

Article

Digitalization of Higher Education: Students' Perspectives

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Abstract

This study examines the use of digitalized educational solutions among students in higher education institutions (HEIs). Drawing upon theories of technology, digitalization, and education, we analyze the suitability of different digitalization solutions for students in HEIs. Educational organizations that apply different digitalized technologies provide customizable platforms for authoring and disseminating multimedia-rich e-education and smart education. However, pedagogical practices indicate several gaps between the level of HEI digitalization achieved and its suitability for HEI participants. Thus, we analyze the state of various digitalized technologies in HEIs and their suitability for meeting students' expectations. The results of our research show that students most highly rate modern educational methods such as practical learning supported by access to digitized materials via websites, social networks, and smartphones while assigning a lower rating to the use of classic education, supported by digital textbooks and traditional technologies such as Skype, Zoom, podcasts, and online videos. This study has several theoretical implications, among which is the need to further develop highly digitized materials and purpose-designed digitized solutions for individual areas and specific educational purposes. The practical implications indicate the need to expand the use of website networks, smartphones, and smart table solutions in modern educational practices in HEIs.

Keywords: digitalization; education; educational technologies; higher education institutions; students



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1. Introduction

This study examines differences in the use of advanced information technologies and their digital solutions among students at higher education institutions (HEIs). Education is leading and supporting the functioning of society (Ruth et al., 2006; Chaika, 2024) and decisively forming knowledge, skills, competencies, and values of social sustainable development (Goetze, 2019; Raja & Nagasubramani, 2018). In addition, the UN in the Declaration on Sustainable Development Goals (SDGs) (UNESCO, 2012; UN, 2015; UNESCO-IITE et al., 2022) states that education needs to be aimed at “quality education on sustainable development” and provide “accessibility and opportunities for participation in education for all people” (UNESCO, 2012; UN, 2015).

In the last few decades, with the aim of achieving these SDGs, HEIs and other educational institutions have increasingly embraced the digitalization of teaching and learning (USDE, 2015; Managi et al., 2021; OECD, 2021).

Digitalization emerged amidst the development of the Fourth Industrial Revolution (Secundo et al., 2020; Plekhanov et al., 2023), being described in the literature as a “break-

through technological advancement in the 21st century characterized by digitalization, automation, robotization, and the use of artificial intelligence" (Secundo et al., 2020; Dang & Vartiainen, 2022). The public understands digitalization differently, based on the more technical meaning of converting analog information into a digital form (Raja & Nagasubramani, 2018; Mertala, 2020) to the generally accepted broader understanding of adopting digital tools to create new or modify existing products, services, and operations (Selwyn, 2011; Lai & Bower, 2019).

Digitalization enables educational institutions to significantly improve the acquisition of the knowledge and skills of education participants, necessary for their life and work in a highly technologically developed society (Managi et al., 2021; Timotheou et al., 2022). The literature defines educational digitalization as the use of computer services, media, informatization, and communication technology in education-related processes (Selwyn, 2011; Dang & Vartiainen, 2022). Research in this field mainly follows two mainstream concepts: e-education and smart education (Selwyn, 2011; Zhu et al., 2016). E-education is a set of advanced cognitive science principles concerning effective multimedia learning using electronic educational technology (Ruth et al., 2006; EC, 2024). Smart education focuses on developing critical thinking, problem-solving skills, and analytical skills in education, supported by the development and use of digitalized technologies (Selwyn, 2011). To support this, HEIs can use numerous solutions, such as educational videos, learning games (e.g., Kahoot, Quizlet), software (e.g., Prezi, SMART Notebook), and platforms (e.g., Examsoft, Blippar, and Padlet) (OECD, 2021; Timotheou et al., 2022). Both concepts integrate advanced digitalized technologies and educational solutions to achieve specific substantive educational goals (Singh & Thurman, 2019; Rogers, 2020).

Despite its great popularity and prevalence, the rapid development of educational digitalization also reveals gaps between the possibilities of digitalization and their suitability for educational participants (Singh & Thurman, 2019; Dang & Vartiainen, 2022). For example, it has been less thoroughly explained how advanced technologies and their solutions support different forms, fields, and levels of education (Sweller et al., 2019; Secundo et al., 2020). Several scholars (Mayer & Moreno, 2003; Fernández et al., 2023) have thus called for digitized solutions that will more comprehensively support the spectrum of different educational methods (El-Sabagh, 2021; Chaika, 2024) and will be more adapted to the needs and expectations of different education users (El-Sabagh, 2021; Wohlfart & Wagner, 2023). We sought to build upon these studies by analyzing how digital technologies support students' teaching and learning experiences in HEIs.

To give our study analytical traction, we analyze issues related to three areas of the digitalization of HEIs.

Our first goal is to analyze the importance of various digitalized teaching methods for students in HEIs. Based on this analysis, we aim to evaluate and assess the possibilities and advantages of using various digitalized teaching methods for education in HEIs (Lai & Bower, 2019; Lacka & Wong, 2021).

The second goal is to analyze the importance of selected individual digitalized solutions for students in HEIs. Our research complements previous studies on the importance of differently digitalized individual solutions, educational materials, and sources to support students in HEIs (Johnson et al., 2016; Wohlfart & Wagner, 2023).

Third, we shape and analyze the use of selected, differently digitalized individual solutions among students in HEIs (Zhang et al., 2020; Wohlfart & Wagner, 2023). By considering the actual use of different forms of digitalization in HEIs, we expand upon the previous studies conducted in this area (Barrett et al., 2015; Rogers, 2020) with a systematic analysis of digitalized solutions in HEIs. In this study, we thus present proposals for implementing more user-oriented digitalization education support in HEIs.

In the following sections of this manuscript, we first provide theoretical foundations for addressing the digitalization of education in HEIs and the use of digital solutions among students. Within this framework, we present the development of digitalization, educational digitalization, and selected digital solutions for educational support. We proceed by presenting and analyzing the opinions of the sampled students regarding the importance and actual use of available digital solutions in HEIs. We then present solutions focused on creating more user-friendly digital solutions, with suggestions about how HEIs can implement diverse digitalization support for users with different needs and expectations. We conclude this study with a discussion of the research results, a presentation of possible applications of the research results, and an indication of potential directions for further studies.

2. Materials and Methods

2.1. Theoretical Framework and Hypotheses

2.1.1. Digitalization of HEIs

Several definitions of digitalization are presented in the literature, which all relate to the information transformation of society (Barrett et al., 2015; Demir, 2021). Information transformation is especially important for developing, acquiring, and transferring knowledge in educational institutions (Frolova et al., 2020; Demir, 2021). In doing so, educational institutions use different educational theoretical foundations, e.g., behaviorism, cognitivism, and constructivism (Roblin et al., 2018; Galanouli et al., 2024), and domains, e.g., computer-based training, online learning, and mobile learning (Sweller et al., 2019; Galanouli et al., 2024), for teaching and learning in different fields, disciplines, forms, levels, and types of education. For further insight into educational characteristics, refer to the International Standard Classification of Education (ISCED) (UNESCO, 2012; OECD, 2023).

