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PAPER

Teachers' Digital Skills and Methodological Characteristics of Online Education

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ABSTRACT

In the field of education, the prominence of information and communication technology (ICT) tools in supporting learning and teaching has been steadily increasing. To effectively implement digital education, it is essential to foster teachers' digital skills, especially in terms of tool utilisation and content development. The period of school closures during the pandemic and the subsequent transition to online education underscored the importance of participants' digital preparedness. Online education posed many challenges for teachers, students and parents. After overcoming the initial technical obstacles, the methodological renewal of education emerged as a key issue. In the summer of 2022, our team conducted an online questionnaire survey involving 292 educators from nine European countries. Our research aimed to investigate online education during the COVID-19 period, encompaassing its positive and negative aspects, methodological considerations and the impact of online education on traditional classroom education. The research findings show that respondents consider the improvement of participants' digital skills to be the most positive aspect of online education. However, they also highlight that this form of teaching provides limited opportunities to motivate learners and is less effective than face-to-face education. The outcome of this research hold practical implications, particularly in teacher training and in-service teacher training. It draws attention to the specifics of digital/online education and the possibilities of developing digital skills.

KEYWORDS

digital skills, online education, methodological renewal

1 INTRODUCTION

In today's public and higher education, the prominence of digital education, as well as learning and teaching supported by information and communication technology (ICT) tools, has become increasingly evident [1–3]. For the effective implementation of digital education, in addition to appropriate IT tools, a paradigm shift in pedagogical methodology is essential [4], which also requires the

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development of teachers' digital skills [5, 6], primarily in terms of effectively utilising tools and content development [7].

The Digital Competence Framework (European Digital Competence Framework for Citizens, DigComp) defines five primary areas of digital competence:

- Information and data management (Collecting, using and storing information);
- Communication and cooperation (Digital, internet-based communication);
- Creating digital content (Creating digital content);
- Problem-solving (Problem-solving, practical application);
- Security (ICT security) [7, 8].

It is necessary for future teachers to familiarise themselves with the possibilities of digital education during their training. However, according to the TALIS 2018 [9] survey, this aspiration is not fully realized: The proportion of teachers whose training included the use of ICT tools for educational purposes in Bulgaria is 57.6%, in Cyprus 62.7%, in Hungary 51.4%, in Malta 70.4%, in Italy 52.2%, in Portugal 46.9%, and in Spain 38%. Based on the research results, the use of ICT tools for educational purposes has been significantly more emphasized in teacher training in recent years than before, so recently graduated teachers are more confident in using digital tools than more experienced teachers.

According to the findings of the Hungarian research [10], 72.3% of the teachers surveyed reported using digital devices on a daily basis, both in their personal life and in their work. Still, the respondents only had general user knowledge (N=7185). 80% of the respondents expressed the need for further development of their digital competencies. Specifically, they anticipated the enrichment of educational content, the simplification of school administration tasks and the easier monitoring of student results through the widespread adoption of ICT tools and new methods.

Another crucial factor for the success of digital education is the digital competence of students, which is manifested in the ability to self-regulate learning and effectively use devices [11]. According to research that gathered teachers' opinions [12], the number of students fully prepared for digital education is relatively low. Less than half of the students demonstrate proficiency in using digital tools and accessing appropriate educational content and interfacess. While students generally perform modestly when it comes to using educational applications, they excel in managing social media content.

During the COVID-19, the issue of teachers' digital skills was given increased attention, as it was seen as essential for the implementation of online education.

Our study focuses on exploring teachers' digital skills and the key characteristics of online education, with an emphasis on methodological aspects and the impact of online teaching during the COVID-19 pandemic on traditional, face-to-face education.

2 IMPACT OF DIGITAL EDUCATION AND LEARNING DURING THE PANDEMIC

The expansion of distance education and the accessibility of the Internet have necessiated the development of appropriate methodological models for e-learning.

One pedagogical endeavour addressing this need is digital pedagogy, which has been extensively studied by Hungarian researchers in both theoretical and practical contexts [13–15]. With the ongoing changes and technological advancements, we are witnessing the emergence of digital transition and a digital culture. The COVID-19 pandemic, which began in the spring of 2020, brought distance learning and ICT-supported e-learning environments to the forefront, resulting in the rapid implementation of digital educational solutions.

