

Digital Learning Management for Adolescents

Alexandra CONSTANTIN¹

Camelia STĂICULESCU²

Abstract

Contemporary adolescents are considered digital natives due to their immersive digital behavior shaped by society. The aim of this study is to examine the ability of 11th grade students from the exact sciences profile to incorporate digital resources into their learning activities. Data were collected via a self-administered digital questionnaire and the responses of 16 students were analysed. Findings show not only a pedagogical decrease in digital resources use compared to the eLearning period, but also a lack of students' digital abilities in terms of online research activities. Despite the prevalent apprehension in the socio-educational environment regarding the increasing adoption of AI-based systems in academic settings, the adolescents participating in this study reported that they have not utilized Chat GPT for educational objectives. In conclusion, this paper can constitute the supporting pillar of future research that could investigate the impact of integrating artificial language models into the educational process of the upper cycle of high school.

Keywords: digital learning, digital resources, digital activities, adolescents, digital learning management, digital skills

JEL classification: I21, I24, I29

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1. Introduction

The education sector is under the spectrum of an urgent need for adaptability to the demands of the labor market generated by the emergence of the current digital era, expressed in terms of competencies that teachers and students must acquire in a structured and coherent manner.

As economic activities have increasingly expanded to virtual spaces by integrating artificial intelligence for efficiency, there is a growing emphasis on developing competencies unique to human nature that cannot be fully replicated by autonomous systems (Kolade & Owoseni, 2022).

Driven by the urgency of transitioning learning activities to the online environment, digital technologies have reshaped the entire educational system by adapting education to the digital universe in which teachers were forced to apply specific methods and strategies (Ceobanu et al., 2022).

¹ Alexandra Constantin, Bucharest University of Economic Studies, Constantin7alexandra21@stud.ase.ro

² Camelia Stăiculescu, Bucharest University of Economic Studies, camelia.staiculescu@dppd.ase.ro

According to researchers in the field of education sciences (Cropley, 2019; Sipică & Toma, 2022; Akimov et al., 2023), there are several essential components of core competencies that schools must develop in order to equip students psychopedagogically for Industry 5.0. These include critical reasoning, the ability to generate relevant and original content that complements the ideas of others, cooperation, efficient and constructive communication within a team, innovation, and the ability to integrate web tools into one's own educational approach.

Moreover, the response of the Romanian authorities to the educational crisis precipitated by the pandemic was belated and entailed providing students with tablets after their return to in-person classes. This has been criticized as an economically and educationally unjustified expenditure of resources, because the acceleration of education digitization necessitates equipment such as personal computers (Pup, 2022).

2. Literature review

The global closure of schools and universities necessitated both the readaptation of the educational climate through the adoption of the e-Learning paradigm by educational institutions (Michigan, 2020; Tam & El-Azar, 2020) and the alteration of students' behavioral habits. Despite being digital natives, many students lacked the ability to effectively utilize digital tools for learning (Botnariuc et al., 2020).

On one hand, the digital revolution in education has had several negative consequences, including the exacerbation of social inequalities and digital exclusion (Hatos, 2019; Holmes, 2022). Rural schools were particularly impacted by this digital exclusion due to a lack of digital infrastructure, technology, and competent teaching staff capable of facilitating online learning (Tunegaru, 2021; Werfhorst et al., 2022; Grişcenko, 2022).

Other issues highlighted by the scientific literature (Adam & Metljak, 2022; Luca & Gheorghită, 2022) include the following aspects: maintaining students' attention; their involvement in classes with the video camera turned off; poor participation in synchronous school activities; difficulties in managing and coordinating the class, didactic and extracurricular time; the use, structuring and application of didactic strategies beneficial to the online context; the lack of digital competencies for the use of specific educational software.

On the other hand, the experience of online education has shown that the highest level of digital literacy is characteristic of teachers with a maximum of 5 years of experience at the lectern, who have been trained in the integration of virtual learning environments into didactic activity (Adam & Metljak, 2022). At the same time, studies (Müller et al., 2021; Luca & Gheorghită, 2022) show that there have been positive behavioural changes among introverted and shy students, with a higher level of involvement and participation in didactic activities than during in-person classes.