The literature mainly highlights the benefits for educational institutions of using various digital tools, such as cyber-physical systems (CPSs), cloud computing, cognitive computing, and artificial intelligence (Moore et al., 2011; Rice & Ortiz, 2021). These solutions enable educational organizations to enhance their flexibility and agility in providing education and better satisfy the needs and demands of their participants/users (Rogers, 2020; Chen, 2024). The latest advancements in technologies provide customizable, inexpensive platforms for authoring and disseminating multimedia-rich education that are considered in the literature as digitalized education (Singh & Thurman, 2019; Managi et al., 2021). The idea was then further developed into more comprehensive digitalization concepts of education, such as e-learning and smart education (Lai & Bower, 2019; Chaika, 2024), which differently support digitalization of education (Rogers, 2020; Chaika, 2024).

The concept of e-learning originates from the technological development of solutions to support online education, training, and knowledge sharing conducted over the internet (Timotheou et al., 2022; Chaika, 2024). The intention is to design and use advanced educational technologies and their digitalized solutions (Moreno & Mayer, 2007; Agerwal et al., 2025) to reduce educational participants' cognitive and intrinsic loads (Hsu, 2008; Plekhanov et al., 2023; Chen, 2024). E-learning development has continued with research into various aspects of learning in an advanced digital environment (Moore et al., 2011; Fernández et al., 2023). Often mentioned are distance and virtual learning and the development of new learning pathways supported by advanced tools and platforms such as learning management systems (LMSs), application programming interfaces (APIs), and Massive Open Online, with the intention of leading and supporting traditional and newer methods of education (Fernández et al., 2023; Wohlfart & Wagner, 2023). On the contrary, the latest studies in this field focus more on the use of AI-driven adaptive learning and gamified education platforms, which change the actual content and method of learning

(Dang & Vartiainen, 2022; Wohlfart & Wagner, 2023). Despite applying advanced technologies and supporting various pedagogical theories (Dawley & Dede, 2014; Lawrence & Tar, 2018), e-learning mainly provides basic information that supports the needs of the educational process (Dawley & Dede, 2014; Demir, 2021).

The introduction of newer educational methods initiated the development of smart education, with the aim of developing educational solutions to cultivate critical thinking, problem solving, and analytical skills in education (Bajaj & Sharma, 2018; Chen, 2024) and promote the development and use of digitized technologies and artificial intelligence (Selwyn, 2011; Bajaj & Sharma, 2018). The fundamental advantages of this concept are the consideration of students' educational behaviors, the support of personalized learning, the creation of innovative and stimulating educational environments, and the provision of targeted learning support for different participants (Fernández et al., 2023; Galanouli et al., 2024). Digitalization is, therefore, suitable in educational institutions that apply the latest pedagogical approaches and methods (Dawley & Dede, 2014; Plekhanov et al., 2023) and operate in innovative and development-oriented environments (Roblin et al., 2018; OECD, 2021).

The implementation of e-education or smart education is supported by different types of computer hardware and software and various teaching practices, which scholars define collectively as educational technology, abbreviated as EduTech or Edtech (Singh & Thurman, 2019; Mertala, 2020). Among these factors, studies often mention the application of information and communication technologies (ICTs), such as Edtech, learning technology, multimedia learning, etc., in various areas of education. For further research on diverse educational technologies, see Moore et al. (2011) and Tanner and Alvi (2019). Equally, individual educational technologies can also include combinations of different technological solutions. Among them, the literature exposes physical technologies—like videos, computers, mobile devices, the Internet of Things (Fernández et al., 2023; Wang et al., 2024)—and combinations of technologies—e.g., blogs, collaborative software, virtual classes (Zhang et al., 2020; Chen, 2024)—each of which significantly supports digitalized education at different levels of digitalized education (Frolova et al., 2020; OECD, 2021).

Media headlines focus on the broad possibilities and benefits of technological development and continue to reinforce public opinion about the needs for further digitalization of education (Zhuang et al., 2023; EC, 2024; Wang et al., 2024). However, such an approach remains primarily focused on technological breakthroughs (Demir, 2021; Wohlfart & Wagner, 2023) and insufficiently considers the several social issues associated with the introduction of new technologies in education (Singh & Thurman, 2019; Sweller et al., 2019).

For example, distance learning represents a general technological solution that can be used for teaching and learning in most educational institutions, assuming that the infrastructure, equipment, and knowledge necessary for its use are provided (Johnson et al., 2016; Chen, 2024). In addition, its use is suitable for various contexts, including the teaching of general and specialized knowledge and skills and for individual groups of learners (Moreno & Mayer, 2007; Timotheou et al., 2022). In addition, several recent studies indicated the need for a broader explanation of the relationship between advanced technologies and individual fields/levels of education (Roblin et al., 2018; Plekhanov et al., 2023). Researchers have thus reported differing results on the use of audio and video solutions among participants in preschool and higher education institutions, finding that we can achieve the same pedagogical goals by using differently digitized learning materials (Zhu et al., 2016; Timotheou et al., 2022) and that most educational institutions apply combinations of advanced technologies in their work (Sweller et al., 2019; Fernández et al., 2023). Moreover, previous studies also do not comprehensively address social differences in the use of digitalization in environments with different social and cultural characteristics (UNESCO-IITE et al., 2022; Zhuang et al., 2023).

This situation raises questions regarding integrating new educational methods into digitalized education (Ruth et al., 2006; Tanner & Alvi, 2019) and developing more broad and holistic education practices in the future (Hsu, 2008; Wohlfart & Wagner, 2023). In addition, the gap between the achieved level of digitalization of education and the digitalized needs of its participants raises the question of how to balance the fundamental objectives of education.

In search of answers to the above-mentioned open questions, we aimed to analyze the state of digitalization in HEIs.

2.1.2. The State of Education Digitalization in HEIs

Studies so far indicate that the adequacy of education digitalization depends on its support for educational needs, as determined by the educational approaches and methodologies used (Demir, 2021; Chen, 2024). Meanwhile, scholars report that individual educational organizations use the same educational technologies to support different educational methods (Johnson et al., 2016; Singh & Thurman, 2019) or different technologies to support the same educational methods (Mertala, 2020; Rogers, 2020). In the literature, the prevailing studies analyze the suitability of digitalized education and its solutions in traditional and modern educational environments (Bajaj & Sharma, 2018; Dang & Vartiainen, 2022).

