through improved digital literacy.

Keywords: digital competences; digital literacy; lifelong learning; retraining; technological integration

1. Introduction

In the era of the digital revolution, digital skills are crucial for professional success and personal development. Particularly in the field of vocational education and training (VET), the need to strengthen these skills is more pressing than ever. The topic of "Improving the Digital Skills of VET students" highlights the innovation and importance of digital skills in an ever-changing digital environment (Harris and Clayton, 2020).

The originality of this subject lies in its focus on the continuous upgrading of VET students' skills to meet the demands of the modern labor market. Unlike traditional education that provides basic knowledge, retraining offers updated skills that respond to new technological developments and trends. Additionally, the concept of lifelong learning is promoted, enhancing VET students' ability to adapt to changes and remain competitive (Caves and Baumann, 2018).

The investigation of this matter is necessary for several reasons. First, the rapid evolution of digital technologies necessitates the regular refreshing of knowledge and skills. Digital literacy is no longer an extra skill but a core requirement in many professions. Retraining enables VET students to acquire specialized knowledge and become familiar with new tools and software essential for their professional

development (Li and Pilz, 2023).

Second, unemployment and underemployment are significant problems in many countries, and improving digital skills can help mitigate these issues. VET students equipped with modern digital skills have a greater chance of finding employment and meeting the demands of employers. Employers seek workers who can integrate directly into the production process without requiring extensive on-the-job training (Harris and Clayton, 2020; Smith et al., 2021).

Lastly, digital skills enhance not only professional careers but also social inclusion and participation in a digital society. VET students who develop digital skills can actively contribute to business innovation and productivity, promoting overall economic development. Digital skills facilitate the participation of individuals in the digital society, ensuring they are not left behind in an increasingly digital world (Belaya, 2018; Kibrit et al., 2022).

In summary, improving digital skills is an innovative and necessary approach to VET. It is a fundamental way to ensure that VET students are properly prepared for the challenges of the modern labor market and to achieve overall economic and social progress.

2. Literature review

Examining "Digital Skills" and "vocational education and training" highlights the interaction of these concepts and their impact on the development of workers and the economy. The literature review proves that the development of digital skills through reskilling is crucial for strengthening VET and human resource development. Continuous education and the integration of new technologies are essential to meet modern challenges and promote social and economic development. These terms are key elements of the modern literature on education and training (Li and Pilz, 2023; Merino et al., 2021).

2.1. Digital skills in vocational education and training

The term "Digital Skills", as shown in **Figure 1**, proves to be of great interest in the research field, with 137,600 sources found in the ScienceDirect online database matching this concept. This multitude of sources highlighted the importance and breadth of the subject in today's digital world (ScienceDirect/Digital Skills, 2024).

Digital skills have included a wide range of competencies related to the ability to use Information and Communication Technologies (ICT). These skills have ranged from basic computer and file management skills to more advanced skills, such as programming, data analysis, and project management in digital environments. According to Livingstone's et al.'s (2023) research, digital skills were categorized into basic and advanced and were necessary to achieve digital literacy.

In addition, digital skills played a key role in social inclusion and equality. People who did not have access to digital technologies or did not have the necessary skills to use them effectively risked being left behind, thus creating a digital divide. Addressing this digital divide was critical to promoting equity and social cohesion (Asghar et al., 2022; Yang et al., 2024).

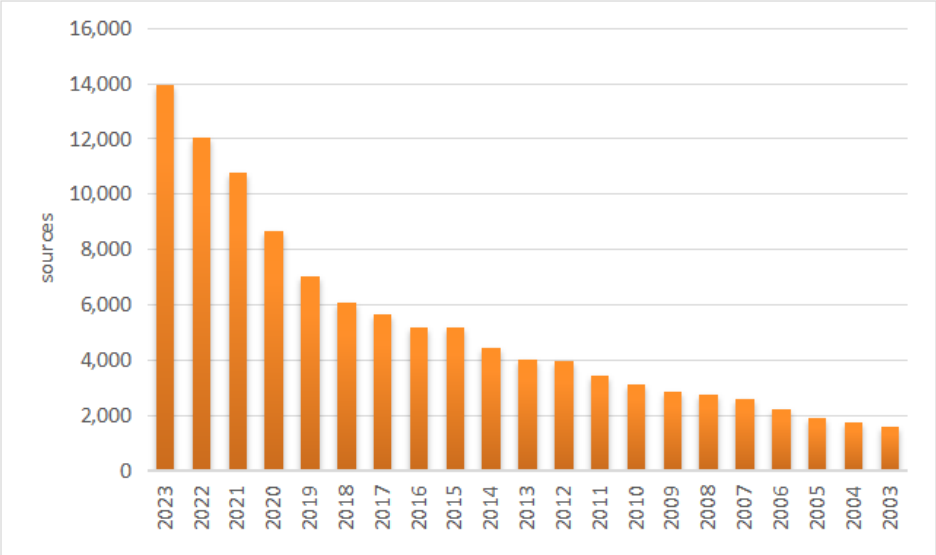

Figure 1. Sources of the term "Digital Skills" in ScienceDirect by year.
Source: (ScienceDirect/Digital Skills, 2024).

Retraining has been an important strategy for developing digital skills. As technology evolved rapidly, the skills required in the job market were constantly changing (Seyffer et al., 2022). Continuous education and retraining helped employees stay up-to-date and adapt to new demands. Research of Bhatti et al. (2022) indicated that retraining was not only a way for workers to improve their skills, but also a critical factor in improving productivity and innovation in businesses.

One of the most important studies in this area examined the impact of training in business applications on the digital skills of entrepreneurs and the digital capabilities of their businesses. The training was offered to immigrant entrepreneurs in Athens, and data were collected before and after the training. The results showed that training in business applications improved entrepreneurs' attitudes towards technology, their willingness to change, and their digital skills, as well as increased their use of business applications. Additionally, it enhanced the digital capabilities of businesses in areas, such as communication, social networks, customer relationship management, and project management (Drydakis, 2022).

Tomczyk's (2021) research analyzed the stated and actual levels of digital skills of future educational staff in VET in Poland. The data showed that there was a significant gap between VET students' stated and actual levels of digital skills, with only less than 20% reaching the minimum level in word processing skills and only 1.6% in spreadsheet skills (Tomczyk, 2021).

Research by Hämäläinen et al. (2015) focused on the digital skills of older VET students and their opportunities for education and employment in the digital world. This study analyzed data from several surveys and found that older VET students have lower levels of digital skills compared to the general population, with even lower levels for historically disadvantaged groups. The study also emphasized the importance of daily computer use, even through standardized daily activities. The authors acknowledged that while daily computer use did not provide a competitive advantage in acquiring digital skills for younger age groups, it significantly benefitted older VET students. Those over 50 years old could acquire digital skills through

simple, repetitive daily tasks such as paying bills or using an instant messaging app. Finally, the research pointed to opportunities to support the development of digital skills in older VET students, which could improve their economic outcomes (Hämäläinen et al., 2015).

Digital skills training for older adults VET students in four European countries was examined in research by Blažič and Blažič (2020). This study highlighted the challenges that adult VET students faced when learning to use digital devices and services, such as difficulty understanding terminology and technical details. The results indicated that even basic digital skills could be challenging for older adults VET students with no prior experience. Moreover, the daily computer use, such as using email, browsing the internet, and handling basic software applications, was often particularly difficult for these students to master. The need for more comprehensive and accessible training programs was evident, emphasizing practical, everyday computer skills to help older adults VET students to integrate better into the digital world. Providing additional support and resources, such as simplified instructional materials and hands-on practice, could significantly improve their learning outcomes and overall digital literacy (Blažič and Blažič, 2020).

The study by Jackman et al. (2021) highlighted the need for a coordinated global response to digital skills education, especially for primary and secondary students. The study highlighted that digital skills training was essential for success in the digital world and for reducing inequalities. Similarly, in the context of VET, the importance of digital skills could not be overstated. Equipping VET students with robust digital skills was crucial for their employability and adaptability in the labor market. Furthermore, integrating digital skills training into VET programs can bridge the gap between traditional education and modern workplace requirements. Effective digital skills education in VET not only enhanced students' technical abilities but also promoted lifelong learning. By focusing on both core and advanced digital skills, VET institutions could better prepare their students for the demands of current and future job markets (Jackman et al., 2021).

The systematic literature review by Van Laar et al. (2020) examined the determinants of 21st-century skills and 21st-century digital skills. This review highlighted the need for research into the determinants of communication and collaboration skills. The study pointed out that most existing studies focused on demographic and socioeconomic factors, neglecting social factors, such as social support (Van Laar et al., 2020).

On the other hand, a search of the term "vocational education and training" (VET) in the online database ScienceDirect revealed the existence of 30,373 sources related to this concept, as shown in **Figure 2**. This wealth of sources demonstrated the importance and breadth of VET in the academic and research community (ScienceDirect, 2024).

Vocational education and training referred to educational programs that aimed to provide practical and theoretical knowledge and skills that were directly applicable in the labor market. This form of education focused on connecting education to the needs of various professional fields, ensuring that VET students were well-prepared for entry and advancement into specific occupations (Belaya, 2018).

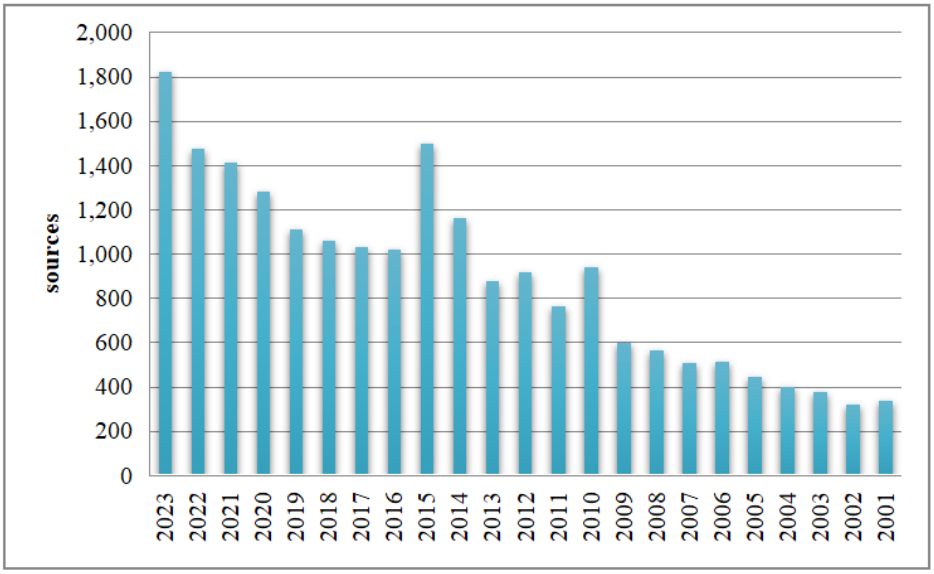

Figure 2. Sources for the item "Vocational Education and Training" in ScienceDirect by year.
Source:(ScienceDirect, 2024).

VET played a critical role in economic development and social inclusion. VET helped reduce unemployment and underemployment by enhancing workers' skills and abilities and improving their employability. In addition, VET contributed to improving the productivity and competitiveness of businesses by providing a skilled and qualified workforce (Bilbao et al., 2021; UNESCO, 2016).