Due to the impact of COVID-19, educational institutions worldwide experienced temporary or extended closures and switched to online education (digital education, distance education). The unexpected situation required quick and flexible solutions [4, 16, 17]. Online education presented many challenges for teachers, students and parents alike [18]. The level of digital preparedness among participants varied; with many becoming acquainted with IT tools and the intricacies of digital education. Once the initial technical obstacles were overcome, the methodological transformation of education emerged as a key issue.

Various research studies have investigated the process and outcomes of the transition to online education.

In Hungary, it was found that 95% of students participated in online education but 5% did not, potentially compromising their academic progress in their subsequent studies [19].

According to the findings from interview research [4], online education had several positive aspects. It led to improvement in teachers' digital skills and methodological approaches. Students became more accountable for their own work. Online assignments made learning more enjoyable. The online environment was considered to cause less stress to students. However, online education also had various drawbacks. The lack of a social environment hindered students's ability to build and maintain personal relationships, resulting in severe psychological problems and feelings of isolation. This negetively impacted their behaviour and academic performance. Teachers found it challenging to assess and evaluate students' fundamental knowledge, which possed difficulties for tracking their progress. In disadvantaged communities, reaching and engaging with students was difficult and, in some cases, even impossible.

In 2020, an online survey on the School Education Gateway portal gathered responses from 4859 participants. 86% of the respondents were teachers or school leaders. The survey explored the challenges of online education. One significant finding of the survey was that motivating students emerged as the biggest challenge faced by educators [19].

The period of online education drew attention to many issues, such as the necessity to develop digital competence and establish new, effective teaching-learning methods that can be effectively applied in the digital world [4].

When teachers and students transitioned back to face-to-face education, they brought with them a wealth of experiences that could beapplied in the teaching-learning process, enhancing their overall educational approach.

The advantages, disadvantages, opportunities and dangers of online education are summarized in the Table 1 below (based on [19]):

Table 1. SWOT analysis of online education

Strengths	Weaknesses	Oportunties	Threats
It was safe during the pandemic due to the minimization of personal contact	Deficiencies in infrastructure conditions	The concept of digitization has become widely known, and knowledge of it can create social demand	Differences between regions and social groups became stronger
Education remained sustainable	Adequate digital competence is required for implementation	It opened up space for the development of digital competences	The risk of missing out increased
It gave impetus to learning about digital educational opportunities	A significant increase in parental responsibilities is the key to success	It brought new personal competencies to the surface	Data protection issues increased
It pointed out the shortcomings of the digital educational environment	The possibilities of personal, individualized support have decreased	The period gave the actors a digital self-evaluation	Lack of independence and self-regulation can result in falling behind
	He/She wanted high individual motivation or strong parental support		It significantly increased the workload and time spent on those involved
	Low effectiveness of online education		

3 METHOD

In the spring of 2022, a research study was conducted using an online international questionnaire survey involving N=292 active teachers from nine European countries. The research employed quantitative-based questionnaires developed by our team, which were distributed to the chosen target group using simple random sampling. The objective of the research was to identify the characteristics, benefits and drawbacks of online education, as well as explore the possibilities in digital education. The measurement instrument mainly consisted of closed-ended questions.

Our primary research questions were the following:

- How do the surveyed teachers evaluate online education?
- Did reaching the students cause problems for them during the digital work schedule education?
- To what extent are the experiences of online education during the Pandemic used in current classroom education?

Based on the results in the literature [4, 11, 16, 19] and our own educational experience, the following hypotheses were formulated:

1. Respondents consider digital competence development to be the greatest positive aspect of online education.
2. The biggest problem of online education is considered to be the lack of social interactions and the isolation of the participants.

3.1 Characteristics of the research sample

Table 2 presents the summary of the questionnaire responses provided by N=292 teachers from nine European countries in a valid and usable manner.