In this context, scholars consider traditional education to be an approach based on continuing to pass on those skills, facts, and standards of moral and social conduct that educational institutions consider necessary for future advancement (Beck, 1956; Timotheou et al., 2022). In HEIs, it is mainly implemented in the form of a progressive education characterized largely by student-centered instructions; the acquisition of valuable knowledge and skills; integrated, interdisciplinary subjects and theme-based units; analysis, evaluation, and innovation; and a focus on the social development of students (for further details, see Johnson et al. (2016), Rice and Ortiz (2021), and Wohlfart and Wagner (2023)).

Several studies report that traditional education can be supported by textbooks and lectures in various digitalized forms as well as digitalized solutions such as the internet, library, and outside expert systems when dealing with selected topics (Sweller et al., 2019; Timotheou et al., 2022). Equally, individual digital technologies can support the achievement of the various specific goals of such educational processes (Singh & Thurman, 2019; Demir, 2021). Video systems can thus expand the scope of cooperation between teachers, learners, and other educational participants from different environments through video conferences and virtual classrooms (Mertala, 2020; Rice & Ortiz, 2021). In addition, online engagement tools and teaching response systems support the delivery of more personalized and supportive education for individuals (Dawley & Dede, 2014; Roblin et al., 2018). Digitized solutions are also significantly changing teaching courses via the use of quizzes; interactive whiteboards; a virtual environment for project implementation; and access to educational films, course-based games, and interactive learning tools (El-Sabagh, 2021; Wohlfart & Wagner, 2023). In the educational literature, such digitalized support is often associated with Education 4.0, which describes the desired learning approach that aligns with the emerging Fourth Industrial Revolution (Zhang et al., 2020).

Modern education is focused on the comprehensive and sustainable development of academic disciplines while, at the same time, being fostered by the active use of the latest advanced technology, thus facilitating high-quality education for learners and creating a more engaging and interesting learning process (Fernández et al., 2023; Dawley & Dede, 2014). Modern education is characterized by the implementation of new methods and approaches originated in various pedagogical paradigms, following evolving societal needs, and considering emerging educational practices (USDE, 2015; OECD, 2021). The literature indicates the usage of e-learning, blended learning, gamification, adaptive learning, micro-

learning, and networked learning support (Rogers, 2020; Demir, 2021) and newly emerging digitalized tools that support the achievement of specific educational goals (Wohlfart & Wagner, 2023; Chen, 2024).

Within this framework, basic educational processes can be supported using a variety of tools (Lawrence & Tar, 2018; El-Sabagh, 2021): online platforms such as School Education Gateway, ETwinning, and EPALE; cloud storage, e.g., Dropbox, One Drive, and Gdrive; document generation tools, such as Microsoft Office; delayed communication tools, such as email and mobile social networks; and live interactions supported by a combination of video meeting tools, such as Zoom, Skype, MS teams, and collaborative cloud tools, such as Miro, Padlet, and others. Educational institutions can invoke existing knowledge provided in openly accessible knowledge repositories, such as LinkedIn Learning, Google Classroom, Coursera, YouTube, and GitHub, mainly focusing on text-supported video materials (Tanner & Alvi, 2019; Zhang et al., 2020; Wohlfart & Wagner, 2023). The next-generation AI-supported tools and services, combining the use of computers and IoT Devices (including mobile) with augmented and virtual environments, will enhance the experience of undertaking projects (Timotheou et al., 2022; Agerwal et al., 2025). These are accompanied by tools designed for real-time language translation; text generation; audio; 360-degree video generation; virtual meetings; collaborative virtual spaces; and intelligent, ethically correct analyses of participation-related behavior patterns (Zhu et al., 2016; Rice & Ortiz, 2021), with existing environments such as Uptale.io, Viverse, and Insta360 currently being used for those purposes (Tanner & Alvi, 2019; Wohlfart & Wagner, 2023). Such digitalized support is often associated with the concept of Education 5.0 (and beyond that, Education 6.0), which the literature describes as an innovative approach to education that integrates advanced technology and the latest learning methodologies to create a student-centered learning environment (El-Sabagh, 2021; Agerwal et al., 2025).

Slovenia began a comprehensive digitization of its education system after 1990 by developing strategic documents in this area, such as the Project Informatization of Education, Strategic Guidelines for the Introduction of ICT, and the Action Plan for Digital Education in Slovenia (Zhuang et al., 2023; EC, 2024).

These policies provided the necessary substantive and methodological framework regarding a general educational context; public digital education infrastructure; the access, use, and governance of digital technology and data in education; and support for innovation and research and development (R&D) in digital education (Beck, 1956; Wang et al., 2024). Numerous projects have also been successfully implemented, such as the program for computer literacy in education, the e-bag program, and the B-Rin project (OECD, 2023). Currently, the curriculum reform process for general subjects in HEIs is underway, and one of its goals is the horizontal introduction of digital competencies for students (OECD, 2023; EC, 2024).

The use of solutions for the digitization of education led to the development of new educational methods to deliver effective education by appropriately leveraging the affordances of digital technologies (Zhuang et al., 2023; OECD, 2023). The set of pedagogical methods for use in advanced digital technology environments and the study of how to teach using digital technologies are often referred to in the literature as digital pedagogy (UNESCO-IITE et al., 2022; Wang et al., 2024). To support digital pedagogy, various projects have been implemented in Slovenia, such as the Digital and Sustainable Teacher—which includes half of Slovenia's teachers and aims to improve their digital competencies and knowledge of computer science—and the Innovative Pedagogy 5.0 project—which aims to develop innovative learning scenarios for the development of students' basic competences and skills in computing and informatics (Zhuang et al., 2023; CEDEFOP, 2024). Thus, the OECD (OECD, 2021) report indicates that Slovenia has designed and adapted a combination

of traditional and advanced pedagogical methods in accordance with its developmental, educational, and cultural characteristics and the expectations of education participants.

Based on studies on the importance of various pedagogical methods for current students in HEIs (Zhuang et al., 2023; OECD, 2021; EC, 2024), the use of available educational methods in solutions in Slovenian HEIs (OECD, 2023; CEDEFOP, 2024), and taking into account specific social and cultural characteristics of education in Slovenia (Nedelko et al., 2022; UNESCO-IITE et al., 2022), we propose the following research question:

RQ1: Which teaching methods do students at considered HEIs rate the most effective?