The literature highlighted the need for continuous upgrading of VET programs in order to respond to the evolving needs of the labor market. The integration of modern technologies and innovative teaching methods in VET was essential to prepare VET students for the challenges and opportunities of the modern working reality (Caves and Baumann, 2018; UNESCO, 2016).

The rapid development of technology necessitated the integration of digital skills into VET programs. Research of CEDEFOP pointed out that VET students need to be equipped with the necessary digital skills to cope with the demands of the digital age. This included not only basic digital literacy but also advanced skills such as data analysis, programming, and the use of specialized software tools. Integrating digital skills into VET programs enhanced VET students' ability to adapt to change and take advantage of new technological opportunities. Digital skills and continuous training were keys to the professional development and adaptability of employees (European Centre for the Development of Vocational Training, 2019; Harris and Clayton, 2020).

VET also had important social and economic implications. It promoted social inclusion by providing education and training opportunities to people who would otherwise have limited access to education and the labor market. VET helped reduce inequalities and strengthened social cohesion, creating equal opportunities for all. In addition, VET contributed to economic development by creating a well-trained workforce that can support business innovation and competitiveness. Investments in human resource education and training had immediate and long-term benefits for the economy (Backes-Gellner and Lehnert, 2021; Veres et al., 2021).

The extensive literature on VET demonstrated the importance and

multidimensional nature of this concept. VET was not only a mechanism for the professional development of VET students but also a critical factor for economic development and social inclusion. The continuous upgrading of VET programs and the integration of digital skills were necessary to meet the challenges and opportunities of the modern labor market (Pozo-Llorente and Poza-Vilches, 2020).

The fluctuations in the term "vocational education and training" from 2010 to 2015 are largely attributable to the effects of the 2008 global financial crisis. The majority of EU countries were compelled to adopt austerity measures that impacted the VET sector. During these years, governments reduced budgets for education and training. However, a notable paradox emerged, characterized by a non-linear increase in the production and publication of research papers. Despite the reduced investments, policies in many developed countries emphasized the enhancement of VET. Consequently, there was a non-linear rise in research activity. This trend is also linked to policies that encouraged the immediate entry of VET students into the labor market instead of prolonged education, primarily to reduce average wages. As a result, an unstable environment was created, reflected in the fluctuations of publications during the period 2010–2015. As the economic situation began to stabilize after 2015, the expected linearity in research output resumed. The decrease observed from 2014 and 2015 to 2016 is considered reasonable as policies related to VET returned to their previous state (Gupta et al., 2024; Wongmonta, 2023).

Another reason for the non-linear increase in publications can be attributed to technological advancements and shifting educational priorities. During these years, there was rapid progress in educational technologies, with the integration of digital tools and online learning platforms becoming more widespread. This is reflected in the increased number of publications from 2010 to 2015, as research focused more on the application of new technologies in VET. Additionally, the expansion of international education initiatives, such as the Erasmus plus program, bolstered research and publications on best practices in VET and the integration of learner and teacher mobility. Therefore, the increase in publications in 2014 can be linked to the significant rise in funding and participation in Erasmus plus programs, which promoted the exchange of good practices and innovation in VET (McGrath and Yamada, 2023; Moldovan, 2018).

2.2. The role of Erasmus programs in enhancing digital skills in VET

The Erasmus plus program of the European Union for the period 2021–2027 aims to promote education, training, youth and sports, supporting the personal and professional development of citizens. The program focuses on providing opportunities to acquire digital skills through mobility and retraining activities (Digital Skills and Jobs Platform, 2021).

In Erasmus plus projects KA121-VET and KA122-VET, participants in mobility activities have the opportunity to acquire advanced digital skills. Students participating in internships can develop skills in areas, such as digital marketing, digital design, app development and cyber security. Participating teachers can gain experience in using digital education tools and specialized software (Martins et al., 2024).

Erasmus plus is stepping up its efforts to expand opportunities to more

participants and organizations, focusing on quality improvement and promoting a greener and digital society. The program supports priorities and activities set out in the European Education Area, the Digital Education Action Plan and the European Skills Agenda (Alonso De Castro and García-Peñalvo, 2023).

The lack of digital skills is a significant barrier to many sectors of the economy, including agriculture, industry, and financial services. Around 35% of the workforce lacks sufficient digital skills, while 40% of businesses report difficulties in finding skilled professionals. The digital opportunity traineeships program aims to bridge this skills gap by offering hands-on training in partnership with businesses (Teixeira et al., 2023).

Erasmus plus promotes collaboration between academic and professional organizations through the mobility of individuals and collaboration on projects. Participants have the opportunity to spend a mobility period abroad, participate in volunteering and receive language training. Organizations can collaborate on projects in the fields of education and training, school education and European sports events (Organ et al., 2023).

Therefore, the development of digital skills through the Erasmus plus program is crucial to prepare participants for the labor market and enhance their personal and professional development. The program promotes inclusion, innovation, and sustainability, ensuring that participants acquire the necessary skills to meet the demands of the modern society and economy (Martins et al., 2024).

2.3. The impact of educational platforms on digital skills in VET

Educational platforms have become integral to the development of digital skills within VET. These platforms provide structured environments where students can engage with digital content and receive immediate feedback. The integration of educational platforms into VET programs has significantly enhanced the accessibility and quality of digital skills training. These tools not only support traditional classroom learning but also allow students to develop their competencies independently, often through interactive and personalized learning experiences (Gupta et al., 2024).

The study by Tsarapkina et al. (2022) focused on digital transformations in education and the impact of technology on VET. The authors analyzed the challenges and opportunities arising from the integration of digital technologies in the educational process. The use of digital learning tools and platforms improved the accessibility and quality of education, allowing VET students to develop the skills needed in the modern digital economy (Tsarapkina et al., 2022).

In the research of Burns et al. (2020), the development of digitally competent VET students in VET in Serbia and Russia was examined. The study highlighted the need for continuous professional development to effectively integrate digital technologies into the educational process. The authors emphasized the importance of developing daily computer use skills in daily school activities, especially in laboratory classes (Burns et al., 2020).

Allmann and Blank's (2021) study re-examined the theory and measurement of digital skills in the age of compulsory computer use in VET classes. The authors proposed a new methodology for skills research, which involved observing beginners

in the process of learning new skills and interviewing the people who help them. This study highlighted the need to change current ways of measuring skills and examined the policy implications of this theory (Allmann and Blank, 2021).

The study by Bernacki et al. (2020) examined the effect of brief digital education on VET students' learning skills and performance in STEM educational platforms. Results showed that a short, self-directed online course could improve desired learning behaviors and student performance at minimal cost to VET students or educators (Bernacki et al., 2020).

In the article by Larsen et al. (2022), the importance of artificial intelligence (AI) in the digital and green transition of local and regional labor markets in Europe was considered. The authors highlighted the use of AI as a tool for skill development, providing personalized learning and feedback to VET students. The application of AI in education could improve the effectiveness of retraining by allowing students to acquire up-to-date and relevant skills. Additionally, integrating AI into VET could facilitate personalized learning and provide feedback to students. This could improve the effectiveness of retraining by allowing students to acquire up-to-date and relevant digital skills. Moreover, the use of social media platforms in VET could enhance students' ability to network and seek professional opportunities, providing a learning environment tailored to their needs (Larsen et al., 2022).

The study by Clipa (2021) highlighted the importance of training VET students and teachers in digital skills, especially during the pandemic. This research underlined the need to adapt educational policies to the new digital realities and the priority of digitization in the public policies of all European countries. In VET, integrating digital skills was very important. Educational platforms helped make this happen by giving VET students access to many digital resources and interactive learning tools. These platforms improved learning by offering personalized paths and real-time feedback. Including digital skills in VET programs ensured that students were ready for the job market, where digital know-how was a must. Additionally, these platforms supported ongoing training for teachers, keeping them updated with the latest digital tools and methods, which benefited their students (Clipa, 2021).

Furthermore, generative AI technologies, such as large language models and generative adversarial networks (GANs), are increasingly influencing educational practices and the essential digital competencies required in the education. Recent research highlighted that these technologies not only enhanced productivity but also fostered creativity and collaboration between students and machines, making it imperative for educational systems to integrate AI-related skills into their curricula to prepare students for an AI-driven world. Additionally, a UNESCO report emphasized that the rapid integration of generative AI into the global education system necessitated upskilling and reskilling students to equip them with the necessary digital competencies. This included adaptability, ethics, and a culture of continuous learning, which were crucial as AI become more prevalent in educational environments. Therefore, modern digital skills education had to evolve to include competencies related to generative AI, ensuring that learners were adequately prepared for the challenges and opportunities presented by these advancing technologies (Saúde et al., 2024; UNESCO, 2023).

The literature review highlighted the complexity and necessity of retraining VET

students in digital skills. Educational organizations must develop programs that meet the current and future needs of the labor market, integrate modern technologies, and offer flexible educational solutions. Cooperation with the private sector, continuous training, and a personalized approach, are key to the success of this endeavor.

2.4. The influence of social networks on digital skills development in VET

The rapid expansion of social networks has had an impact on the way digital skills are developed within VET. These platforms offer students opportunities to engage with digital tools in practical and interactive ways. In particular, the combination of social networks with Massive Open Online Courses (MOOCs) has enhanced the learning experience. Through these integrated platforms, VET students can access a diverse range of resources, collaborate with peers, and apply digital skills in real-world scenarios (Larsen et al., 2022).

Digital skills training in Portuguese VET students was examined in the study by Lopes et al. (2023). Through an online questionnaire, data were collected from 573 workers. The results showed that when training was conducted in combination with digital online platforms, the digital skills of students improved significantly. Additionally, when educational institutions provided incentives for attending social networks through Massive Online Open Courses (MOOCs), the improvement in digital skills was also substantial. Practically, the impact of using digital tools during training was one of the most significant reasons for the development and enhancement of digital skills (Lopes et al., 2023).

Eynon's (2021) study examined the development of digital skills for VET students, highlighting the need of utilization of social media platforms. The research highlighted that the use of social media contributed to the acquisition of digital skills to a greater extent than the educational programs provided in VET. The main reason for this was related to the diversity of tools used by social media users in their daily engagement. As a result, there is a significant improvement in their digital skills (Eynon, 2021).

Subsequently, the research of Tomczyk (2021) highlighted the importance of digital skills for VET stakeholders, including not only students but also teachers. Through qualitative and quantitative analysis, this study indicated that digital literacy was a crucial function for developing digital skills related to cybersecurity (Tomczyk, 2021). This particular skill was of utmost importance, especially when students navigated social platforms due to the high number of misleading emails. Nowadays, most students seeking professional employment or internships searched for information through social platforms (e.g., LinkedIn). However, misleading emails were a daily occurrence, and despite efforts to eliminate them, this had not been definitively achieved. Consequently, the skill related to cybersecurity should be developed within a broader framework in the VET sector, at both student and teacher levels. After all, job searching via the internet, particularly through social platforms, was a reality and would become increasingly necessary in the future (Mostova and Taranenko, 2023; Tomczyk, 2021).

Finally, the study by Milenkova et al. (2020) examined digital skills and literacy in social media. The students of VET surveyed reported that they felt confident in

creating diverse digital content and products and were aware of the dangers of hybrid media wars (Milenkova et al., 2020).