In the post-pandemic era, education can no longer be constrained by space and time, as the number of e-Learning platforms has exploded due to the increased interest of educational units in digital resources (Sipică & Toma, 2022). Furthermore, teaching staff benefit from co-financing of training courses for a new competency-based curriculum through the European Social Fund (European Commission, 2022).

Above all, ICT technology has a positive influence on economic development and the essential conditions for the internet to produce benefit are increasing access to education and reducing the level of digital exclusion (Habibi & Zabardast, 2020).

3. Methodology

First, the design of this research started from the premises of positive effects of the use of technology in the teaching of economic subjects by increasing the involvement in class (H.2) and the level of digital skills of students (H.1). The 25 students of the 11th grade of the “Mihai Eminescu” National College of Bucharest represent the group of subjects involved in this study. Subsequently, in order to achieve the proposed objectives and to answer the two research questions, a measurement and data collection instrument was designed for students, the electronic questionnaire. This aimed to identify the current level of digital competencies possessed by students, as well as to identify responses for the two research questions, regarding the ways in which adolescents use digital resources for learning (RQ.1) and their opinions on the integration of technology in the educational act (RQ.2).

Furthermore, the main dependent variables measured were the degree of involvement and the level of digital competencies of adolescents, while the independent variable tested was the use of technology in teaching economics. As such, the research instrument (31 items) was designed by including these variables in the core theme of the information measured through the formulated questions.

Finally yet importantly, the application of the questionnaire was carried out during the period of March 24 - April 1, 2023. Given that the mentioned period corresponded with the week of the baccalaureate exam simulations when online learning took place, students received the electronic questionnaire on their institutional email address. Out of 25 students who make up the target group of respondents, 16 valid responses were obtained.

4. Findings

The socio-demographic profile of 17-year-old adolescents indicates that all respondents live in Bucharest, but three students come from disadvantaged socio-economic backgrounds (single-parent families). The group of subjects presents a preponderance of the male biological gender (72%), but only half of them responded to the questionnaire, along with all their female colleagues (7 girls).

Computer usage skills represent a strong point of this class since half of the adolescents declare that they have an advanced level, while the other half claim to have an intermediate level. No responses were offered for the beginner level of competence. In addition, all responding students appreciated that they can integrate multimedia resources in the form of text, music or digital image into the products of learning activities.

On the other hand, most students declared that they have an intermediate level of MS Office competence (68%), and a quarter of them consider themselves at an advanced level of using the Office package. Only one respondent appreciated that he has a beginner level of MS Office competencies.

Considering the correlation between the number of hours spent on the computer and the development of digital competencies, it is noteworthy that 50% of the surveyed adolescents reported using the computer or laptop multiple times per day. One quarter of students indicated that they use this type of electronic device only once daily, and an equal proportion of youth reported accessing their computer/laptop once per week.

The results presented above should be interpreted alongside those provided by Figure 1, which illustrates the main types of electronic devices owned by students and to which they have unrestricted access for collaborative use (together with parents or siblings). In this regard, it is noteworthy that two students do not possess a personal laptop connected to the internet, and six respondents (37%) stated that they do not have a personal computer connected to the internet (Figure 1). At the same time, all adolescents who completed this questionnaire reported using a personal smartphone.

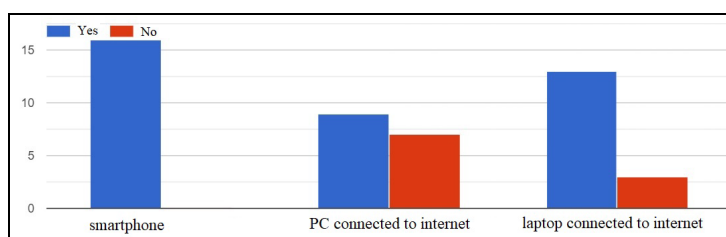


Figure 1. Type of electronic devices owned by students

Source: Author's own contribution.

As the frequency and duration of technology and digital resource use are directly related to the development of digital competencies, Figure 2 highlights students' responses to these two questions. On the one hand, three-quarters of adolescents claimed that they use digital resources for learning for 1-3 hours per day, while a quarter of young people acknowledged that they use them for less than one hour per day (A).