Table 2. Distribution of teachers participating in the questionnaire by country (N=292)

Country	N	%
Albania	4	1.4
Bulgaria	42	14.4
Cyprus	18	6.2
Greece	11	3.8
Hungary	130	44.5
Malta	6	2.1
Italy	24	8.2
Portugal	26	8.9
Spain	31	10.6
Sum	*292*	*100.0*

65.6% of the respondents were women, 34.4% were men (N=291). 11.3% were younger than 30, 15.1% were between 31 and 40, and the majority (73.3%) of them were over 40 (N=291).

The distribution of teachers' professional experience aligns with their age distribution. 10% of respondents have been teaching for 2 years or less; 7.2% for 3–5 years; 14.8% for 6–10 years; 14.5% for 11–15 years; 12.4% for 16–20 years and the largest number of respondents, 41%, have been engaged in education and/or training activities for more than 20 years (N=290), indicating substantial pedagogical experience.

8.5% of respondents teach in lower primary education and 12.7% are in higher primary education. Most of the responding teachers work in secondary education: 28.3% teach in general secondary education and 29% in vocational training. Additionally, 8.1% of them teach in higher education and 13.4% in other fields (N=283).

Among the respondents, 24.4% are involved in teaching science subjects; 30.24% teach humanities subjects; 14.78% teach a foreign language; 16.49% skills subjects and 21.15% teach professional subjects. (Some teachers teach more than one type of subjects) (N=291).

In terms of administrative role, 8.9% of the respondents are heads of institutions; 3.9% are deputy heads; 24.1% of them are employees who perform management-relatedtasks and oversee the work of others, and 63.1% of them are employees who do not have any management responsibilities (N=282).

34.4% of respondents teach in the capital city, 17.9% in county seats, 38.9% in cities or towns and 8.8% in villages (N=285).

3.2 Experiences of online education introduced due to the pandemic

The first part of our research focused on assessing the impact of COVID 19-related closures on the work of the interviewed teachers.

It was found that for the majority of the respondents,their educational institution did not come to a complete halt during the pandemic-related closures. Instead, they were able to continue teaching online and maintain communication with students, colleagues and partners through digital devices and managed to deliver the current teaching materials to students. Please refer to Table 3 for further details.

Table 3. Characteristics of online education introduced due to the pandemic (on a 4-point scale: 1: not typical at all; 2: rather not typical; 3: more typical; 4: completely typical)

	Median	Deviation	N
During the closure due to the pandemic, I was able to teach online.	3.36	0.895	169
During the closure due to the pandemic, the operation of our institution and organizational unit came to a complete halt.	1.60	0.972	166
During the closure due to the pandemic, we managed to deliver the current study materials to all my students.	3.34	0.846	168
During the closure due to the pandemic, the students could easily be activated.	2.66	0.869	167
During the closure due to the pandemic, I lost contact with colleagues.	1.99	0.925	167
During the closure due to the pandemic, I tried and learned many new distance learning tools and methods.	3.28	0.804	167
During the closure due to the pandemic, we mainly communicated with each other, with my students and partners, using digital devices.	3.52	0.786	165
Communication with partners (students, parents, maintainer, companies) became slower and/or more difficult during the closure due to the pandemic.	2.44	0.944	169
After the reopening of the institution/organizational unit, I was able to make good use of the experiences gained during the closure (e.g. use of digital tools, distance learning methods, new types of communication forms)	3.19	0.902	168

We then explored the advantages and disadvantages of online education using two sets of reliable questions. The reliability of the positive aspects of the questionnaire was supported by Chronbach's alpha value 0.93 and for the negative aspects, the value was 0.91.

Regarding the positive aspects of online education, our findings align with previous research [4, 11, 16, 19]. The responding teachers believe that the greatest benifit of online education is the development of digital competences. On a 4-point scale, the average response was 3.4, indicating a high level of agreement among the respondents. This result confirms our initial hypothesis.

The responding teachers found online education a safe solution against the virus and regarded it as a positive aspect that posed a challenge for them. However, they did not believe that it would attract the students' interest more than traditional education. (Table 4)

The Spearmann correlation analysis revealed that the closest correlation among the positive aspects was between the development possibilities of students' thinking and creativity (r=0.846, p=0.000).