The OECD (OECD, 2023) and CEDEFOP (CEDEFOP, 2024) have also reported on the good practices and challenges encountered in digitalized educational solutions in Slovenian HEIs, such as the Digital and Sustainable Teacher, Innovative Pedagogy 5.0, and Informatics for All projects. Among these challenges are questions related to tools aimed at improving students' digital competencies and skills, knowledge of artificial intelligence, data mining, and physical–cyberspace interactions as well as the development of digital environments and platforms for digitized study (UNESCO-IITE et al., 2022; Zhuang et al., 2023). Several recent studies have thus reported on the differences in digitalized educational solution use among HEIs due to variations in their achieved level of comprehensive educational digitization (Mertala, 2020; Fernández et al., 2023). Based on previous research into the varying state of digitalized educational solution usage in HEIs (Moreno & Mayer, 2007; Lacka & Wong, 2021) and the results of reports on their status specifically in Slovenian HEIs (UNESCO-IITE et al., 2022; OECD, 2023), our research focuses on addressing the current state of digitalized educational solution use in selected HEIs. We, therefore, propose our second research question:

RQ2: What is the current state of use of diverse digitalized educational solutions in considered HEIs?

While the application of digitalized educational solutions in HEIs represents their institutional state of use, the actual use of individual digitalized solutions among students depends on several factors (UNESCO-IITE et al., 2022; OECD, 2023). Among them, researchers mention societal, situational, and institutional factors that shape the content and technical environment for using digitalized solutions by students at HEIs (Frolova et al., 2020; OECD, 2021; Timotheou et al., 2022). Recent studies in this field emphasize the importance of the characteristics, needs, and expectations of current students as key factors in the use of individual digital educational solutions (Plekhanov et al., 2023; Wang et al., 2024). For example, studies report that students more often use solutions on personal phones and social networks and use solutions on other platforms less often (Hsu, 2008; Chen, 2024). In addition, current students more often use educational solutions that enable AI-driven adaptive learning and/or are based on gamified education platforms, as these more effectively support their personal needs and expectations regarding the conditions and implementation of education (Zhuang et al., 2023; Chen, 2024).

Addressing the research on how often students use different digitalized education solutions in their study (Zhuang et al., 2023; Agerwal et al., 2025) and reports on the frequency of digitalized solution use among students in Slovenian HEIs (OECD, 2023; EC, 2024), we propose the final research question:

RQ3: Which digitalized educational solutions do students most often use in their study process?

2.2. Methods

To collect data, we used a questionnaire developed as part of a research program “Innovative company in transition”, which took place on sampled faculty from Slovenia.

The participating students attended courses in informatics, digitalization, and management and were familiar with the basic concepts and content of the survey.

The questionnaire in the original research includes the following sections: (1) application use, perception of digital technologies, and behavior in the online environment; (2) attitudes regarding the use of teaching methods in the pedagogical processes of higher education organizations; (3) attitudes regarding the use of technologies in the pedagogical processes of higher education organizations; and (4) attitudes regarding the use of artificial intelligence in the pedagogical processes of higher education organizations. The questions were designed based on theoretical knowledge, empirical studies in this field, insights into the digitalization of higher education, and our experiences working in higher education organizations.

2.2.1. Sample and Procedure

For our research, we used a non-random sample, as we included students to whom we had access during the implementation of the pedagogical process in the selected (sampled) HEIs. To prevent ethical concerns from being raised, we followed the ethical standards and recommendations contained in the revised Declaration of Helsinki. This study was also approved by the Ethics committee of sampled Faculty, approval number 2024/5.

The survey was conducted in the sampled Faculty in the 2024/2025 academic year. The sample for this study consisted of 189 students' answers obtained in sampled faculty from the University of Maribor (Slovenia).

The average age of the participants was 20.07 years. The study participants were 28.9 percent males and 71.1 percent females. Overall, 85 percent of the participants were undergraduate students, while 15 percent were master's students.

2.2.2. Measures

In line with this study's aims, we included the following questions from the survey sections 1, 2, and 3. First: "How effective are the following teaching methods?" From this question, respondents rated the effectiveness of 13 teaching methods on a five-point interval scale, with responses rating the teaching method from (1) not at all effective to (5) very effective. Second, the respondents assessed the importance of using the selected 13 teaching methods, including 12 teaching methods based on information technologies and traditional teaching methods, namely, traditional textbooks. This assessment was performed using a five-point interval scale, rating the teaching method from (1) not at all important to (5) very important. Third, the respondents also assessed the extent to which the selected 13 teaching methods, as in the previous question, are used in the pedagogical process. They used a five-point scale, rating the teaching method from (1) never used to (5) used very often. For this study, we also used selected demographic data, such as the gender and age of the participants and their current level of study.

2.2.3. Research Design and Analysis

The calculations were performed using the IBM SPSS 29 platform. We used typical elements of descriptive statistics, namely, the independent sample *t*-test and the paired-samples *t*-test. We outlined the mean values and standard deviation for the aggregated sample of students regarding the effectiveness of teaching methods. We also calculate the differences between males and females regarding their perceived effectiveness of teaching methods. To calculate the differences between the preferred and actual usage of teaching methods in the pedagogical process in HEIs, we used a paired-samples *t*-test. In both analyses, we used Cohen's *d* to analyze the effect size. In the first analysis, men were the control group, and in the second, actual usage of teaching methods.

As we had unequal sample sizes regarding males ($N = 55$) and females ($N = 135$), we applied a correction to allow for the different sample sizes. The results are summarized in Tables 1 and 2.

Table 1. Effectiveness of teaching methods.

Teaching Method	Aggregate Sample		Males		Females		Corrected t-Statistics ^a	p-Values	Corrected p-Value	Effect Size (Cohen's d)
	M	SD	M	SD	M	SD				
1. Learning through solving practical problems	4.31	0.73	3.90	0.87	4.47	0.60	5.12	<0.001	0.013	−0.82
2. Learning by doing (e.g., practical teaching)	4.26	0.85	3.99	1.07	4.36	0.72	2.77	0.024	0.312	−0.44
3. Learning through insight into tests	4.13	0.85	4.07	0.83	4.15	0.86	0.59	0.538	1	−0.10
4. Class discussion	4.04	0.93	3.77	1.14	4.14	0.82	2.50	0.038	1	−0.39
5. Visual learning (learning visual material)	3.76	0.87	3.58	0.89	3.83	0.87	1.79	0.092	1	−0.28
6. Learning by working in small groups	3.69	1.00	3.62	0.99	3.71	1.02	0.56	0.585	1	−0.09
7. Learning through play	3.67	1.09	3.15	1.21	3.86	0.98	4.23	<0.001	0.013	−0.68
8. Study guides	3.59	0.91	3.34	0.85	3.70	0.92	2.50	0.015	0.195	−0.40
9. Learning through listening (e.g., podcasts, online lectures)	3.56	1.08	3.30	1.14	3.67	1.05	2.15	0.034	1	−0.35
10. Learning through notes available online	3.50	1.04	3.46	1.00	3.53	1.05	0.42	0.668	1	−0.07
11. Learning from a textbook	3.44	0.95	3.12	0.98	3.58	0.91	3.09	0.003	0.039	−0.50
12. Learning through homework	3.33	1.10	3.23	1.20	3.36	1.05	0.74	0.442	1	−0.13
13. Learning from a digital textbook	3.18	0.99	3.00	0.98	3.26	0.99	1.65	0.103	1	−0.27

Notes: $N = 189$; ^a when a correction is applied for different sample sizes, the critical value for t-statistics is 1.973. We can reject the null hypothesis if the corrected value is above this reference value.