On the other hand, three-quarters of respondents reported spending over 4 hours per day connected to electronic devices, while the remaining students consume digital content for purposes other than learning between two and four hours daily (B).

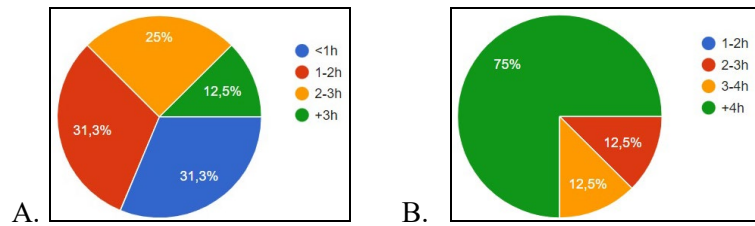


Figure 2. Duration of daily use of digital learning resources (A) and technology (B)

Source: Author's own contribution.

Since the total time spent by adolescents in the online environment exceeds that allocated to consulting digital resources for learning, a very important aspect is the identification of the reasons why young people are attracted to the virtual environment. From the 16 responses offered by students to this open-ended question, the main factors identified by them were represented by: increased accessibility level, ease of technology use, large number of information and learning resources, personal efficiency increase. Only one student stated that they were attracted by "socialization," while another did not know why they were attracted to online.

The main purposes for which adolescents claimed to use electronic devices are highlighted in Figure 3. The first preference among respondents is consulting digital resources for homework and study (100%), closely followed by socialization (94%) and foreign language study (68%). In contrast, less than half of respondents stated that they use technology for programming (43%) and only 6% of them declared that they are passionate about robotics (Figure 3).

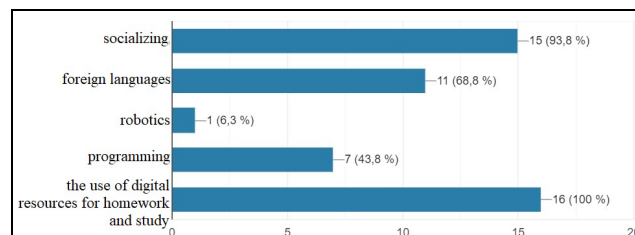


Figure 3. Purposes of technology use

Source: Author's own contribution.

Since all teenagers stated that they use technology primarily to consult digital resources for learning, an extremely important aspect is their digital skills for documentation. In this regard, Figure 4 is eloquent, demonstrating that students have a poor level of digital documentation skills.

For example, nearly 70% of respondents admitted to using the Google search engine to locate digital learning materials. In addition, 19% of students admitted that they use reference sites (referate.com, Wikipedia, etc.) to document

themselves online for assignments. Only one student stated that he uses the digital resources indicated by the teacher to do the homework.

At the same time, the concerns of the teaching staff about the use of the Chat GPT language model by students for homework are not confirmed, since none of the teenagers surveyed mentioned this digital resource based on artificial intelligence among those used for homework (Figure 4).

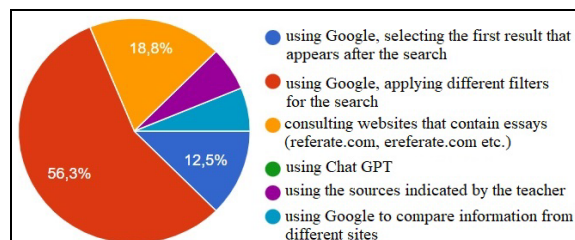


Figure 4. Ways to search for information on the Internet for school assignments

Source: Author's own contribution.

Regarding the ways of using digital resources, the majority of young people claimed that they use them to complete their homework (94%) and to acquire new skills (69%) in the fields of interest (Figure 5). Next, the use of digital resources in carrying out learning activities at school is mentioned by less than half (44%) of the teenagers questioned; while four respondents added that they use technology to participate in extracurricular courses (25%).

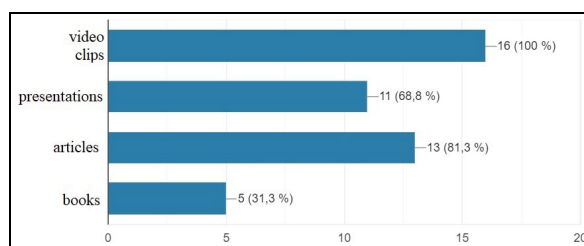


Figure 5. Digital resources used by students for educational purposes

Source: Author's own contribution.