Table 4. Positive aspects of online education (on a 4-point scale: 1: not at all; 2: somewhat; 3: mostly; 4: completely)

Digital Education is Attractive to me Because...	Median	Deviation	N
I can also teach from home	2.91	1.008	172
the daily schedule is more favorable	2.73	1.101	171
it is modern	2.99	0.976	172
I can be more creative	2.62	1.036	171
it makes students more interested	2.06	0.938	172
it is varied	2.44	0.944	172

(Continued)

Table 4. Positive aspects of online education (on a 4-point scale: 1: not at all; 2: somewhat; 3: mostly; 4: completely) (*Continued*)

Digital Education is Attractive to me Because...	Median	Deviation	N
it is possible to develop students' creativity	2.38	0.957	172
there is an opportunity to develop students' thinking	2.37	0.946	171
students can be trained to cooperate	2.46	0.928	171
it offers a sense of achievement	2.31	0.966	171
it is a challenge	3.05	1.013	172
it a safe solution against the virus	3.17	0.997	168
it develops digital competences	3.40	0.822	171

According to the respondents, the most significant drawback of online education was the lack of social relationships Not only did it make the participants feel lonely but it also hindered the development of social skills and perpetuated social inequalities (Table 5). The lack of social interactions received the highest average score of 3.27 on a 4-point scale. Of the average scores for the listed aspects, only this one was above 3, indicating the severity of the problem. This finding is consistent with the previous research [4, 19] highlighting the negative effects of online education, thus supporting our second hypothesis. In a cross-tabulation analysis of the data, comparing educational institutions, we observed that primary teachers felt the lack of peer connections more strongly than teachers in secondary education (Chi-squared test, p=0.000).

Based on the correlation analysis performed on the data, the connection between communication and the understanding of the course material was the closest (Spearmann correlation, r=0.766, p=0.000). This implies that if communication is not effective in digital education, students may encounter difficulties in understanding the course material. Pedagogical communication encompasses the reception of information (new knowledge) from the teacher, and its understanding and processing rely on the student's active presence and desire to learn.

Table 5. Negative aspects of online education (on a 4-point scale: 1: not at all; 2: somewhat; 3: mostly; 4: completely)

The Downside of Online Education is that...	Median	Deviation	N
it is not available to all students	2.80	1.031	172
not all teachers are prepared for it	2.91	0.939	172
the participants become lonely	2.99	0.967	172
there is no feedback in the lessons	2.39	0.927	172
does not engage students' attention	2.29	0.942	171
the assessment is not realistic	2.70	0.996	170
social relationships are lacking	3.27	0.962	172
the teacher's personality is missing from the lessons	2.91	1.008	172
there is no opportunity for personality development	2.63	0.973	172

(Continued)

Table 5. Negative aspects of online education (on a 4-point scale: 1: not at all; 2: somewhat; 3: mostly; 4: completely) (*Continued*)

The Downside of Online Education is that...	Median	Deviation	N
students do not understand the material	2.28	0.761	172
communication is ineffective	2.41	0.884	172
it puts additional burden on parents	2.80	0.971	170
opportunities for personalised support are reduced	2.56	0.979	170
there is a greater risk of attrition and separation	2.65	1.051	170
social inequalities continue to grow	2.94	1.056	171

To explore further correlations, two clusters (groups) were obtained by K-Mean cluster analysis after the standardisation of the data. The first cluster comprises of teachers who hold an optimistic view of online education. This group constitutes 57.4% of the respondents. The second group comprises of teachers who adopt a pessimistic stand towards online education, emphasising its negative effects. This group acounts for 42.6% of the responding teachers.

The respondents from Albania, Cyprus, Italy, Portugal and Bulgaria showed the highest level of optimism towards online education. On the other hand, the respondents from Spain, Greece and Hungary were the most pessimistic. Respondents from Malta were relatively balanced as the ratio of optimistic to pessimistic teachers was 50–50% (Chi-squared test based on p=0.000).

In terms of educational level, primary teachers rated online education more negatively than secondary teachers (Chi-squared test, p=0.009). They probably faced more methodical challenges while making the transition.

Regarding seeking professional help with digital education, the respondents primarily relied on their professional work community and other colleagues (Figure 1).