Table 2. Preferred and actual usage of teaching methods in the pedagogical process in HEIs.

Teaching Method	Preferred Usage		Actual Usage		Paired Differences		t-Test ^b	p-Value	Corrected p-Value	Effect Size (Cohen's d)
	M	SD	M	SD	M	SD				
1. Websites containing teaching materials	3.97	0.84	3.28	1.22	0.69	1.36	6.86	<0.001	0.013	0.51
2. Smartphone	3.83	0.99	3.31	1.14	0.52	1.15	6.13	<0.001	0.013	0.45
3. Smartboard	3.72	1.07	3.06	1.44	0.66	1.38	6.64	<0.001	0.013	0.48
4. Printed textbooks ^a	3.69	1.02	3.91	1.03	−0.22	1.35	−2.22	0.028	0.364	−0.16
5. Digital textbooks	3.61	1.01	3.40	1.10	0.21	1.35	2.12	0.036	0.468	0.16
6. MS Teams platform	3.59	1.03	3.20	1.11	0.38	1.25	4.21	<0.001	0.013	0.31
7. Google Classroom	3.44	1.19	2.60	1.40	0.84	1.43	8.07	<0.001	0.013	0.59
8. Online video (YouTube, etc.)	3.14	1.05	2.19	1.09	0.95	1.34	9.74	<0.001	0.013	0.71
9. Learning systems based on games	3.14	1.08	2.07	1.01	1.07	1.23	11.84	<0.001	0.013	0.87
10. Social networks	3.13	1.09	2.38	1.30	0.75	1.32	7.74	<0.001	0.013	0.57
11. Zoom platform	2.99	1.18	1.77	1.08	1.22	1.40	11.98	<0.001	0.013	0.87
12. Podcast	2.74	1.19	1.52	0.95	1.21	1.32	12.49	<0.001	0.013	0.92
13. Skype	1.95	1.09	1.43	0.96	0.52	1.00	7.20	<0.001	0.013	0.52

^a the classical teaching method; ^b paired t-test results.

The data were normally distributed, which allowed for us to use parametric statistics.

Since we tested several hypotheses on the same dataset, the problem of multiple hypothesis testing arose. We corrected the results of the hypothesis testing by employing the commonly used Bonferroni correction, which is the most stringent test among several available and offers the most conservative approach to controlling false positives (Type I error) (Yoav & Hochberg, 1995). In our case, we encountered the issue of differences between men and women in terms of their attitudes towards learning tools, even though there are no differences (analysis given in Table 1), and that there are differences between the desired and actual use of learning tools, even though there are no differences (analysis given in Table 2). Bonferroni correction was used as a conservative approach to adjust the significance threshold, thereby reducing the probability of a Type I error and ensuring the credibility and robustness of our results.

We applied the Bonferroni correction for the first and second sets of analyses. We multiplied each p -value by 13 (the number of tests performed in our analyses). The comparison of the corrected p -value to a value of 0.05, which was set as the significance level for determining whether the null hypothesis was rejected (corrected p -value = p -value * number of tests < 0.05), reveals possible differences after relying on the corrected p -value (Yoav & Hochberg, 1995). We report the corrected p -value in Tables 1 and 2.

To obtain a comprehensive insight into the relatively important use of information technologies in the pedagogical process, we must also consider the traditional and still-dominant methods of teaching and transferring knowledge. Therefore, in addition to demonstrating the importance of information technologies and their actual use in the pedagogical process, we also incorporated one classical method, namely, the use of textbooks, which was included in the questionnaire.

3. Results

Table 1 and Figure 1 present students' attitude regarding the effectiveness of teaching methods, showing the results for the aggregated sample.

Students consider solving practical problems, learning by doing, learning through insights into tests, and class discussion the most effective teaching methods. Comparing the effectiveness of teaching methods, women consider all methods to be more effective than men do. Women consider three teaching methods significantly more effective than their male counterparts. The largest and most significant differences were identified for learning by solving practical problems, followed by learning by playing and learning from a textbook.

Looking at the effect sizes, which reveal how the substantially different males and females perceive the effectiveness of teaching methods, gender has the largest effect (Cohen's $d > 0.8$) on perceiving the effectiveness of learning through solving practical problems. A medium effect size of gender (<0.5 Cohen's $d < 0.8$) is for learning through play and learning from textbooks, while a small effect size of gender (<0.2 Cohen's $d < 0.5$) is for learning by doing, study guides, class discussion, learning through listening, visual learning, and learning from digital textbooks. For all remaining teaching methods, there is no effect of gender on the perception of teaching methods.

Table 2 and Figure 2 present the perceived importance of different teaching methods and their actual use in the pedagogical process at a higher education institution.