The participants in this study are in the upper cycle of high school, follow the real profile and have studied for almost three years in the online environment. Therefore, they should have already acquired an average level of digital documentation, learning, collaboration or assessment skills.

In fact, the pandemic period forced the adaptation of the educational sector to the virtual space by disseminating textbooks in digital format on the manuale.edu.ro platform, as well as other open educational resources uploaded to numerous free online platforms used by teachers (WordWall, MentiMeter, Livresq.com etc.) However, only a third of respondents stated that they used digital books to carry out learning activities (Figure 5).

Also in Figure 5, the hierarchy offered by the majority of preferences of the questioned adolescents can be noticed, which places videos in the first place in the top of digital resources used by students for educational purposes. If articles occupy second place in the top of preferences for consumption of digital resources for learning (81%), multimedia presentations are only on the third step of this ranking (69%). Although most teenagers (81%) mentioned articles among the main digital resources used for instructional purposes, only two students stated that they prefer text-based courses (Figure 6).

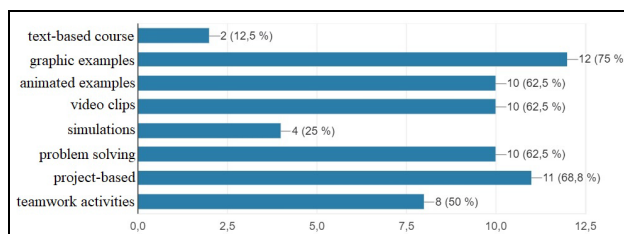


Figure 6. Learning methods preferred by teenagers

Source: Author's own contribution.

The other less preferred learning methods by the respondents were simulations (25%) and team activities (50%), as shown in Figure 6. In contrast, Figure 6 illustrates that most students stated that they learn with the help of diagrams and graphical representations (75%), as well as project activities (69%). In third place are problem solving (62%), animated examples (62%) and video clips (62%).

In addition, students stated that they prefer to study online independently and without the help of a teacher (56%), while the rest of the participants indicate the need for real-time support from a teacher when learning online.

Considering the positive impact of democratizing the educational process on learning behaviour, engagement and student motivation, question no. 14 from the initial questionnaire offered the possibility to specify the frequency with which they would like to control certain components of formal education, such as: (1) various optional courses/subjects, (2) the content of the studied course, (3) the level of difficulty of the course, (4) the testing period, (5) the exercises/activities of the course, (6) the theme/typology of projects, (7) the way of communicating in relation to the teacher, (8) the way of communicating in relation to other colleagues, (9) the schedule and (10) their own study time.

As a result, students expressed their preference to frequently decide (“always” and “often”) in a percentage of 81% the testing period. In second place in the ranking of educational components that adolescents would like to influence are equally (69%) the following elements: optional subjects, course content, course activities and project typology. The third position is represented by the way of communicating in relation to the teacher and by controlling their own study time, which were specified by 62% of respondents. In addition, half of the questioned students stated that it is important for them to be involved in decisions regarding

the level of difficulty of the course and the way of communicating in relation to other colleagues. Less than half of them (48%) stated that the schedule should be made after consulting students.

The next question (no. 15) investigated the nature of educational services that adolescents would like to benefit from through the virtual space via Google Classroom or another educational platform: (1) preparation tests, (2) video/multimedia resources, (3) glossary/dictionary of terms, (4) grades from tests/projects, (5) sending homework/projects, (6) communication with the teacher, (7) information about the schedule, (8) information about projects, laboratories, extracurricular activities, (9) learning materials. In this regard, 62% of respondents stated that they would like to receive “whenever necessary” grades from tests and projects, and 56% stated that preparation tests represent an educational service they are interested in.

Only 44% of students stated that it would be useful to benefit “whenever necessary” from video/multimedia resources, sending homework/projects to be done, communication with the teacher; and 37% appreciated that the online environment should be exploited by including educational services that facilitate access to learning materials, information about the schedule and about projects, laboratories and other extracurricular activities (visits, trips etc.).