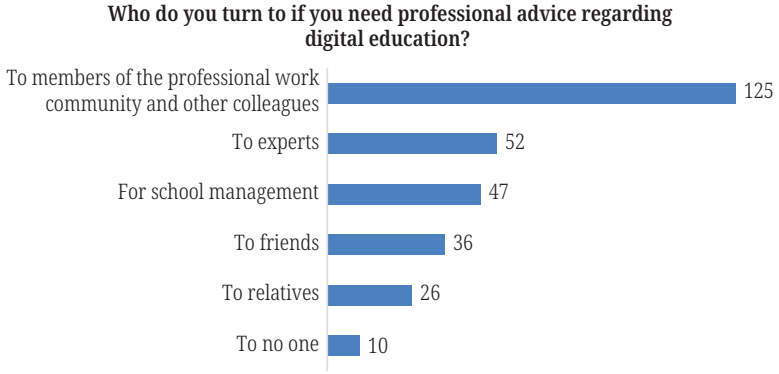

Fig. 1. Possibilities of seeking professional help (main, respondents could indicate several answer options, N=292)

The research examining online education [19] and everyday experiences has drawn attention to the fact that due to school closures, students suffered learning setbacks that primarily affected disadvantaged students. Our research has also revealed that one of the major issues of online education is that many students have dropped out. It is concerning to find that 23.5% of the responding teachers could not regularly reach even half of the students during online education. 3% of them reached 76–100% of the students, and 7.3% reported not being able to reach 26–75% of their students at all. (Table 6)

According to a Hungarian research study involving teachers (N=425), it was found that 16% of students were unable to participate in education during the school closures caused by the pandemic. In classes where the number of cumulatively disadvantaged students was high, this rate was 31% [20, 21].

Table 6. Availability of students during online education

	What Percentage of Students was Regularly Reached in Online Education? (N=166)	What Percentage of Students Could not be Reached in any way? (N=165)
0–25%	9	89.7
26–50%	14.5	6.7
51–75%	16.3	0.6
76–100%	60.2	3

Cross-tabulation analysis was used to examine deeper connections between the data, and a significant correlation was found between those who dropped out of digital education and the proportion of disadvantaged students studying in the educational institution (based on the Chi-square test performed on the data: p=0.008). In institutions where the proportion of disadvantaged students is lower, the teachers were able to achieve better results with the students.

However, the fact that "the teacher reached the student" does not automatically mean the student's active participation in the learning-teaching process. In the online space, it is a much more difficult task for the teacher to support the student's learning process and manage and supervise the didactic processes (checking the student's imprinting through the appropriate number of repetitions and exercises, i.e., the acquisition of skill-level knowledge and/or the development of skills through the appropriate number of exercises).

According to the responding teachers, the main reasons for students' absence was a lack of motivation and responsibility. According to the teachers, the lack of digital devices came only after these two factors: the lack of personal space and communication (Figure 2).

A comparison with the background variables revealed that the lack of motivation in secondary-level vocational training was the most emphasised by the teachers. On the other hand, in primary education, the availability of equipment was identified as the most problematic factor (Chi-squared test p=0.000).

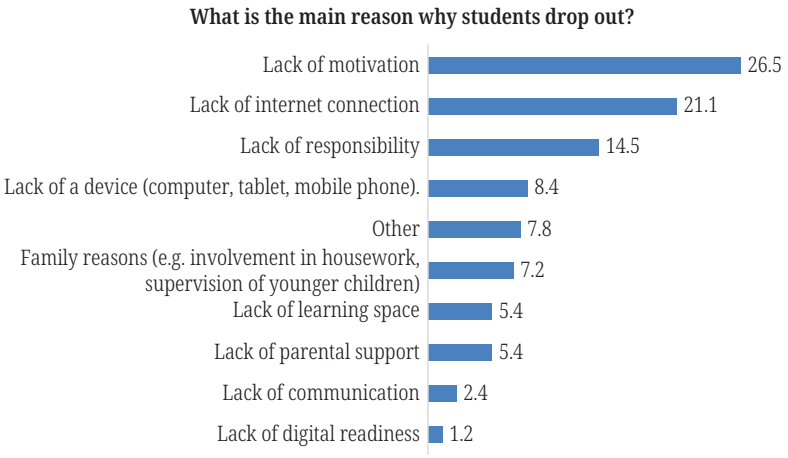

Fig. 2. The main reasons for students dropping out (%, N=166)