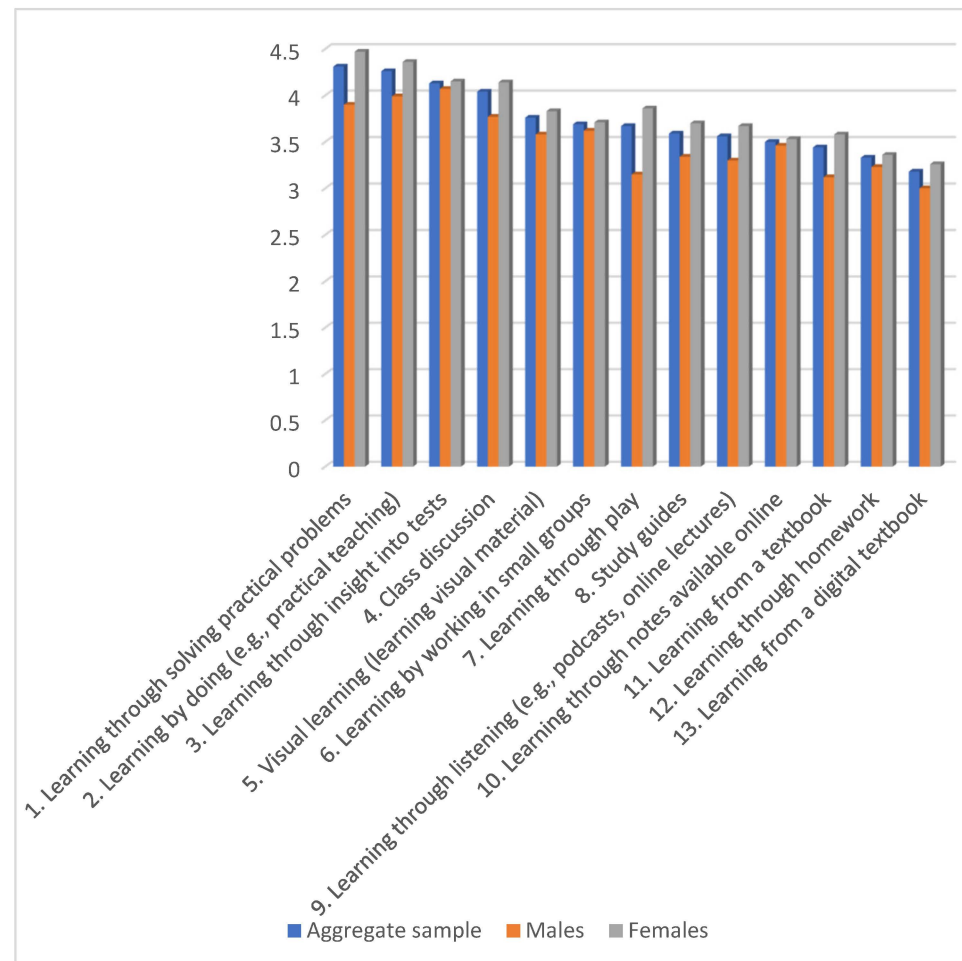


Figure 1. Effectiveness of teaching methods.

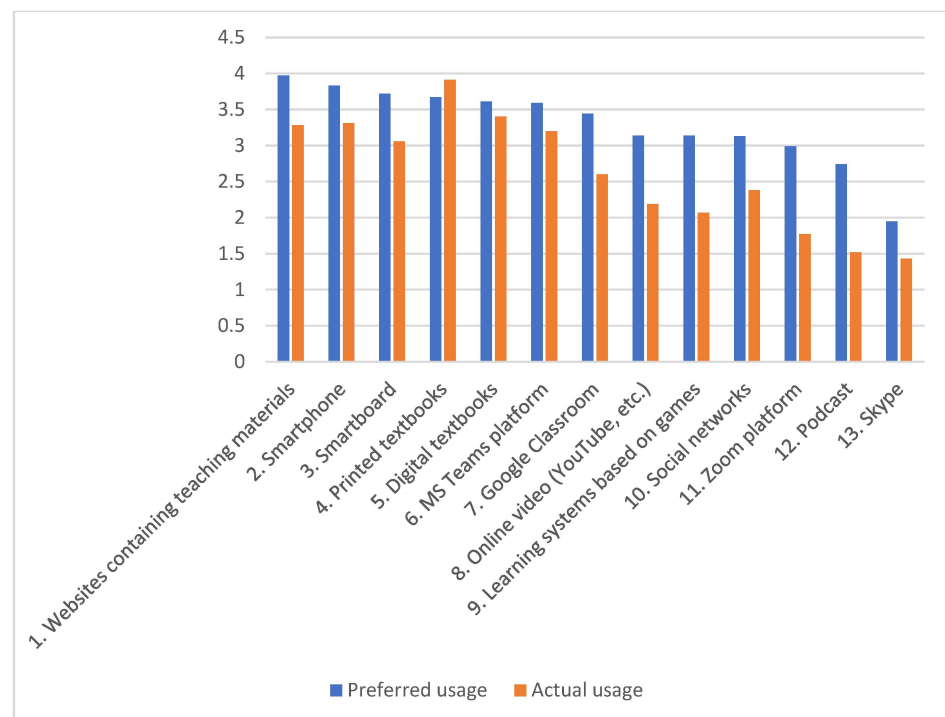


Figure 2. Preferred and actual usage of teaching methods in the pedagogical process in HEIs.

Regarding teaching methods in HEIs, printed textbooks lead by a wide margin, with digital textbooks, smartphones, and websites with learning materials following behind. Regarding preferred use, websites containing learning materials, smartphones, and smartboards are the top choices.

Looking at the effect sizes, which reveal how the actual use of teaching methods affects the perception of preferred use of teaching methods, the actual use has the largest effect (Cohen's $d > 0.8$) on perceiving the effectiveness preferences about the use of podcasts, Zoom platforms, and learning systems based on games. A medium effect size of actual use (<0.5 Cohen's $d < 0.8$) is for online video, Google classroom, social networks, Skype, and websites containing teaching materials, while a small effect size of actual use (<0.2 Cohen's $d < 0.5$) is for smartboard, smartphone, and the MS Team platform.

4. Discussion

This study's main purpose is to show which digitalized educational methods HEI students consider most effective while highlighting the gap between students' actual use of digital tools in HEIs and their preferences for using modern education methods based on digital technology.

Students perceive the most effective teaching methods to be solving practical cases and learning by doing. This can be attributed to the negative perception of young people regarding the absorption of theory and its usefulness because they put more emphasis on the practical utility of knowledge (Hsu, 2008; Wang et al., 2024). We can argue that the sampled students emphasize practical learning over purely theoretical approaches. In addition, this reflects the status of the sampled students, who want to focus primarily on applied skills, significantly reducing the student workload (Plekhanov et al., 2023), as well as their desire to choose "what and how to study" (Chen, 2024). Furthermore, digital textbooks are in second place, while the desire to use digital textbooks is lower, behind websites containing teaching materials, smartphones, and smart boards. This shows that today's young adults focus mainly on digital sources of knowledge, which can be attributed to the digital environment that current students have inhabited since birth (Singh & Thurman, 2019; Lacka & Wong, 2021).

Looking through the prism of gender, women consider all teaching methods to be more effective than men do, while women consider three methods to be significantly more effective than their male counterparts. The biggest differences in the assessments of effectiveness are found for learning through solving practical problems, learning through play, and learning from a textbook. Several potential factors influencing the differences in perception can be identified, like different levels of learning engagement, with women being more engaged in learning, which may lead to higher ratings of the effectiveness of teaching methods. Furthermore, the differences may be due to different learning preferences, with women, for example, considering some teaching methods to contribute more to their education than males. Finally, the differences may be due to gender differences, which are observed in different gender studies across disciplines (Johnston & Salaz, 2019; Wang et al., 2024).

The comparison of actual and preferred usage of teaching methods reveals a consistent pattern, where students want to use a variety of digital and modern teaching methods to a greater extent than they actually do in the educational process. Their strong inclination toward using digital teaching methods can be mainly due to the following reasons: (1) current students are "digital natives", who are familiar with the use of digital technology and are accustomed to it from everyday life; (2) the interactivity of the content, as various digital technologies can present demanding and complex concepts easier than we can do with traditional textbooks; (3) accessibility, as digital resources are always and everywhere available, which allows for students to access learning content 24/7 anywhere so that

they can adapt to their obligations; and (4) the practicality of the content, as many digital teaching methods support active participation and practical and experimental learning. For more information about the above-mentioned reasons, refer to [Lai and Bower \(2019\)](#), [Fernández et al. \(2023\)](#), and [Wang et al. \(2024\)](#).