3. Hypotheses

The literature review was a crucial step in assessing the research community's contributions to the issue of digital skills among VET students. The investigation conducted in the previous chapters of this research paper led to the following research hypotheses:

3.1. Erasmus key action 1 mobility programs and digital skills

The EU has introduced significant innovations in the priority axes of the Erasmus Plus programs, which began in the 2014–2020 programming period and continue in the 2021–2027 period. The Erasmus Plus programs emphasize EU VET policies based on those formulated by the European Centre for the Development of Vocational Education and Training, CEDEFOP, with digital skills being one of the four key pillars. The EU has prioritized Digital Transformation in Education and Training, promoting the continuous enhancement of digital skills for both teachers and students of VET (Khalaf Sakr et al., 2024; Mihajlović et al., 2024).

Additionally, events like the European Commission (2023b) highlight the importance of digital skills for the labor market. The EU has also developed the Digital Competence framework (DigComp), allowing citizens to self-assess their skills for free. Consequently, Erasmus programs foster the development of digital skills, significantly aiding young participants in their integration into the labor market. Thus, the first hypothesis is formulated as follows (European Commission, 2023b; García-Delgado et al., 2023):

H1: VET students who have participated in Erasmus Plus programs possess higher levels of digital skills than those who have not.

3.2. Digital skills and daily computer use

A significant portion of the scientific community, as evidenced by the literature review, supports the notion that daily computer use positively contributes to the development of digital skills among VET students. Advocates of this view argue that regular computer use facilitates skill acquisition through everyday functions of popular software and social media. They suggest that interacting with information, performing basic and standardized tasks, such as making payments, uploading and sending files, and installing applications can enhance the digital skills needed in daily life. Conversely, some argue that daily computer use alone is not a strong or necessary condition for developing digital skills, seeing it more as a habit rather than a skill acquisition process. They believe daily computer use positively affects older individuals (over 50) more than younger ones. Accordingly, the second research hypothesis is formulated as follows (Eiríksdóttir, 2020; Sánchez Prieto et al., 2020; Yang et al., 2023):

H2: The daily use of computers, through standardized procedures, positively affects the level of digital skills of VET students.

3.3. Educational platforms and digital skills

During the COVID-19 pandemic, the use of educational platforms became crucial in EU countries, helping organize lessons more effectively. These platforms (e.g., Moodle, e-class) provided VET students with organized access to educational materials and instructor feedback, as well as opportunities for modern e-learning and collaboration in forums. Familiarity with these platforms not only facilitated the learning process but also enhanced VET students' digital skills, which are valuable in the labor market. Educational platforms continue to be widely used, and the educational community recognizes their ongoing contribution. Thus, the third research hypothesis is formulated as follows (Sá et al., 2021; Smith et al., 2021):

H3: VET students who use educational platforms (such as Moodle) demonstrate better digital skills in the educational process.

3.4. Social networks and digital skills

Social networks inherently require digital skills and support a wide range of functions. They are integral to the daily lives of many users, including most VET students, who often create profiles at a young age. While the educational community has made efforts to replace social networks with educational platforms for course support, VET students continue to use social networks as a habitual activity. Despite this, social networks also aid in developing digital skills, providing tools for communication, information exchange, and professional networking. For VET students, social networks offer opportunities for professional development, such as Massive Open Online Courses (MOOCs) and job searches on platforms like LinkedIn. Consequently, the fourth research hypothesis is formulated as follows (Ozilhan Ozbey et al., 2024; Sarı and Aypay, 2024; Seo and Lee, 2024):

H4: Frequent use of social networks enhances VET students' skills in creating and managing professional content on platforms like LinkedIn and MOOCs.

4. Methodology

The creation of the questionnaire was carried out in two main axes, targeting purely VET students. The first axis consists of seven questions related to the demographic characteristics of the sample. These questions examine gender, age, field of study of the VET students, the use of computers in everyday life, Internet access, participation in Erasmus Plus mobility, and a self-assessment of the level of digital skills. The second axis of the questionnaire included the specialized questions. Based on the literature review, four important categories were created, each containing six questions. Below in **Figure 3**, which is created by Microsoft Visio 365, the four categories are shown with distinct pastel colors, while the thematic areas of the questions are indicated with corresponding pastel circles (Allmann and Blank, 2021).

Table 1 describes the explanation of variables used in questionnaire and provides a detailed breakdown of the variables utilized in the questionnaire designed for this study. The variables are organized into four primary categories: Everyday digital activities (C1), educational and professional digital skills (C2), data management and analysis (C3), and creativity and innovation (C4). Each category contains specific digital skills that are essential for VET students, enabling a thorough assessment of

their digital competencies. This structured approach allows for a nuanced analysis of how different digital skills are developed and applied in the context of VET, ensuring a comprehensive evaluation of digital literacy among students.

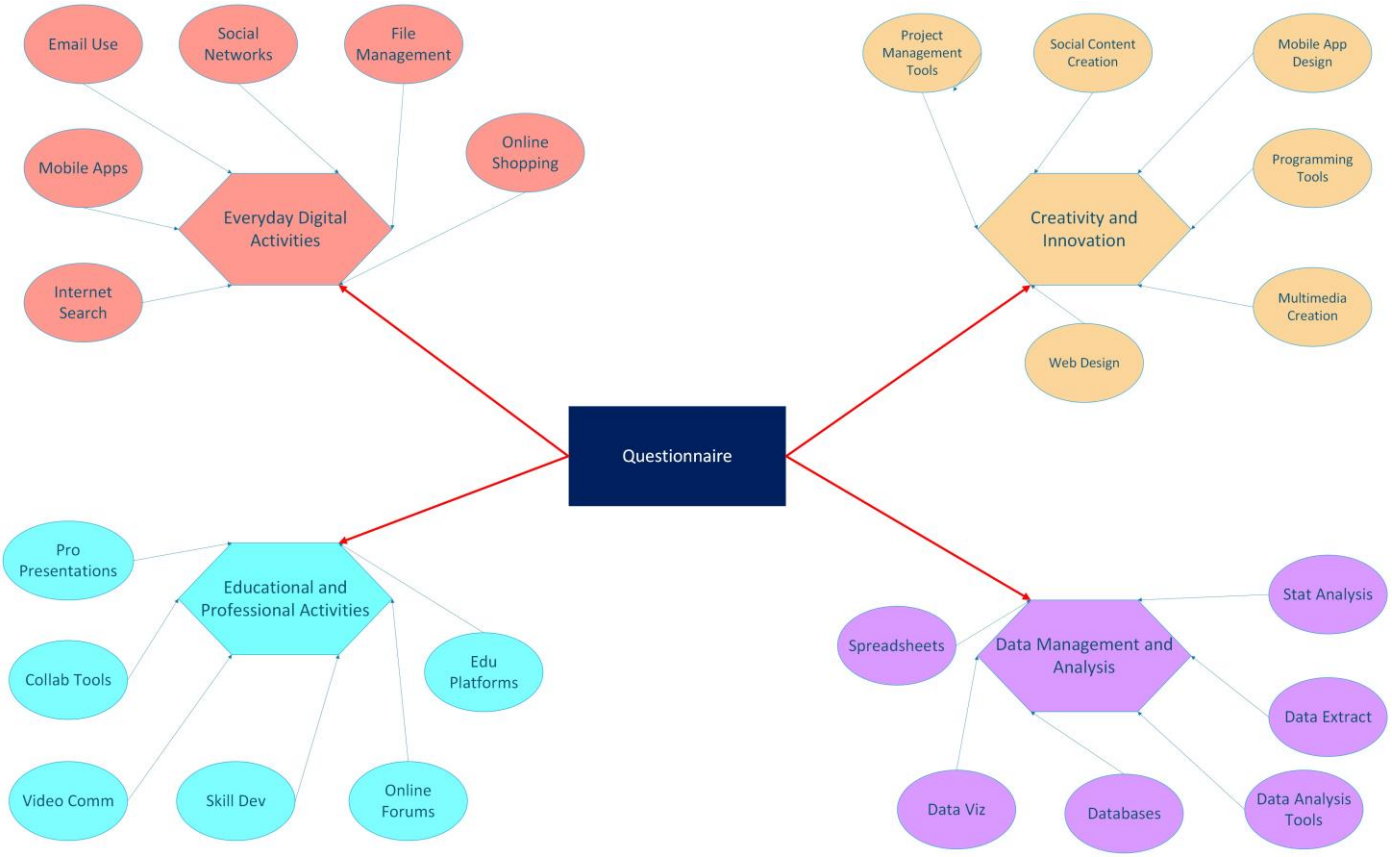

Figure 3. Structure of the questionnaire.

Table 1. Explanation of variables used in questionnaire.

Category 1: Everyday digital activities (C1)				**Category 3: Data management and analysis (C3)**			
C1Q1	Internet search	C1Q4	Online shopping	C3Q1	Spreadsheet software	C3Q4	Databases
C1Q2	Email use	C1Q5	File management	C3Q2	Data visualization	C3Q5	Data extraction
C1Q3	Social networks	C1Q6	Mobile apps	C3Q3	Data analysis tools	C3Q6	statistical Analysis
Category 2: Educational and professional digital skills (C2)				**Category 4: Creativity and innovation (C4)**			
C2Q1	Educational platforms	C2Q4	Video communication	C4Q1	Multimedia creation	C4Q4	Mobile app design
C2Q2	Collaboration tools	C2Q5	Skill development tools	C4Q2	Website design	C4Q5	Project management tools
C2Q3	Online forums	C2Q6	Pro presentations	C4Q3	Programming tools	C4Q6	Social content creation

This questionnaire was distributed to four VET educational institutions with adult students in Greece. The research was conducted during the winter semester of the 2023–2024 school year, from 17 October 2023, to 14 February 2024. The institutions participated in Erasmus Plus programs of Key Action 1 during the current programming period (2021–2024). All the students asked to complete the questionnaire were adults, and some had participated in the mobility programs, though not all. The information process was conducted via email, and the completion of the questionnaires was entirely anonymous and digital. A link to the questionnaire on the

Survey Monkey platform (https://www.surveymonkey.com/) was shared with the students via email. A total of 1632 emails were sent, and the response rate was extremely satisfactory, with 382 completed questionnaires. The publicity of the survey and the information provided at each school contributed to this.

The questionnaire was written in Greek, and the expected completion time was approximately 30–35 min. The questions related to self-assessment of digital skills rather than specific knowledge. The special part of the questionnaire used a five-point Likert scale, and answering all questions was mandatory. For the demographic questions, respondents were given predefined answers to ensure relative uniformity. Before completing the questionnaire, students were informed of the research purpose and had access to the researchers' contact information. No student was excluded from the research process, and GDPR data protection was maintained according to the current Greek legislation.

5. Results

The statistical analysis of the questionnaire began with descriptive statistics for the demographic characteristics. The research hypotheses were tested by using the structural equation modeling (SEM) statistical method (Guenther et al., 2023).

At this point, it is important to analyze the reliability and internal consistency of the questions using Cronbach's alpha coefficient. **Table 2** below shows the analysis of the coefficient by question category, as well as the overall reliability of the entire questionnaire. The results indicated high reliability, with Cronbach's alpha ranging from 0.85 to 0.90 for the individual categories of questions and reaching 0.89 overall for the questionnaire. These values indicate very good to excellent internal consistency, suggesting that the questions are consistent and reliably measure the respective skills. Specifically, category 2, concerning educational and professional digital skills, had the highest reliability index (0.90), while the other categories also showed very good values. This high internal consistency strengthens the validity of the research results and confirms that the questionnaire is a reliable tool for measuring VET students' digital skills (Cheung, 2019).