Verbality is essential to motivate students for active participation. The teacher's encouraging words play a crucial role in engaging and motivating the students throughout the session. However, it can be challenging to maintain the students' attention and learning activity in the virtual setting. Furthermore, as his/her primary tool, the teacher's personality is only partially enforced in the online space. This explains the contradictory experience that during the pandemic, students' academic results improved almost without exception. However, their knowledge – with a few exceptions – remained below the expected level. According to teachers of science subjects, the effectiveness of online education is only 15–20% of the effectiveness of lessons taught in person. In contrast, the teacher spends almost twice as much time preparing for each lesson than in face-to-face education. The respondents observed that during online education, students requested the most help with questions related to study skills and subject-related content, and the least with personal issues (Figure 3).

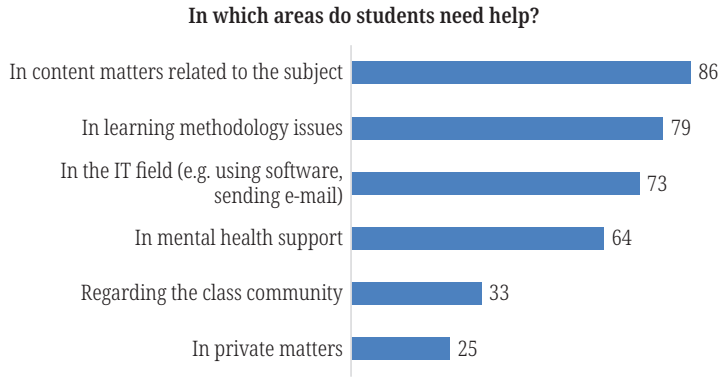

Fig. 3. Student needs in online education based on the teachers' assessment (main, respondents could indicate several answer options, N=292)

The respondents would primarily conduct separate online sessions for dropout students and help them through regular personal meetings (Figure 4). It is an interesting fact that during the pandemic, 31 of the 292 surveyed teachers delivered the material to the students on paper, overcoming the technical difficulties on one hand, and using the personal meeting to motivate the student on the other. This was the only way to prevent many students, who were "unreachable" online, from dropping out, as the weekly face-to-face meetings also allowed the teacher to collect and evaluate the worksheets that had been given out on paper the previous week. The students would complete them independently and give feedback on them.

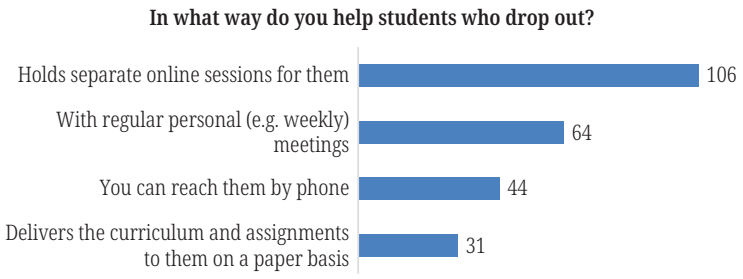

Fig. 4. Assistance to dropout students in online education (respondents could select several answer options, N=292)

Online education also requires methodological renewal. It is essential not to look for technological support for our old methods but to look for the appropriate digital tools for new and innovative methods [22].

Table 7. Methods in online education (%)

	Never	Rarely	Monthly	Weekly	In Every Lesson	N
lecture	8.5	20.0	10.3	29.7	31.5	165
explanation	3.0	5.4	9.0	25.9	56.6	166
narration (description)	10.1	16.5	8.9	29.7	34.8	158
illustration (presentation, illustration)	3.6	5.4	6.0	37.3	47.6	166
discussion	4.9	8.5	9.1	33.5	43.9	164
debate	14.9	23.6	18.6	31.7	11.2	161
cooperative education method	11.7	23.9	16.1	30.1	18.4	163
project method	12.9	24.5	24.5	27.6	10.4	163
game	17.4	26.1	10.6	30.4	15.5	161
role play	37.1	29.6	8.8	19.5	5.0	159
simulation	24.7	27.8	13.6	22.8	11.1	162
shortpresentation	16.1	16.1	19.9	26.7	21.1	161