Next, Item 17 highlights the preferences of adolescents included in the study to use the computer very frequently during class hours. Thus, half of the respondents stated that they prefer moderate use of the computer in class, and the other half considers it appropriate to integrate technology by using the computer “often” and “very often”. It should be noted that none of the participants opted for one of the first two answer options (“rarely” or “very rarely”).

On the one hand, the conclusions of the specialized literature regarding the openness of young teachers towards the integration of technology in the educational process are also confirmed by the expressed opinions of the questioned adolescents (Figure 7). On the other hand, 6% of young people stated that only the teachers of the subjects that use technology integrate its use in the instructional act, while a quarter of the students claimed that their teachers do not show openness towards the integration of technology in teaching (Figure 7). Instead, only two students were of the opinion that the teaching staff presents an open behaviour towards the use of technology during the act of teaching-learning-evaluation.

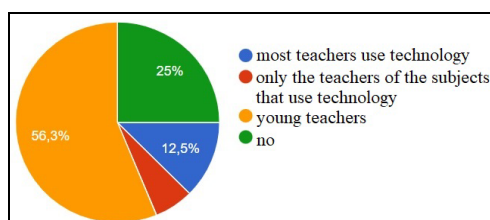


Figure 7. The opinion of the students regarding the openness of the teachers towards the the integration of technology in the didactic act

Source: Author’s own contribution.

Another important aspect was the identification of digital tools used by teachers of other disciplines in pedagogical practice. Hence the following list of 15 digital tools from which the teenagers had the opportunity to select all the variants considered appropriate: multimedia tools, educational software specific to the subject being taught, electronic presentations (PPT), online applications, tutorials, educational platforms, blogs, wikis, web 2.0 tools, online video conferencing, newspapers/electronic boards, Google Maps, electronic mail (e-mail), electronic manual, educational sites (Figure 8).

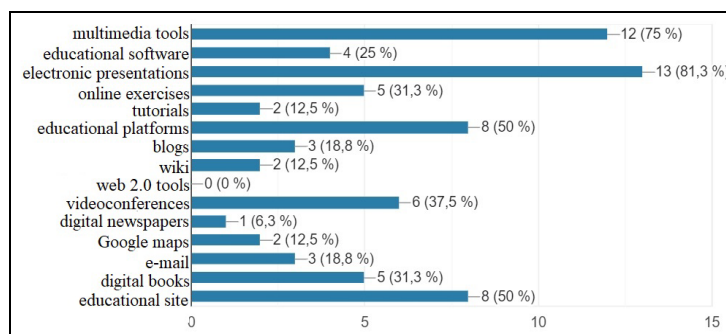


Figure 8. The digital tools used by the teachers of the other disciplines
Source: Author's own contribution.

From the responses of the teenagers highlighted in Figure 8, it appears that teachers mainly used electronic presentations (81%), multimedia tools (75%), educational platforms (50%) and educational websites (50%). In addition, the young people stated that the electronic textbook, online applications and video conferencing are applied in the classroom teaching by only one third of the teachers. Students specify a significantly lower utilization of digital resources in the instructional process for digital tools such as tutorials (12%), wiki (12%), newspapers/electronic boards (6%), Google Maps (12%), and e-mail (19%).

Moreover, item 18 (multiple possible answers) aimed to determine the purpose for which teenagers believe that teachers should use digital resources in the educational process: in teaching, for learning activities, in evaluation, for communication and socialization. According to respondents, all learning activities should include digital resources, while three-quarters of them believed that teachers should use digital materials in instructional activities, and 62% said that for communication and socialization. Only 44% (seven students) believed that technology should be valued through formal assessment methods.

Item 19 was an open question that offered students the opportunity to note personal suggestions for teachers regarding the use of technology in the instructional process. A third of students made no recommendations on this topic, but the other responses mentioned that: “technology should be integrated into the teaching method of teachers either for examples, for exercises, special platforms for the respective subject, in any way that can be useful for both students and teachers”; “(teachers) would help to be more open in using technology, but not to exaggerate”; “(teachers) should use more technology for better teaching of courses”; “(teachers) should bring video materials, educational videos”. Therefore,

the students' suggestions revolve around the teachers' openness towards the integration of technology in teaching, the efficiency of teaching using technology, respectively the preference of young people for educational videos.