Table 2. Cronbach's alpha analysis by category.

Category	Cronbach's alpha
Category 1: Everyday digital activities (C1)	0.85
Category 2: Educational and professional digital skills (C2)	0.90
Category 3: Data management and analysis (C3)	0.88
Category 4: Creativity and innovation (C4)	0.87
Overall	0.89

To evaluate the validity of the questionnaire, a Confirmatory Factor Analysis (CFA) was conducted on four key categories, as shown in **Table 3** (everyday digital activities, educational and professional digital skills, data management and analysis, and creativity and innovation). The average variance extracted (AVE) for each category exceeded the acceptable threshold of 0.5, indicating that the items within each category are strongly related to the constructs they are designed to measure. The

maximum shared variance (MSV) for each category was lower than the AVE, and the square root of the AVE (√AVE) was higher than the MSV, confirming the discriminant validity of each construct. This means that each category is distinct from the others. Additionally, the composite reliability (CR) values, ranging from 0.85 to 0.90, suggest that the items within each category are consistent and reliable. Overall, these findings support the conclusion that the questionnaire effectively measures the intended constructs, with each category being both distinct and reliable.

Table 3. Confirmatory factor analysis.

Category	**AVE (average variance extracted)**	**CR (composite reliability)**	**MSV (maximum shared variance)**	**Discriminant validity (√AVE > MSV)**
Category 1: Everyday Digital activities (C1)	0.66	0.88	0.31	Y**
Category 2: Educational and professional digital skills (C2)	0.71	0.90	0.29	Y**
Category 3: Data management and analysis (C3)	0.68	0.87	0.27	Y**
Category 4: Creativity and innovation (C4)	0.65	0.85	0.28	Y**

**Y = Yes; N = No.

5.1. Descriptive statistics

The descriptive statistical analysis of the questionnaire revealed that 382 adult respondents participated in the survey. Of these, 182 were women (47.64%), 162 were men (42.41%), and 38 chose not to disclose their gender. Additionally, 211 respondents (55.24%) were aged 18–24 years, 88 (23.04%) were aged 25–34 years, 40 (10.47%) were aged 35–44 years, 30 (7.85%) were aged 45–54 years, and 13 respondents (3.40%) were over 55 years old.

Among all respondents, 116 had participated in Erasmus Plus programs during the previous school year, while 266 had not participated in any European mobility program.

The combined descriptive statistical analysis, as illustrated in **Figures 4** and **5**, categorizes the students by gender and field of study, distinguishing those who participated in an Erasmus program from those who did not. **Figure 4** shows participants in an Erasmus program, while **Figure 5** shows non-participants. It is important to note that all Erasmus Plus participants come from various specialties, maintaining the gender ratio. Specifically, the fields of Economics and Administration, as well as tourism professions, exhibit higher participation in the program. Most categories demonstrate proportional gender representation, except in the category of artistic professions, where men are significantly more represented.

In general, literature indicates that women often outperform men in VET and specific professional fields. This trend is also reflected in the overall results of this research. Although Erasmus participants may exhibit some differences, these are not statistically significant. Other factors, such as students' availability for mobility, support from host partners, and specific conditions of mobility prevailing in each program, should be considered (Noguera et al., 2024; Sánchez Prieto et al., 2020).

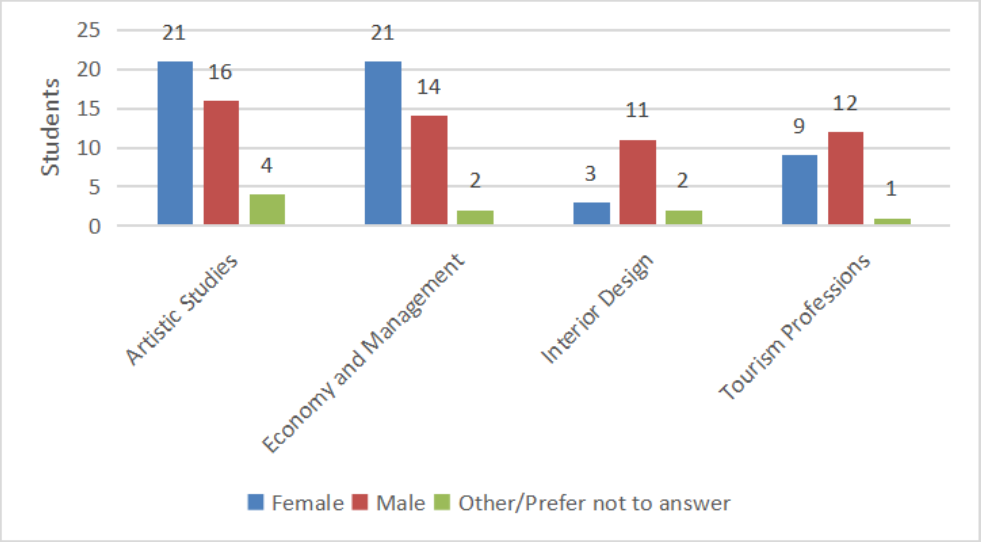

Figure 4. Field of study by gender for Erasmus students.

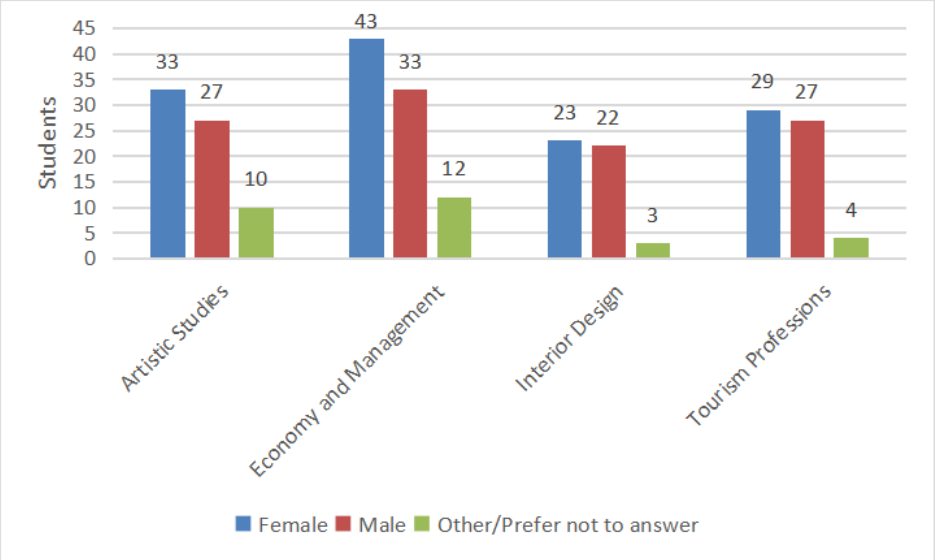

Figure 5. Field of study by gender for non-Erasmus participants.

Figure 6 shows the age groups of students who participated in the Erasmus program, as well as their levels of digital skills. The age groups 18–24 and 25–34 are the most represented among participants. These students exhibit various levels of digital skills, with the majority ranking at levels 3, 4, and 5. A significant number of students demonstrate a high level of digital skills (level 5), especially in the 25–34 and 35–44 age groups. The number of students with low levels of digital skills (levels 1 and 2) is limited. This observation is supported by the "Erasmus Impact Study", which highlights the benefits of Erasmus participation in enhancing both academic and personal skills. Erasmus participants show increased self-confidence, tolerance, and problem-solving skills, which are highly valued by employers (European Commission, 2016; European Commission, 2020).

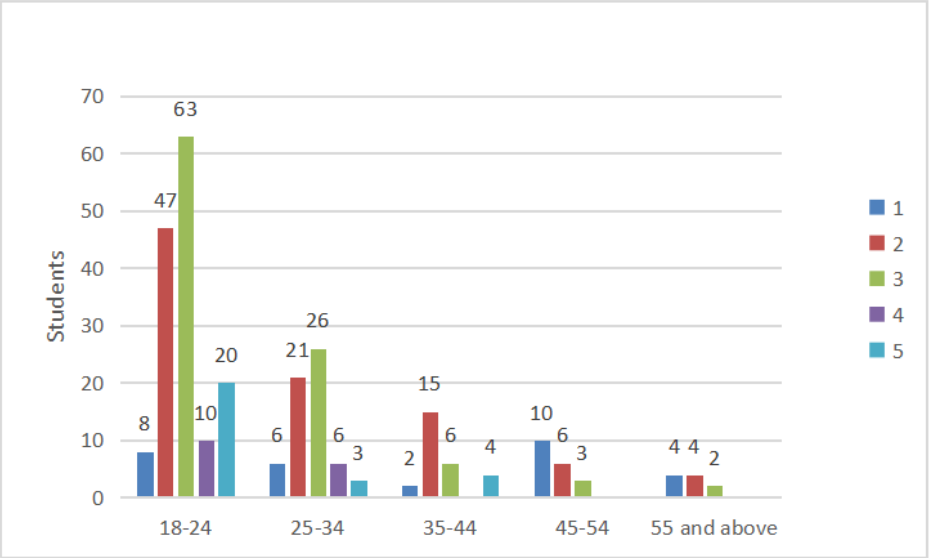

Figure 6. Age and digital skills levels of non-Erasmus participants.

Figure 7 depicts the age groups of students who did not participate in the Erasmus program, as well as their levels of digital skills. In this category, the 18–24 and 25–34 age groups are also the most represented. However, non-participants exhibit a wider distribution of digital skill levels, with fewer students at the highest levels (4 and 5). There is a higher proportion of students with lower levels of digital skills (levels 1 and 2). Overall, non-participants in Erasmus programs seem to have lower levels of digital skills compared to participants. The European Commission study highlights that students who do not participate in mobility programs, such as Erasmus have fewer opportunities to develop critical skills necessary in the modern labor market (European Commission, 2016; European Commission, 2023a).

In summary, there is a positive correlation between Erasmus participation and higher levels of digital skills, emphasizing the importance of international experience in developing students' digital competencies.

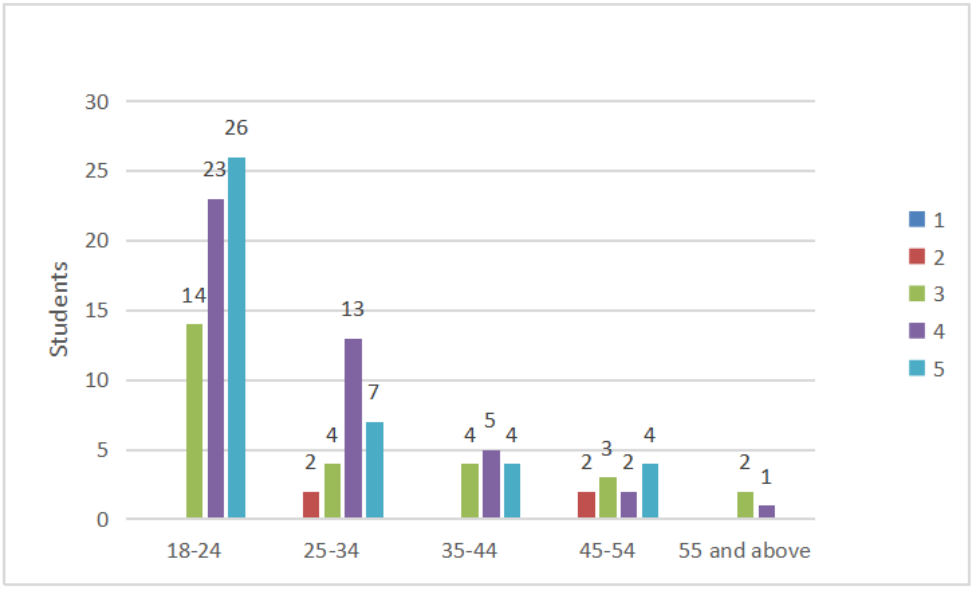

Figure 7. Age and digital skills levels of Erasmus participants.