According to the teaching methods considered, students see websites containing teaching materials as the most desirable educational method based on information technology in a higher education institution's pedagogical process, followed by smartphones and smartboards. This can be primarily attributed to the high use of digital technologies, social networks, and smartphones by young adults in their daily lives ([Chillakuri & Mahanandia, 2018](#); [Nedelko et al., 2022](#)). It is, thus, not surprising that members of this generation also see information technology as crucial in the study process.

If we consider only the importance of using digital technologies in the pedagogical process, we see that it is approaching what the students want, since the integration of smartphones and relevant websites into the pedagogical process is at the fore. The exception is, of course, digital textbooks, which are the most widely used but are not highly appreciated by students. Smartphones have high levels of actual use, which can be attributed to the fact that students widely use smartphones during active work within the pedagogical process, for example, solving interactive tasks, submitting their assignments, and searching for information to solve tasks. Regarding the importance of using information technologies in the pedagogical process, podcasts and Skype are at the tail end. Indeed, Skype can be considered an obsolete technology for young adults, as its usage is mainly limited to older users from previous generations.

Classic textbooks are still the most widely used due to their ease of use, comprehensive coverage of topics, accessibility, better focus, and general acceptance in HEIs ([Johnston & Salaz, 2019](#)). They are followed by digital textbooks, which follow the "logic of using classic textbooks" but in digital form. This indicates that most materials have been digitized, and the next steps regarding implementing information technology have not yet significantly changed the "traditional way of educational material". This is evident in teaching practices in HEIs, as traditional materials have largely been converted into digital formats and are available to students through various learning support platforms provided, e.g., Moodle, MS Teams, etc.

Although classic textbooks are still largely present and important in the education process at HEIs, it is clear that, among all the teaching methods mentioned, students want to use traditional textbooks to a lesser extent. This can be attributed to the obsolescence of the content compared to digital content, where the content is current; the unattractiveness of the content and the lack of interactive content to which students are accustomed from their daily lives; easier access to digital content via smart devices than accessing traditional printed textbooks; lower costs, since there is no need to purchase or borrow textbooks; and the environmental aspect, since it involves less paper consumption and less burden on the environment.

A misalignment between the education methods used in HEIs and those preferred by students can have various negative consequences for implementing the pedagogical process and learning outcomes. When students do not want certain teaching methods, their engagement in work and active participation in the pedagogical process may decrease. For example, merely focusing on textbooks and extensive material leads to a lack of interest in studying. The motivation to study can also decrease, as shown in reduced attendance in the pedagogical process, leading to lower levels of achievement in individual learning units. This argument mainly originates from the fact that teaching methods affect student motivation ([Tanner & Alvi, 2019](#)) and that the classical direct instruction model is still at the forefront of HEIs, while teaching methods that enable research, participation, and

experiential learning are still underused (Johnston & Salaz, 2019). Inadequate teaching methods—in our case, the insufficient use of digital education methods—can significantly increase and expose ineffective learning experiences and slow down competency development, manifesting in lower academic success; this outcome depends largely on the teaching methods employed (Lacka & Wong, 2021; Agerwal et al., 2025).

Finally, it is common for members of Generation Z to change their minds if they are not satisfied with the current conditions, such as changing jobs if they are not happy with the work environment (Nedelko et al., 2022; Fischer & Luiz, 2024). The close link between dissatisfaction with the current situation and the speed of their action may also be a trigger for a drop-out, in the case of high dissatisfaction with the teaching methods used that do not align with their preferences.

5. Conclusions

In summary, methods that would significantly change the primary way in which the pedagogical process is executed have yet to come to the foreground of the educational landscape. This represents an important challenge facing HEIs in the coming years. In addition, the digitalization of HEIs and the use of digital teaching methods can make a significant contribution to achieving the goals of SDG-17. Importantly, in this context, digitalized education will improve the quality of education for marginalized groups and those in distant or remote areas, enabling global access to education. HEIs can use digital platforms to integrate relevant SDG-17 content, thus indirectly contributing to and preparing students to achieve SDG-17 goals when they enter the work environment, as in the case of using digital platforms to discover the importance of SDGs (Zhuang et al., 2023).

Education has traditionally been based on classic textbooks and classic frontal teaching methods (Tanner & Alvi, 2019; EC, 2024). However, new trends are emerging due to the development of modern information technology in recent years and, above all, the evolution of the “digital generation”, members of which have internalized information technology, with their lives significantly dependent on it. For the first time, we are seeing typical HEIs facing an important turning point, such that the selection of teaching methods will have to be adjusted to include more use of digital tools to suit younger populations while simultaneously maintaining sufficient academic rigor (Goetze, 2019).

5.1. Theoretical Implications

This fundamental research reveals the gap between the desired and actual use of digital teaching methods and associated solutions in the context of the educational process of HEIs. These findings contribute significantly to the existing literature on the use of digital teaching methods (Lawrence & Tar, 2018) and the digitalization of HEIs (Fernández et al., 2023), as they offer insights into their state of use in HEIs and their importance for students’ education.

This study, therefore, attempts to comprehensively present the current state of use of the most used traditional and modern teaching methods in HEIs. It offers new insights into further implementing digitalized teaching methods in HEIs based on their individual merits. It calls for immediate action, as there is a significant mismatch between the prevalent teaching methods practiced in HEIs and those that students wish to engage with. This difference is becoming more pronounced due to the growing involvement of younger generations in information technologies (Frolova et al., 2020; Agerwal et al., 2025), which are an important part of their everyday lives, and HEIs cannot keep pace with these adaptations.

5.2. Implications for Practice

The most notable implications for practice in this research are the following. An important signal for HEIs is that students' rate the use of websites containing teaching materials and smartphones as very important. HEIs will have to incorporate more and various teaching methods based on modern information technology, which plays an important role in the lives of students who have information technology written in their DNA (Chillakuri & Mahanandia, 2018; Nedelko et al., 2022). To increase student motivation, it will, thus, be necessary to offer more of this kind of learning content and to incorporate students' mobile phones and other digital technologies into the study process (Hsu, 2008; Chen, 2024).

A key step for HEIs in the future will be the development of studies focused on solving practical cases and learning through practice, supported by appropriate technology for participants, e.g., websites, learning materials, smartphones, and smart boards. When HEIs consider the needs of students, it becomes necessary to focus on more practical educational methods while ensuring that theory will still be included to a sufficient extent, as it would be dangerous for HEIs to focus too much on practical cases and knowledge. By focusing only on examples, however, a significant part of the theory is lost, since there are not enough practical examples that could be included to sufficiently and comprehensively cover the entire theory of a field, i.e., an individual study subject. It is, therefore, important that HEIs move beyond the debate between theory and practice (Goetze, 2019; Agerwal et al., 2025), designing the curriculum in such a way that universities will still be a place for theoretical as well as practical research, which is becoming more and more important, especially from the perspective of young people.