Next, the following two questions referred to the learning platforms used during the pandemic (item 20), as well as those currently used by students (item 21). Thus, the data presented in Table 1 suggest a decrease in the use of digital learning platforms in the post-pandemic era compared to the time of the pandemic.

Table 1. Ranking of digital learning platforms used during the pandemic versus those used today

No.	Digital learning platforms used in the pandemic	No.	Digital learning platforms in use today
1.	Google Classroom, Google Meet (100%)	1.	Google Classroom (75%)
2.	Zoom (94%)	2.	Whatsapp (56%)
3.	Kahoot! (87%)	3.	Zoom (44%)
4.	Whatsapp (81%)	4.	Google Meet (12%)
5.	Padlet (37%)	5.	Kahoot!, Padlet, Teams, Facebook, Google Forms, Edmodo, eTwinning, Webquest, Powtoon, Mentimeter, Moodle (0%)
6.	Teams (19%)		
7.	Facebook, Google Forms (6%)		
8.	Edmodo, eTwinning, Webquest, Powtoon, Mentimeter, Moodle (0%)		

Source: Author's own contribution.

Since the number of digital learning platforms currently used is twice as small as during the health crisis, it is easy to understand the preference of digital natives for their teachers to integrate electronic devices connected to the internet to a greater extent in the pedagogical approach. For example, reading the rankings illustrated in Table 1 suggests a decrease in the use of interactive platforms that offer virtual rewards, such as Kahoot!, as well as intensifying the role of the WhatsApp platform in current educational communication, even surpassing Zoom and Meet platforms. At the same time, students confessed that they have not used the following digital learning platforms so far: Edmodo, eTwinning, Webquest, PowToon, Mentimeter and Moodle.

Despite the lower use of technology compared to the health crisis period, adolescents are aware of the need for teaching with the help of technology to maximize the results of their learning efforts. In this sense, three quarters of the respondents claimed that by using technology in the classroom they will register a progress in learning, and a quarter of the students did not know how to answer (item 22).

However, the main context in which they considered that digital competences can be developed is represented by the home environment (94%), while the formal framework of education is placed in second position (87%), and private courses in third place with 81%. It should be noted that all students chose at least three of the four possible options, including the professional environment in the ways of developing digital competences.

At the same time, the surveyed teenagers identified the double dimension of the need to develop digital skills for both personal and professional life in the majority (94%), with only one opinion expressed on the exclusivity of a professional purpose (item 24). It is noteworthy that the adolescents surveyed, who follow the real profile with a specialization in mathematics-computer science, studied ICT for one hour per week until the 10th grade and computer science for two hours per week according to the framework plan in grades IX-X. From the 11th grade onwards, they had four hours per week of computer science. Despite the fact that annual averages in grades IX and X for ICT are an essential component in obtaining a professional competence certificate for grade XII graduates, only four teenagers believed that their digital competences developed as a result of studying ICT (Figure 9).

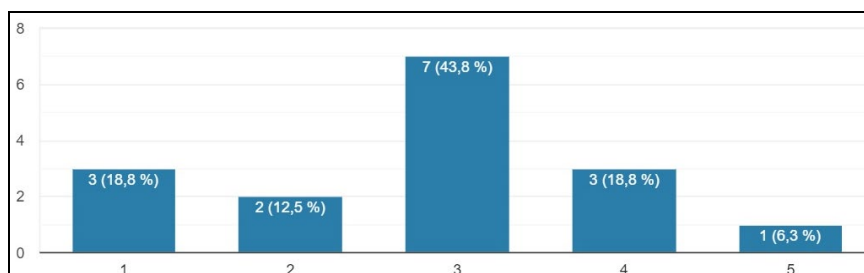


Figure 9. Students' opinion regarding the impact of ICT skills on their own digital skills (using the Likert scale, where "1= very low" and "5= very high")

Source: Author's own contribution.

As a result, Figure 9 highlights a neutral opinion of seven of the questioned students, who declared a moderate impact of ICT skills on their own digital skills, while two teenagers assessed the impact as "small", and three students claimed that the impact of was "very small".