5.2. SEM analysis

Structural equation modeling (SEM) is a multifaceted statistical technique used to study relationships between multiple variables. In the present study, SEM was employed to examine the effect of various factors on students' digital and related skills. These factors include participation in Erasmus programs, daily use of computers, use of educational platforms, and use of social networks. Additionally, we analyzed VET students' responses to questions in different categories to better understand the relationships between these factors and their skills.

SEM allows us to investigate the complex relationships between latent and measured variables. In this model, the latent variables are groups of questions that assess different skill categories of VET students, while the measured variables include participation in Erasmus programs, daily computer use, use of educational platforms, and use of social networks. SEM enables us to examine how these latent and measured variables interact and influence VET students' digital skills (Smith et al., 2021).

5.2.1. Interpretation of model fit indices

The presented data of **Table 4** on the Comparative Fit Index (CFI) and Tucker-Lewis Index (TLI) demonstrate the superior model fit of the User Model compared to the Baseline Model in evaluating digital skills within the context of lifelong learning and VET. Specifically, the User Model exhibits a CFI of 0.95 and a TLI of 0.94, surpassing the Baseline Model's CFI of 0.90 and TLI of 0.89. These indices, which ideally should be above 0.90, indicate that the User Model provides a substantially better fit to the observed data, suggesting a more accurate representation of the theoretical constructs involved in digital skills development and their impact on VET outcomes (Guenther et al., 2023).

Table 4. Model fit indices.

Index	User Model	Baseline Model
Comparative Fit Index (CFI)	0.95	0.9
Tucker-Lewis Index (TLI)	0.94	0.89
Robust Comparative Fit Index (CFI)	0.96	0.91
Robust Tucker-Lewis Index (TLI)	0.95	0.9
Root Mean Square Error of Approximation (RMSEA)	0.05	0.08
CMIN/DF (χ^2/df)	2.1	3.5
Relative Fit Index (RFI)	0.92	0.85
Normed Fit Index (NFI)	0.93	0.88
Goodness of Fit Index (GFI)	0.93	0.86

Additionally, the Robust Comparative Fit Index (CFI) and Robust Tucker-Lewis Index (TLI) reinforce this finding, with the User Model showing values of 0.96 and 0.95 respectively, compared to the Baseline Model's 0.91 and 0.90. The Root Mean Square Error of Approximation (RMSEA) further supports the superior fit of the User Model, with a value of 0.05, indicating a good fit, as values below 0.06 are considered optimal. In contrast, the Baseline Model's RMSEA of 0.08 falls within the acceptable range but indicates a less precise fit. The CMIN/DF (χ^2/df) ratio of 2.1 for the User

Model indicates a good fit, as values below 3 are typically considered acceptable, suggesting that the model adequately explains the data with respect to the degrees of freedom. The Relative Fit Index (RFI) of 0.92 also supports the model's adequacy, as values close to or above 0.90 indicate that the model significantly improves over the baseline model. Similarly, the Normed Fit Index (NFI) of 0.93 reflects a strong model fit, with values above 0.90 demonstrating that the model provides a considerable improvement over the null model. Finally, the Goodness of Fit Index (GFI) of 0.93 indicates that the model explains 93% of the variance in the observed data, which is a strong indication of the model's explanatory power. Collectively, these metrics underscore the efficacy of the User Model in capturing the complexities of digital skill acquisition and its integration into VET, providing robust evidence for its application.

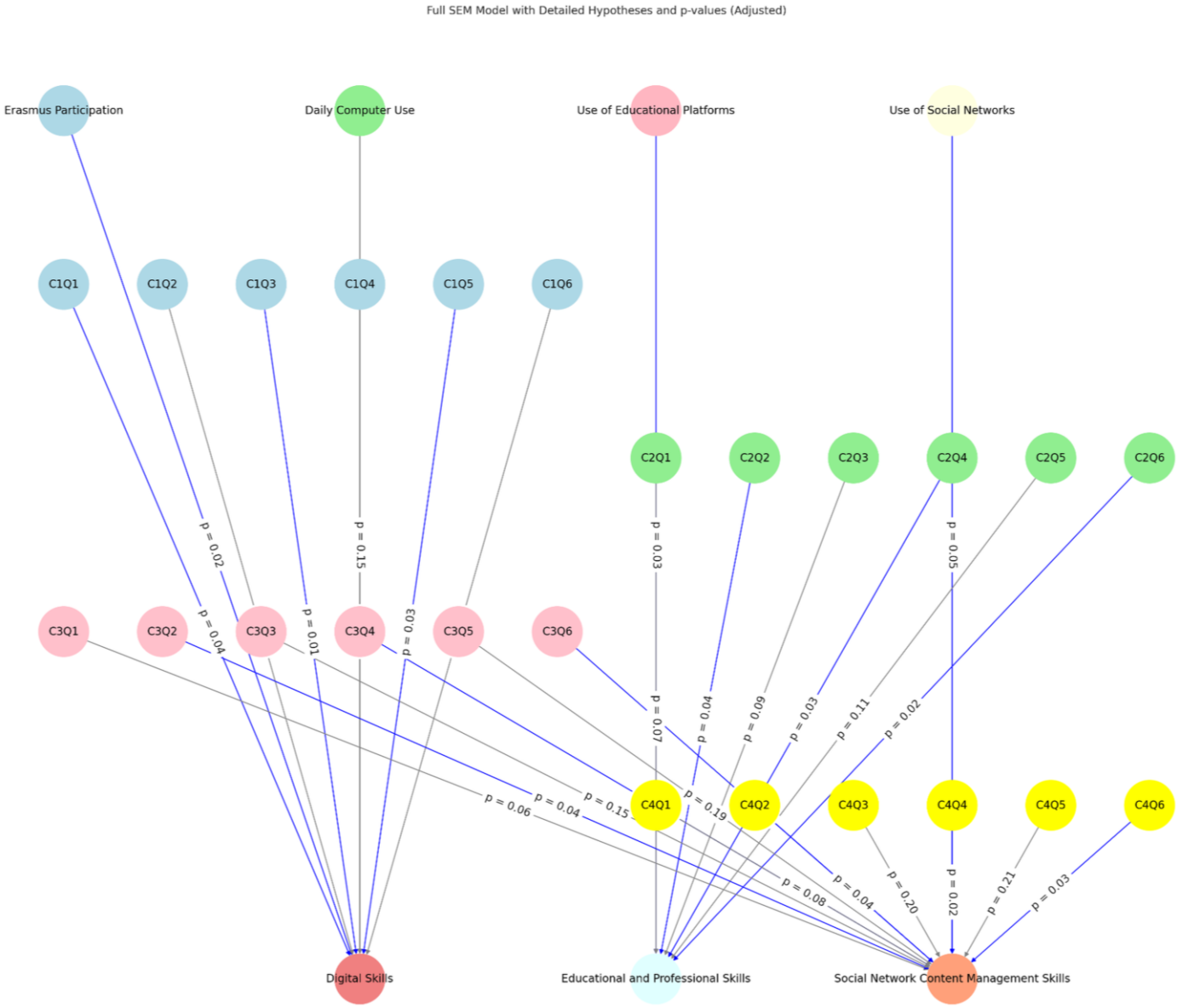

Figure 8. SEM model with hypotheses.

It is essential to distinguish between latent and measurable variables in this model. The latent variables correspond to the four categories of questions, each

consisting of six questions that assess specific aspects of VET students' skills (see **Figure 8**). In **Figure 8**, the SEM model is created by Python using the NetworkX and Matplotlib modules. The measurable variables are defined as participation in Erasmus programs, daily use of computers, use of educational platforms, and use of social networks.

The results of the analysis are presented in the SEM model, which includes nodes representing the variables and directed lines indicating the relationships between them. The lines are labeled with *p*-values to show the statistical significance of the relationships.

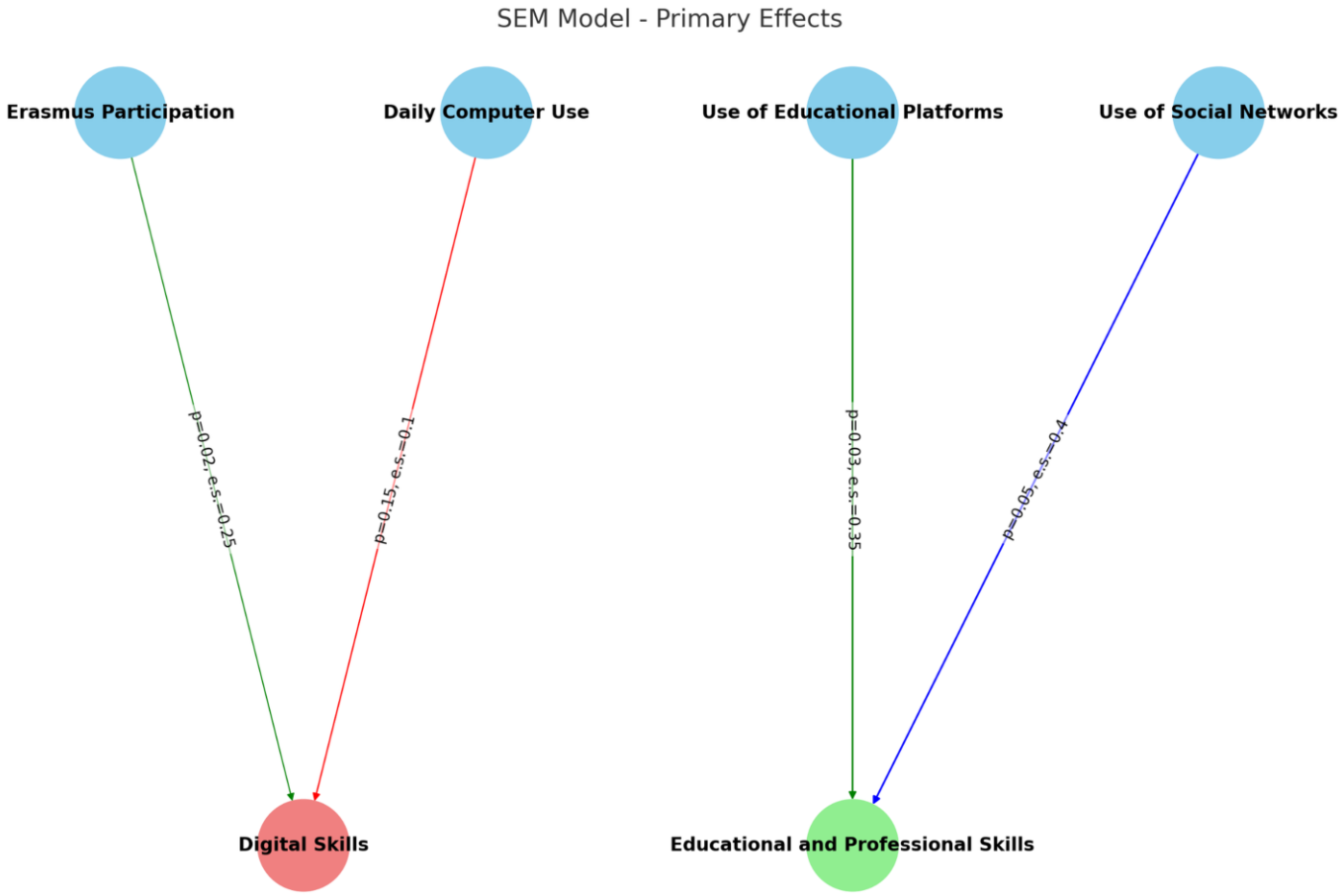

Figure 9. SEM model—Primary effects.