The most frequently used methods in online education are: lecture, explanation, narration, illustration and discussion. These methods were used in every lesson by a significant number of responding teachers. Of the participant-centred methods, discussion, cooperative methods, project methods and games were less frequently utilized in online education. Roleplay and simulation were seldom or never employed, as reported by the majority of respondents. (Table 7)

37% of the respondents used a curriculum available on the Internet for online education, and 32% developed their own digital curriculum for education. However, 19% of them did not use any digital curriculum at all in online education (Figure 5).

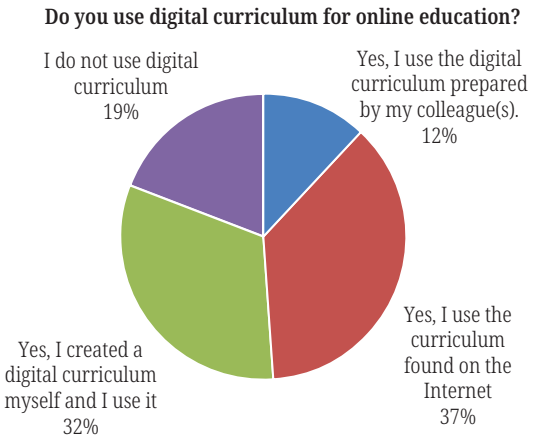

Fig. 5. Use of digital curriculum in online education (%, N=161)

The above findings align with the literature's assertion that the COVID-19 period provided oppotunities for educational innovation [23, 24].

3.3 Effects of online education on face-to-face teaching

The study examined the impact of online education on subsequent classroom teaching. The findings revealed that 36% of respondents now use ICT tools more often than before. Additionally, 28% continue to use digital teaching materials in face-to-face education. It is worth noting that 14% of them create their digital curriculum. Conversely, the teaching methods of 21% of respondents remained unaffected by online education; as they continued to teach in the same way as before (Figure 6).

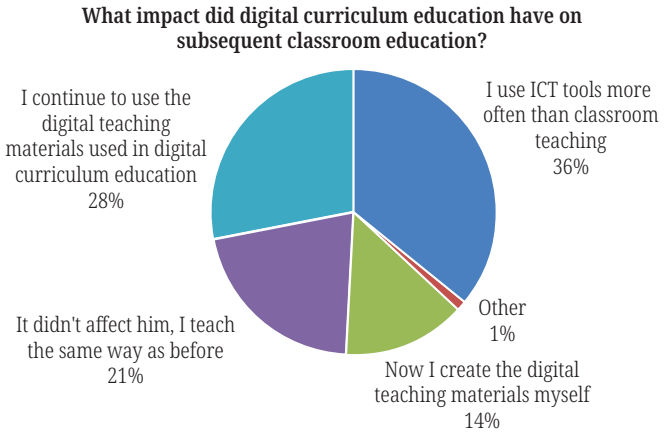

Fig. 6. The effect of online education on face-to-face education (%, N=159)

In addition, the respondents also use innovative teaching methods in their work, with the project method and collaborative learning being the most prominent among them (Figure 7).

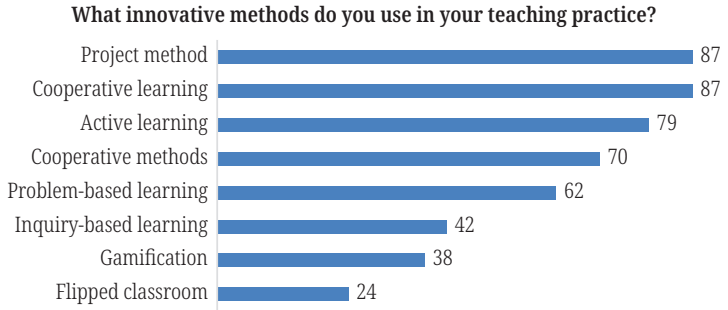

Fig. 7. Application of innovative teaching methods (main, respondents could indicate several answer options, N=292)

45% of respondents (N=220) use digital competencies in their teaching. They believe that teachers and students need creativity, digital competence, problem-solving and communication skills to succeed in digital education (Figure 8). Furthermore, the set of questions related to this topic demonstrated high reliablity, with a Chronbach's alpha value of 0.95 (Figure 8).