The importance of using textbooks and digital textbooks indicates that studying comprehensive and systematic displays of knowledge is no longer predominant among students' interest (Seemiller & Grace, 2018). This presents a significant challenge for teachers in HEIs, who will have to adapt their material to be more interactive, e.g., designing shorter units with material that is accessible online.

Among the teaching methods practiced in HEIs, printed textbooks are by far the most used, while in terms of student uptake, they are only in fourth place, behind the most popular digitalized educational methods, such as websites containing teaching materials, smartphones, and smart boards. This indicates a significant lag in HEIs regarding the adaptation of the teaching process and the integration of digitized teaching methods; in the future, HEIs thus need to focus much more on accelerating the adoption of digitalized teaching methods in the education process. At the same time, it will also be necessary to find ways to significantly reduce the use of printed textbooks, replacing them with digital resources, such as digital textbooks, and with websites that contain teaching materials. These actions will enable HEIs to be more responsive to student preferences while contributing to social responsibility objectives using e-resources.

The findings of this study indicate the need to reconsider classic materials, such as textbooks and digital textbooks, that currently support learning and knowledge transfer as well as adding new or more digitalized teaching methods. In doing so, HEIs must assess the situation to understand and consider the students' specific digital preferences, learning styles, and learning needs (Seemiller & Grace, 2018).

HEIs must also consider a wider range of digitalized teaching methods and associated education solutions, which will address the different needs of students and ensure diversity in studies, which can significantly increase the motivation of their students. Thus, using methods that students prefer and are currently underutilized, such as podcasts, Zoom, and games, can reduce the gap and increase engagement of students. Using interactive teaching methods will contribute significantly to student performance (Chen, 2024). Based on current students' general desire to be involved in decision-making (Bajaj & Sharma,

2018), it is necessary to involve students in the academic decision-making processes regarding the adoption of digitalized teaching methods. In addition, the specificity of student populations as well as reductions in the duration and amount of collective and individual work (Chen, 2024; Agerwal et al., 2025) call for the materials supporting the teaching process to be adapted to increase diversification, which will satisfy members of Generation Z in accordance with their ever-new impulses; it is necessary to provide shorter modules that are easier to absorb.

In parallel with introducing digitalized teaching methods, HEIs must develop teachers' digital knowledge, competencies, and skills, enabling them to use advanced digital teaching methods and solutions. HEIs must also allocate sufficient funds to purchase and ensure the functioning of the digital education equipment that will be used.

Comparing actual and preferred usage reveals a noticeable difference between how much students prefer using certain teaching methods and how much they actually use them. This substantial gap calls for greater integration and more intensive use of teaching methods in the educational process and curriculum enhancement as well as a change in strategy and operation of HEIs. Given the findings of this study, the most urgent need is to accelerate the adoption of digital teaching methods and resources, which will reduce the dominance of traditional textbooks in the educational process and provide more accessible and digital content to students, which follows their preferences. By intensifying the use of digital teaching methods, HEIs will also have to ensure the development of the necessary digital competencies of teaching staff so that teachers can effectively use digital teaching methods. In addition, it is also necessary to provide for appropriate infrastructure (e.g., online learning platforms, smartboards, etc.). Furthermore, it would be necessary to redesign the curriculum to include more practical-based learning to enable students to acquire more practical knowledge. In the longer-term, it would be necessary to involve students to a greater extent in decision-making regarding the use of digital teaching methods so that there would be no excessive discrepancies between current and preferred usage of teaching methods. In the longer-term, gender should also be an important driver of curricula development, as gender has a significant influence on the perception of the effectiveness of several teaching methods. Thus, HEIs could consider gender as a factor in the development of strategies and curricula. Understanding these differences can guide HEIs in designing curricula in a way that is more inclusive and responsive to diverse learning needs. For example, for individual subjects in selected cases, they could adjust the use of teaching methods for male and female students, which could contribute to the greater effectiveness of education.

Due to a single faculty, discipline-specific, and non-random sampling, the findings primarily reflect the chosen specific context. The results of this study are, thus, not generalizable but should be considered as preliminary findings indicating important trends in the perception of the effectiveness of teaching methods and, in particular, regarding the disparity between the actual and desired use of digital teaching methods. Caution is, therefore, needed when generalizing the results of this study to other disciplines and the wider population. A strong argument for possibilities for the generalization of the results, despite a non-random sample and using students from a single faculty and a specific context, lies in the similarities of young adults from Generation Z, which allows for generalization of the results, subject to constraints.

5.3. Limitations

The most significant limitations of this study are as follows. The first limitation is related to the field of study, as the sample represents students of social sciences, namely, students of economics and business, who may have different attitudes regarding teaching

methods and the use of information technology in the pedagogical process than students of other sciences, e.g., engineering and natural science. Self-reported data can lead to biases, as students may overrate or underrate the actual usage and perceived usage of educational methods. It should also be pointed out that the sample includes business students in a study program that is quite practically oriented, given they must complete an obligatory internship during their studies; this could impact their perception of the importance of and need for practically oriented education programs. The large number of digitalized teaching methods used in HEIs may lead to a situation where students find it difficult to assess the significance and importance of individual teaching methods and individual digitalized solutions. The generalization of these findings may, thus, be limited, and it is necessary to critically judge their usefulness due to the limited sample size and the lack of diversity in terms of geographic locations, cultural backgrounds, fields of study, etc.

5.4. Future Research Directions

The findings from this study suggest many possible directions for future research. The most interesting and promising future research direction involves exploring the use of teaching methods in HEIs among students from Generation Z through the lens of gender due to the differences between males and females from the student populations (Fischer & Luiz, 2024). This represents a key avenue for further research, as differences emerge between men and women in terms of their perceptions of the effectiveness of teaching methods, as outlined above. Future research should also consider expanding the scope to students in other fields of study. Examining the gap between what students want and what HEIs offer is also a promising direction for possible research. Furthermore, it would be beneficial to study the possibilities of including and using artificial intelligence in the pedagogical process. Additionally, future research might consider less-used digital tools and those that have recently emerged, such as augmented reality and blockchain technologies (Fischer & Luiz, 2024).

All possible research directions can benefit from a longitudinal approach that can provide insights into the evolution of teaching methods from the perspective of Generation Z. Additionally, it would make sense to conduct research in an international environment and focus attention on different cultural areas, also monitoring the possible influence of culture on the preferences and perceptions of teaching methods among student populations.

To sum up, future research should be conducted on a randomized sample, which will include students of different disciplines, which will allow for the validation and extension of our findings.

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