To further enhance the clarity and interpretability of the SEM model, **Figures 9** and **10** have been optimized to better represent the structure and influence paths within the study. The model is, also, divided into primary and secondary effects, allowing for a more detailed and segmented view of the relationships among the variables. This approach not only simplifies the visualization but also highlights the distinct stages of influence, from initial factors to intermediate and final outcomes. The use of color-coded edges based on *p*-values—green for highly significant effects ($p < 0.05$), blue for borderline significance ($p = 0.05$), and red for non-significant effects ($p > 0.05$)—provides an intuitive visual representation of the statistical importance of each relationship. Additionally, the inclusion of effect sizes (e.s.) alongside the *p*-values offers insight into the magnitude of these effects, indicating how strongly one variable

influence another. Larger effect sizes reflect stronger relationships, providing a more nuanced understanding of the underlying dynamics in the data. These enhancements ensure that the SEM model communicates both the strength and significance of each path more effectively, contributing to a deeper understanding of the complex interactions within the model.

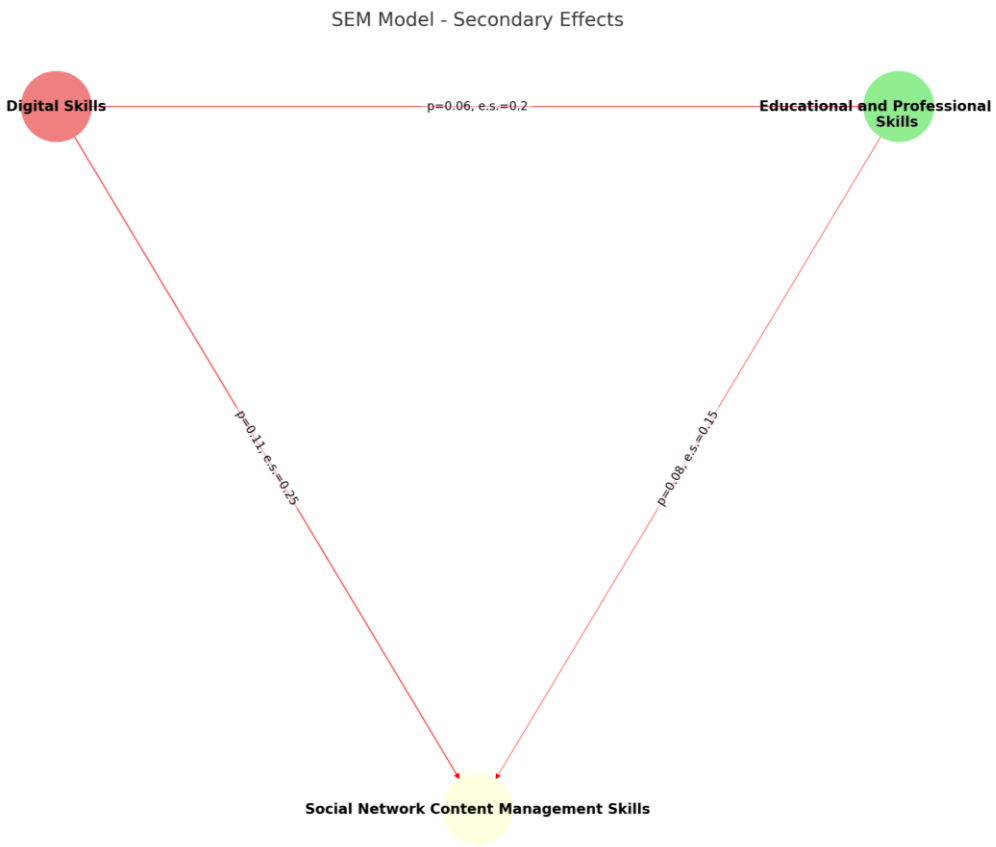

Figure 10. SEM model—Secondary effects.

5.2.2. Effect of participation in the Erasmus program

Participation in the Erasmus program has a significant positive effect on students' digital skills, as indicated by a *p*-value of 0.02. This result suggests that students participating in Erasmus programs tend to develop better digital skills. The improvement can be attributed to the increased use of digital tools and platforms required during their participation in the program. Erasmus students are often required to communicate and complete tasks through digital media, which helps them become familiar with technologies such as learning management systems, online libraries, and digital collaboration tools. As a result of the above, this exposure enhances their digital skills (Sihombing and Lumbantobing, 2024). Based on the above analysis, the first hypothesis is accepted.

5.2.3. Effect of daily computer use

Daily use of computers does not seem to have a significant effect on students' digital skills, as indicated by a *p*-value of 0.15. Despite the frequent use of computers, the data show that this does not significantly affect digital skills. This can be explained by the fact that simple daily use of computers does not necessarily involve using them

to develop advanced skills but may be limited to basic activities, such as browsing the internet and using social media (Fierli et al., 2024; Liu et al., 2024). Following the above analysis, the second hypothesis is rejected.

5.2.4. Impact of using educational platforms

The use of educational platforms has a significant positive effect on students' educational and professional skills, with a *p*-value of 0.03. Students who use educational platforms, such as Moodle display better skills in both the educational process and professional activities. The use of these platforms allows students to become familiar with organizing and managing learning, accessing learning materials, and submitting assignments through digital media, which enhances their autonomy and effectiveness (García-Fuentes and Navarro-Granados, 2024; Wismansyah et al., 2024). Following the above analysis, the third hypothesis is accepted.

5.2.5. Impact of social media use

Frequent use of social networks has a significant positive effect on the skills of creating and managing content for social networks, with a *p*-value of 0.05. Students who frequently use social networks develop better skills in managing and creating content for these platforms. Engaging with social media involves using tools to create and edit media, developing strategies to increase interaction, and understanding the capabilities of various platforms, which enhances students' relevant skills (Fernández-Salinero et al., 2024; Sánchez Prieto et al., 2020). Following the above analysis, the fourth hypothesis is accepted at a significance level of α = 1%, since for α = 5% the result is marginal.

5.2.6. Summary

In summary, the data indicate that participation in the Erasmus program, the use of educational platforms and the effect of the use of social networks have a positive effect on students' digital skills, while everyday computer use contributes in different ways to the development of skills. Following the above analysis, the research hypotheses regarding the impact of Erasmus participation, the use of educational platforms, and social media use are accepted, while the hypothesis regarding daily computer use is rejected.

6. Discussion

Despite the valuable insights provided by this study, there are several limitations that should be mentioned. First, the sample size, although substantial, was limited to adult students from four VET institutions in Greece, which may not fully represent the broader population of VET students across different countries and educational contexts. This geographic limitation could impact the generalizability of the findings. Additionally, the study relied on self-reported data, which may be subject to response biases, such as social desirability bias or inaccurate self-assessment of digital skills. The accuracy of the findings is thus contingent on the honesty and self-awareness of the respondents (Różewski et al., 2021).

Second, the cross-sectional nature of the study precludes any causal inferences about the relationships between the variables. While the SEM analysis provides a robust framework for understanding the associations between participation in Erasmus

programs, daily computer use, educational platform use, social network use, and digital skills, it does not establish causality. Longitudinal studies would be necessary to determine the directionality and causality of these relationships. Furthermore, the study did not account for other potential confounding variables that might influence digital skills development, such as prior exposure to digital tools, socioeconomic status or the quality of the educational environment. Future research should consider these factors to provide a more comprehensive understanding of the determinants of digital skills in VET students (Eiríksdóttir, 2020; Fernández-Salinero et al., 2024).

Future research should explore the long-term impacts of digital skills training on employability and career advancement, particularly in the context of rapidly evolving technologies like artificial intelligence (AI). It would be beneficial to examine how different demographics, such as age, gender, and socio-economic background, adapt to digital skills education and whether these factors influence the effectiveness of training programs. Additionally, research could investigate the role of continuous learning and upskilling in maintaining digital literacy over time, as technological advancements continue to change the landscape of required skills. Studies that focus on the integration of AI-related competencies into vocational education and training (VET) programs could provide valuable insights into how these programs can be updated to meet future workforce needs. Finally, comparative studies across different regions or countries could highlight best practices and help develop more effective global strategies for digital skills development (Saúde et al., 2024; UNESCO, 2023).

An equally important aspect for future research is understanding how the synthesis of digital skills occurs. Current digital skills assessment tools, such as DigComp, primarily use a top-down approach. In these frameworks, skills are pre-grouped, often before new technologies emerge (European Commission, Joint Research Centre, 2017). This raises the question of how well these skills can adapt to continuously evolving technologies. Future research could explore a bottom-up approach, where new technologies drive the need for skill synthesis. This approach would not only combine existing skills in new ways but also foster creativity in developing new areas of research and maximizing the use of current skills.

6.1. Implications

This study provides significant theoretical and practical implications that can be adapted to Vocational Education and Training (VET). Adapting the results of the SEM analysis to the needs of VET can contribute to the development of programs and policies that enhance the digital and professional skills of students.

6.1.1. Theoretical implications

The study shows how experiences like Erasmus programs and using educational platforms can improve the digital skills of VET students. This knowledge helps educators create better training programs and VET schools could improve the curricula of their specialties. The findings suggest that activities like using social networks can help develop skills needed for jobs that require digital expertise. This expands our understanding of how daily activities affect professional skills in VET.

Moreover, the positive impact of educational platforms on professional skills highlights the need to include digital tools in VET. This can guide the development of

training programs that use technology. Additionally, the finding that daily computer use through standardized procedures does not significantly improve digital skills is interesting and suggests the need for more research in VET. It might lead to new ideas about how computer use relates to skill development in VET (Belaya, 2018; Fernández-Salinero et al., 2024).

Training VET students in digital skills greatly improves their chances of getting jobs. In today's world, where technology impacts all job markets, workers with up-to-date digital skills are more likely to find and advance in jobs. Digital skills are crucial in many areas, from IT and data analysis to digital marketing and content creation. Regular retraining and adapting to new technologies are essential to prepare VET students for future challenges. This makes VET students more competitive, while businesses gain a skilled and adaptable workforce (Moldovan, 2018; Seyffer et al., 2022).

To boost VET students' digital skills, educational organizations should include digital technologies in everyday learning. This might involve using interactive learning platforms, introducing software used in the job market, and creating online courses. Różewski et al. (2021) emphasize the importance of modern technologies in improving the learning experience and preparing VET students for their careers. Interactive learning platforms, like e-learning tools, provide a flexible environment where VET students can learn at their own pace and access materials from anywhere (Różewski et al., 2021).