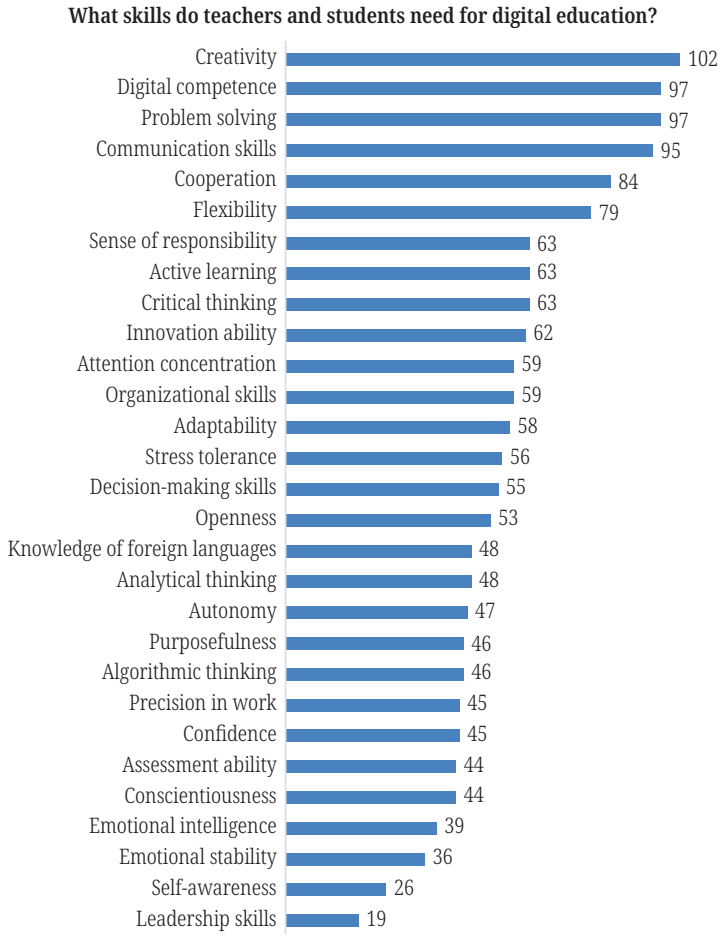

Fig. 8. Skills needed for digital education (respondents could mark several answer options, N=292)

4 CONCLUSIONS

In the spring of 2022, an international survey was conducted among N=292 teachers from nine European countries. The quantitative-based research aimed to reveal the characteristics, possibilities, advantages and disadvantages of digital education.

The findings of the research pointed out that the restrictions due to the COVID-19 pandemic significantly impacted the work of the responding teachers. Most of those interviewed were able to teach in digital and online form during distance education due to the pandemic. During this period, they used digital devices to communicate with each other and their students. Most of them (80%) delivered the required teaching material to the students.

The responding teachers regard the development of digital competencies as the most significant advantage of digital education. They found it a safe solution against the virus and evaluated it as positive, despite the challenges faced by them. The limited scope of the teacher's motivational possibilities, the low efficiency of the teacher's personality due to the "limited presence" in the online space and the lack of social relationships were considered the most significant drawbacks of online education. These factors contributed to feelings of loneliness, hindered the development of social skills, and exacerbated social inequalities.

According to the respondents, the main reasons for the low level of students' activity may be the lack of motivation and responsibility. During the

teaching-learning process, the students mainly required help with study skills and subject-related content.

The respondents primarily used curricula found on the Internet for online education, but several of them also created or developed digital curricula themselves. Many people were using ICT tools and systems more often than before, in attendance-based education. In other words, digital education paved the way for innovation opportunities in the educational culture.

Respondents believe that creativity, digital competence and problem-solving are most needed by teachers and students for more effective digital education.

The research results may be helpful for teacher training and in-service training, as they shed light on the specifics of digital and distance education, as well as the need and opportunities for developing digital skills.

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