While students did not provide additional input on the last open question of this subchapter of the electronic questionnaire, which focused on the integration of technology in the classroom for developing students' digital competences, the subsequent subchapter addressed adolescents' preferences for communication. In this regard, one of the questions sought to identify the main communication channels used by digitally native students, who had the opportunity to select three preferred options from the following list: e-mail, SMS, phone call, Facebook, Messenger, Instagram, Snapchat, Twitter, WhatsApp, other messaging apps, Skype, Zoom, Discord, Tik Tok. Thus, the WhatsApp application is at the top of the preferences of all students included in the questionnaire-based survey, closely followed by the Instagram application (87%). In addition, only five students stated that they used to call their friends by phone, while only one respondent preferred Messenger, Twitter or Tik Tok applications. On the other hand, young people admitted that they do not use e-mail, Facebook, Snapchat, Skype or Zoom to communicate with friends.

5. Conclusions

Data analysis from a sample of 16 mathematics-computer science students, obtained through the administration of an initial digital competency identification questionnaire, indicates that the primary objectives for utilizing digital resources for learning include the completion of homework assignments and the study of foreign languages, programming, and robotics. These findings also provide insight into the first research question (R.Q.1).

In addition, according to data interpretation adolescent participants exhibited moderate digital competencies. This finding supports the conclusion drawn by Botnariuc et al. (2020) that, despite increased access to digital learning platforms and resources, students may lack the necessary skills to effectively utilize these tools for learning. At the same time, we identified a moderate level of digital exclusion caused by the lack of access to a personal computer connected to the internet for six of the participants in the initial questionnaire. As a result, the conclusion of Holmes' research (2022) is confirmed, which highlights the major role of students' residence in the level of digital exclusion by limiting access to the internet and the benefits of the virtual educational environment. Moreover, data analysis indicates that adolescent participants unanimously believe that their learning activities should incorporate digital resources (R.Q.2). Furthermore, a majority (75%) of study participants reported that teachers should utilize digital educational materials during instruction, with educational videos and animated or graphic examples cited as preferred digital learning resources.

In the opinion of teenagers, the digitization of education should not have stopped after the end of the pandemic, with the majority expressing their desire to continue to benefit from a range of digital educational services: transmitting grades from tests and projects or taking preparation tests in different subjects. As the profile of the teenagers included in the study places them in the paradigm of digital natives, it is easy to understand the high level of affinity they have for using electronic devices in class, confirmed by the results of the first research instrument applied.

Obviously, the two and a half years of e-Learning have created new learning routines, as well as new communication behaviors with which digital natives have become familiar, associating the paradigm of education with the integration of technology in all dimensions of the educational process (teaching, learning, evaluation). However, the survey results indicate a decrease in the use of interactive learning platforms that offer virtual rewards, compared to the pandemic years when education was conducted exclusively online and the number of digital educational resources used in the instructional process was twice as consistent. That is why giving up these new digital learning behaviors is viewed negatively by young people who are mostly (94%) aware of the need to develop digital skills for both personal and professional life.

Furthermore, the age of the teenagers included in the study involves the holistic acquisition of ICT competencies that young people have already developed within the homonymous discipline until the end of the 10th grade. However, only four participants in the initial questionnaire-based survey stated that their own

digital skills have developed because of taking the ICT course. At the same time, the analysis of the initial questionnaire confirms recent studies on the superior openness to the integration of technology in the educational process manifested by younger teachers, compared to teachers with vast experience, who prefer traditional methods. These results are consistent with those presented in other recent studies (Hämäläinen et al., 2021; Antonietti et al., 2022; Runge, 2023), which highlight the low predisposition of teachers with rich experience at the lectern to use electronic devices in teaching.

Last but not least, the school must acquire a higher level of adaptability to the new requirements of the labor market in terms of digital competencies that go beyond the sphere of digital education, so that it can equip all students with the necessary set of skills and competencies imposed by the era of digital technologies (Ceobanu et al., 2022, Werfhorst et al., 2022).

Given the numerous advantages of integrating digital technologies into the educational process, as well as the relatively moderate level of digital competencies of students who have already completed the ICT discipline in full, it is necessary to reconsider the current curriculum of the upper cycle of the real profile, mathematics-computer science specialization, which currently excludes the study of the ICT discipline starting with the 11th grade (Stoica, 2022), although the content of this subject is part of the bibliography of the certificate exam taken by graduates of the 12th grade.

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