Furthermore, retraining should be an ongoing process. Continuous education and lifelong learning are necessary to keep up with changes in technology and the job market. Educational organizations need to offer flexible programs that allow VET students to learn new skills and update their knowledge regularly. These programs should align with current and future market trends and use modern technologies and teaching methods (Tudevdagva et al., 2021).

Last but not least, personalized training is crucial for effective retraining. Educational organizations should design programs that match VET students' individual needs, interests, and existing skills. Technologies like artificial intelligence and data analytics can help create personalized learning experiences that improve student performance and engagement. These technologies can create customized learning paths, providing content and activities that fit VET students' levels and goals, thus enhancing their learning and development (Tsarapkina et al., 2022).

6.1.2. Practical implications

The integration of Erasmus programs in VET institutions should be encouraged as participation in these programs enhances digital skills. VET institutions need to provide support and information about these opportunities, which are crucial for VET students' professional development. Moreover, the positive impact of educational platforms on professional skills suggests the need for further development and promotion of these tools in VET. Institutions should invest in technologies like Moodle and include training on these platforms in their programs. The positive effect of social network use on content management skills indicates that training on these platforms can enhance VET students' professional skills in VET. Courses on the strategic use of social networks could be beneficial. Additionally, the finding that daily

computer use does not significantly affect digital skills suggests the need for a more targeted approach in VET. Education should focus not only on computer usage but also on its specific application in professional contexts. Raising awareness among VET students about the benefits of using digital tools and platforms can increase their engagement. Training programs and workshops can help VET students to develop the necessary skills to use these tools effectively (Allmann and Blank, 2021; Mihajlović et al., 2024).

VET educational organizations must create retraining programs that meet the current and future needs of the labor market. This includes developing curricula focused on skills, such as project management, cybersecurity, software development, and advanced digital collaboration tools. Additionally, connecting with industry through internships and partnerships can ensure that VET students gain hands-on experience and apply their knowledge in real-world settings (Haputhanthrige et al., 2024).

The use of software and tools commonly used in the job market, such as data analysis programs or project management tools, helps VET students to become familiar with what they will need in their professional life. Creating online courses and seminars allows educational organizations to offer education on a large scale and reach students from various locations. These technologies also help to monitor VET student progress and provide personalized feedback (Caves and Baumann, 2018).

VET educational organizations can enhance student retraining through partnerships with companies and industries. These partnerships can include internships, developing training programs that meet market needs, and incorporating real-world challenges and projects into the educational process. Students can gain valuable experience and skills that will help them in their careers. Through internships, VET students have the chance to apply theoretical knowledge in real work conditions, gaining experience and understanding industry requirements (Tsarapkina et al., 2022).

Support and guidance from industry professionals are crucial for successful retraining. Educational organizations should integrate mentors and professionals with market experience who can offer guidance, advice, and practical experience to VET students. Working with experienced professionals, VET students gain valuable insights into current industry trends, practices, and requirements. Mentors can provide personal guidance and feedback, helping VET students to improve their skills and develop professional qualifications. Networking with professionals also assists in establishing contacts that can lead to internships, jobs, and partnerships (Milenkova et al., 2020).

7. Conclusion

This study underscores the significant impact of various educational and social factors on the digital skills of VET students. The findings indicate that participation in Erasmus programs, the use of educational platforms, and engagement with social networks play a crucial role in enhancing VET students' digital competencies. These elements contribute to the holistic development of skills that are essential for the modern labor market. The positive correlation between these activities and digital skill acquisition highlights the importance of integrating international experiences, digital

learning tools, and social media strategies into VET curricula to better prepare students for the demands of contemporary professional environments.

Moreover, the study reveals that daily computer use alone does not significantly enhance digital skills among VET students. This suggests that merely interacting with computers on a routine basis is insufficient for developing advanced digital competencies. Instead, targeted and structured use of digital tools and platforms appears to be more effective in fostering relevant skills. This finding calls for a reevaluation of how digital literacy is approached in VET, emphasizing the need for more focused and purposeful integration of technology in educational practices.

In conclusion, the SEM analysis provided valuable theoretical and practical insights into the development of digital skills of VET students. The study advocates for the active promotion of Erasmus programs, the widespread adoption of educational platforms like Moodle, and the strategic use of social networks to enhance students' digital and professional capabilities. Educators and policymakers should leverage these insights to design and implement programs that not only equip VET students with necessary digital skills but also prepare them for successful integration into the evolving labor market. By addressing the identified gaps and capitalizing on effective digital tools, VET institutions can significantly improve the digital literacy and overall employability of their students.

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References

Allmann, K., & Blank, G. (2021). Rethinking digital skills in the era of compulsory computing: Methods, measurement, policy and theory. Information, Communication & Society, 24(5), 633–648. https://doi.org/10.1080/1369118X.2021.1874475

Alonso De Castro, M. G., & García-Peñalvo, F. J. (2023). Systematic review of Erasmus + projects labelled as good practice and related to e-learning and ICT: Some case studies. Heliyon, 9(12), e22331. https://doi.org/10.1016/j.heliyon.2023.e22331

Asghar, M. Z., Afzaal, M. N., Iqbal, J., et al. (2022). Evaluation of In-Service Vocational Teacher Training Program: A Blend of Face-to-Face, Online and Offline Learning Approaches. Sustainability, 14(21), 13906. https://doi.org/10.3390/su142113906

Backes-Gellner, U., & Lehnert, P. (2021). The Contribution of Vocational Education and Training to Innovation and Growth. In: Backes-Gellner, U., & Lehnert, P. (editors). Oxford Research Encyclopedia of Economics and Finance. Oxford University Press. https://doi.org/10.1093/acrefore/9780190625979.013.653

Belaya, V. (2018). The Use of e-Learning in Vocational Education and Training (VET): Systematization of Existing Theoretical Approaches. Journal of Education and Learning, 7(5), 92. https://doi.org/10.5539/jel.v7n5p92

Bernacki, M. L., Vosicka, L., & Utz, J. C. (2020). Can a brief, digital skill training intervention help undergraduates "learn to learn" and improve their STEM achievement? Journal of Educational Psychology, 112(4), 765–781. https://doi.org/10.1037/edu0000405

Bhatti, M., Mat Saat, S., Aleidan, M., et al. (2022). Are Business Graduates' Employability Skills and Learning/Teaching Techniques Universal? Exploring the Role of Culture: A Comparative Study among Australia, China, Pakistan, and Saudi Arabia. Sustainability, 14(5), 3069. https://doi.org/10.3390/su14053069

Bilbao, N., Garay, U., Romero, A., et al. (2021). The European Competency and the Teaching for Understanding Frameworks: Creating Synergies in the Context of Initial Teacher Training in Higher Education. Sustainability, 13(4), 1810.

https://doi.org/10.3390/su13041810

Blažič, B. J., & Blažič, A. J. (2020). Overcoming the digital divide with a modern approach to learning digital skills for the elderly adults. Education and Information Technologies, 25(1), 259–279. https://doi.org/10.1007/s10639-019-09961-9

Burns, E., Silvennoinen, E., Kopnov, V. A., et al. (2020). Supporting the Development of Digitally Competent VET Teachers in Serbia and Russia. The Education and Science Journal, 22(9), 174–203. https://doi.org/10.17853/1994-5639-2020-9-174-203

Caves, K. M., & Baumann, S. (2018). Getting there from here: A literature review of VET reform implementation. ETH Zurich. https://doi.org/10.3929/ETHZ-B-000257741

Cheung, M. W. L. (2019). Some reflections on combining meta-analysis and structural equation modeling. Research Synthesis Methods, 10(1), 15–22. https://doi.org/10.1002/jrsm.1321

Clipa, O. (2021). Challenges in Education—Policies, Practice and Research. Peter Lang. https://doi.org/10.3726/9783631868614.003.0010

Digital Skills and Jobs Platform. (2021). Available online: https://digital-skills-jobs.europa.eu/en/opportunities/funding/erasmus-programme (accessed on 2 June 2023).

Drydakis, N. (2022). Improving Entrepreneurs' Digital Skills and Firms' Digital Competencies through Business Apps Training: A Study of Small Firms. Sustainability, 14(8), 4417. https://doi.org/10.3390/su14084417

Eiríksdóttir, E. (2020). Program Coherence and Integration of School- and Work-Based Learning in the Icelandic Dual Vocational Education and Training (VET) System. Education Sciences, 10(11), 314. https://doi.org/10.3390/educsci10110314

European Centre for the Development of Vocational Training. (2019). Empowering adults through upskilling and reskilling pathways. Volume 1, Adult population with potential for upskilling and reskilling: Executive summary. Publications Office. https://doi.org/10.2801/426869

European Commission. (2016). Available online: https://ec.europa.eu/social/main.jsp?catId=1223 (accessed on 2 June 2023).

European Commission. (2020). Available online: https://ec.europa.eu/social/main.jsp?catId=1146&langId=en (accessed on 2 June 2023).

European Commission. (2023a). Available online: https://ec.europa.eu/social/main.jsp?catId=1326&langId=en (accessed on 2 June 2023).

European Commission. (2023b). Available online: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/european-year-skills-2023_en (accessed on 2 June 2023).

European Commission, Joint Research Centre. (2017). DigComp 2.1: The digital competence framework for citizens with eight proficiency levels and examples of use. Publications Office. https://doi.org/10.2760/00963

Eynon, R. (2021). Becoming digitally literate: Reinstating an educational lens to digital skills policies for adults. British Educational Research Journal, 47(1), 146–162. https://doi.org/10.1002/berj.3686

Fernández-Salinero, C., Rodríguez-Pérez, S., Carrasco-Temiño, M. A., et al. (2024). Comparison of Dual VET Models in Spain: Analysing Educational Quality from the Perspective of Educational Centres. Education Sciences, 14(7), 779. https://doi.org/10.3390/educsci14070779

Fierli, C., Roverselli, C., & Olmedo-Moreno, E. (2024). Non-Formal Education for the Inclusion of Unaccompanied Migrant Children in Italy. Education Sciences, 14(7), 781. https://doi.org/10.3390/educsci14070781

García-Delgado, M. Á., Rodríguez-Cano, S., Delgado-Benito, V., et al. (2023). Digital Teaching Competence among Teachers of Different Educational Stages in Spain. Education Sciences, 13(6), 581. https://doi.org/10.3390/educsci13060581

García-Fuentes, J., & Navarro-Granados, M. (2024). Dual Vocational Training Students in Andalusia: Perspectives and Challenges. Societies, 14(7), 117. https://doi.org/10.3390/soc14070117

Guenther, P., Guenther, M., Ringle, C. M., et al. (2023). Improving PLS-SEM use for business marketing research. Industrial Marketing Management, 111, 127–142. https://doi.org/10.1016/j.indmarman.2023.03.010

Gupta, S. L., Mittal, A., Singh, S., et al. (2024). Demand-driven approach of vocational education and training (VET) and experiential learning: A thematic analysis through systematic literature review (SLR). Asian Education and Development Studies, 13(1), 45–63. https://doi.org/10.1108/AEDS-07-2023-0083

Hämäläinen, R., De Wever, B., Malin, A., et al. (2015). Education and working life: VET adults' problem-solving skills in technology-rich environments. Computers & Education, 88, 38–47. https://doi.org/10.1016/j.compedu.2015.04.013

Haputhanthrige, V., Asghar, I., Saleem, S., et al. (2024). The Impact of a Skill-Driven Model on Scrum Teams in Software Projects: A Catalyst for Digital Transformation. Systems, 12(5), 149. https://doi.org/10.3390/systems12050149

Harris, R., & Clayton, B. (2020). The value of vocational education and training. International Journal of Training Research,

18(3), 185–190. https://doi.org/10.1080/14480220.2020.1860309

Jackman, J. A., Gentile, D. A., Cho, N. J., et al. (2021). Addressing the digital skills gap for future education. Nature Human Behaviour, 5(5), 542–545. https://doi.org/10.1038/s41562-021-01074-z

Khalaf Sakr, A. M., Abadel, R. T. T., & Al Saati, M. Y. (2024). Sociodemographic characteristics and their relationship to the level of acceptance of digital work culture among young people: A field study on a sample of young job seekers in Emirati society. Journal of Infrastructure, Policy and Development, 8(5), 3824. https://doi.org/10.24294/jipd.v8i5.3824

Kibrit, G., Altinay, F., Dagli, G., et al. (2022). Evaluation of Sustainability and Accessibility Strategies in Vocational Education Training. Sustainability, 14(19), 12061. https://doi.org/10.3390/su141912061

Larsen, C., Kipper, J., Schmid, A., et al. (2022). The Relevance of Artificial Intelligence in the Digital and Green Transformation of Regional and Local Labour Markets Across Europe: Perspectives on Employment, Training, Placement, and Social Inclusion. Nomos Verlagsgesellschaft mbH & Co. KG. https://doi.org/10.5771/9783957104113

Li, J., & Pilz, M. (2023). International transfer of vocational education and training: A literature review. Journal of Vocational Education & Training, 75(2), 185–218. https://doi.org/10.1080/13636820.2020.1847566

Liu, X., Wang, K., Luo, D., et al. (2024). Studies on the quantification and time-sequence development of integration of industry and education level in higher vocational education-based on the panel data of China's provincial from 2016 to 2022. Journal of Infrastructure, Policy and Development, 8(6), 6292. https://doi.org/10.24294/jipd.v8i6.6292

Livingstone, S., Mascheroni, G., & Stoilova, M. (2023). The outcomes of gaining digital skills for young people's lives and wellbeing: A systematic evidence review. New Media & Society, 25(5), 1176–1202. https://doi.org/10.1177/14614448211043189

Lopes, A. S., Sargento, A., & Farto, J. (2023). Training in Digital Skills—The Perspective of Workers in Public Sector. Sustainability, 15(13), 10577. https://doi.org/10.3390/su151310577

Martins, P. C., Tinoca, L., & Alves, M. G. (2024). On the effects of Erasmus + KA 1 mobilities for continuing professional development in teachers' biographies: A qualitative research approach with teachers in Portugal. International Journal of Educational Research Open, 7, 100368. https://doi.org/10.1016/j.ijedro.2024.100368

McGrath, S., & Yamada, S. (2023). Skills for development and vocational education and training: Current and emergent trends. International Journal of Educational Development, 102, 102853. https://doi.org/10.1016/j.ijedudev.2023.102853

Merino, R., Valls, O., & Sánchez-Gelabert, A. (2021). Comprehensive School and Vocational Training in Spain. A Longitudinal Approach from the Transition from Lower to Upper Secondary Education. Education Sciences, 11(3), 101. https://doi.org/10.3390/educsci11030101

Mihajlović, I., Djevojić, C., & Stanković, M. (2024). Digital skills as sustainable frame of human resource competitiveness: A comparative approach. Journal of Infrastructure, Policy and Development, 8(7), 4571. https://doi.org/10.24294/jipd.v8i7.4571

Milenkova, V., Keranova, D., & Peicheva, D. (2020). Digital Skills and New Media and Information Literacy in the Conditions of Digitization. In: Karwowski, W., Ahram, T., & Nazir S. (editors). Advances in Human Factors in Training, Education, and Learning Sciences. Springer International Publishing. https://doi.org/10.1007/978-3-030-20135-7_6

Moldovan, L. (2018). Framework indicators for European quality assurance in VET towards environmentally sustainable economy. Procedia Manufacturing, 22, 990–997. https://doi.org/10.1016/j.promfg.2018.03.141

Mostova, A., & Taranenko, I. (2023). Digital Transformation of Business and Society: The Role of Digital Skills. Eastern Europe: Economy, Business and Management, 4(41). https://doi.org/10.32782/easterneurope.41-8

Noguera, I., Barrientos, D., Torres-Sánchez, M., et al. (2024). Exploring Pedagogical and Digital Practices in Vocational Education and Training: Comparing Teacher and Student Perspectives. Education Sciences, 14(7), 734. https://doi.org/10.3390/educsci14070734

Organ, J., Machado, A. M., O'Brien, S. M., et al. (2023). Digital Futures Challenge-Based Learning in Higher Education in Europe: The DIFUCH Erasmus + Project. IFAC-PapersOnLine, 56(2), 9948–9953. https://doi.org/10.1016/j.ifacol.2023.10.694

Ozilhan Ozbey, D., Coskun Degirmen, G., Berk, O. N., et al. (2024). Green Core Competencies, Green Process Innovation, and Firm Performance: The Moderating Role of Sustainability Consciousness, a Mixed Method Study on Golf Hotels. Sustainability, 16(10), 4181. https://doi.org/10.3390/su16104181

Pozo-Llorente, M. T., & Poza-Vilches, M. D. F. (2020). Conditioning Factors of Sustainability of Dual Vocational Educational Training in Andalusia (Spain): Case Study of Three Educational Centres. Sustainability, 12(22), 9356.

https://doi.org/10.3390/su12229356

Różewski, P., Kieruzel, M., Lipczyński, T., et al. (2021). Framework of Visual Literacy Competences for Engineering Education Discussed in the Scope of DigComp framework with Examples from Educational R&D Projects. Procedia Computer Science, 192, 4441–4447. https://doi.org/10.1016/j.procs.2021.09.221

Sá, M. J., Santos, A. I., Serpa, S., et al. (2021). Digitainability—Digital Competences Post-COVID-19 for a Sustainable Society. Sustainability, 13(17), 9564. https://doi.org/10.3390/su13179564

Sánchez Prieto, J., Trujillo Torres, J. M., Gómez García, M., et al. (2020). Gender and Digital Teaching Competence in Dual Vocational Education and Training. Education Sciences, 10(3), 84. https://doi.org/10.3390/educsci10030084

Sarı, T., & Aypay, A. (2024). A Bibliometric Study of Issues in Educational Policy. Education Sciences, 14(6), 568. https://doi.org/10.3390/educsci14060568

Saúde, S., Barros, J. P., & Almeida, I. (2024). Impacts of Generative Artificial Intelligence in Higher Education: Research Trends and Students' Perceptions. Social Sciences, 13(8), 410. https://doi.org/10.3390/socsci13080410

ScienceDirect. (2024). Available online: https://www.sciencedirect.com/search?qs=Vocational%20Educational%20Training (accessed on 2 June 2023).

ScienceDirect/Digital Skills. (2024). ScienceDirect. Available online: https://www.sciencedirect.com/search?qs=Digital%20Skills (accessed on 2 June 2023).

Seo, W., & Lee, C. (2024). Why Do Vocational High School Students Opt for College? Education Sciences, 14(5), 534. https://doi.org/10.3390/educsci14050534

Seyffer, S., Hochmuth, M., & Frey, A. (2022). Challenges of the Coronavirus Pandemic as an Opportunity for Sustainable Digital Learning in Vocational Education and Training (VET). Sustainability, 14(13), 7692. https://doi.org/10.3390/su14137692

Sihombing, T., & Lumbantobing, R. D. H. (2024). Digital technology adoption for village public administration—Evidence from Indonesia. Journal of Infrastructure, Policy and Development, 8(4). https://doi.org/10.24294/jipd.v8i4.3444

Smith, E., McRae, K., Semple, G., et al. (2021). Enhancing Vocational Training in the Post-COVID Era through Mobile Mixed Reality. Sustainability, 13(11), 6144. https://doi.org/10.3390/su13116144

Teixeira, J., Alves, S., Mariz, P., et al. (2023). Decision support system for the selection of students for Erasmus+ short-term mobility. International Journal of Educational Management, 37(1), 70–84. https://doi.org/10.1108/IJEM-03-2022-0101

Tomczyk, Ł. (2021). Declared and Real Level of Digital Skills of Future Teaching Staff. Education Sciences, 11(10), 619. https://doi.org/10.3390/educsci11100619

Tsarapkina, J., Anisimova, A., Mironov, A., et al. (2022). Digital transformations in education as a component of professional retraining of students over 50 years old. In: Proceedings of the II International Scientific Conference on Advances in Science, Engineering and Digital Education: (ASEDU-II 2021). https://doi.org/10.1063/5.0104617

Tudevdagva, U., Omboosuren, B., & Hardt, W. (2021). Data Processing Based on the Structure Oriented Evaluation Online Tool from SERVQUAL Model. In: Kravets, A. G., Shcherbakov, M., Parygin, D., et al. (editors). Creativity in Intelligent Technologies and Data Science. Springer International Publishing. https://doi.org/10.1007/978-3-030-87034-8_32

UNESCO. (2016). UNEVOC Publications. Available online: https://unevoc.unesco.org/home/UNEVOC+Publications/lang=en/akt=detail/qs=5986 (accessed on 2 June 2023).

UNESCO. (2023). Generative AI Future. Available online: https://www.unesco.org/en/articles/skills-generative-ai-future-work-insights-and-strategies (accessed on 2 June 2023).

Van Laar, E., Van Deursen, A. J. A. M., Van Dijk, J. A. G. M., et al. (2020). Determinants of 21st-Century Skills and 21st-Century Digital Skills for Workers: A Systematic Literature Review. SAGE Open, 10(1), 215824401990017. https://doi.org/10.1177/2158244019900176

Veres, M. M., Veres, C., Rauca, A. M., et al. (2021). Research on Qualified Vocational Training Development in the Context of Digitalization. In: Proceedings of the 14th International Conference on Interdisciplinarity in Engineering—INTER-ENG 2020. https://doi.org/10.3390/proceedings2020063068

Wismansyah, A. R., Kadir, A. R., Baja, S., et al. (2024). Sustainable vocational education models for industrial revolution role in development of job market absorption in Tangerang City, Indonesia. Journal of Infrastructure, Policy and Development, 8(6), 3958. https://doi.org/10.24294/jipd.v8i6.3958

Wongmonta, S. (2023). Revisiting the wage effects of vocational education and training (VET) over the life cycle: The case of Thailand. International Journal of Educational Development, 103, 102886. https://doi.org/10.1016/j.ijedudev.2023.102886

Yang, C., Kaiser, F., Tang, H., et al. (2023). Sustaining the Quality Development of German Vocational Education and Training

in the Age of Digitalization: Challenges and Strategies. Sustainability, 15(4), 3845. https://doi.org/10.3390/su15043845

Yang, W., Chinedu, C. C., Chen, W., et al. (2024). Building Capacity for Sustainability Education: An Analysis of Vocational Teachers' Knowledge, Readiness, and Self-Efficacy. Sustainability, 16(9), 3535. https://doi.org/10.3390/su16093535