AN ASSESSMENT OF THE INTEGRATION OF ICTs INTO TEACHING PROCESSES BY SCIENCE TEACHERS: THE CASE OF ALBANIA

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Abstract

Many studies have recently focused on the importance of the effective integration of Information and Communication Technology (ICT) tools in science education and the need for science teachers to receive adequate training and support to use them effectively. This paper aims to explore the Albanian science teachers' perceptions and use of ICTs in teaching processes. The study provides an interpretative analysis of the opinions of science teachers teaching in the middle and high schools of several Albanian regions expressed in an online survey. Overall, the results suggest that the use of ICT by science teachers in Albania is limited by a lack of proper infrastructure, limited access to technology, and training of teachers on integrating technology. However, there are indications that the adoption of ICT in science education may increase in the future, particularly after the boost from the COVID-19 pandemic emergency.

Keywords – Technological skills, Digital facilities, Science education, ICTs in teaching.

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1. Introduction

The challenges of education today are providing lasting knowledge and building problem-solving skills. This requires working on educational strategies, adding new qualities in teaching, and learning and promoting schooling models towards 'interactive' teaching. Under the ongoing expansion of the integration of ICTs into education, the assessment of their impact on the academic performance has received increased attention (Comi, Argentin, Gui, Origo & Pagani, 2017; Hardman, 2019; Ramírez-Rueda, Cózar-Gutiérrez, Colmenero & González-Calero, 2021).

The use of ICTs in the classroom is considered very important for providing opportunities for students to learn to operate in an information age and assisting them in learning more effectively (Bingimlas, 2009). However, the successful integration of ICTs in education is a complex process, requiring the necessary technological infrastructure, increased teacher training, as well as the willingness and motivation of teachers. For centuries, teachers have been traditional in teaching methodology, primarily by their choice

rather than the environment's influence. Their methods and behavior have changed slowly over time but permanently have not departed too much from traditional teaching methods. Therefore, learning is also based on the conventional way, although students seem more open to innovations and to adapt to new technological methods (Castronova, 2002; Ma, Andersson & Streith, 2005; Murray & Pérez, 2015; Tang, Mao, Xing & Naumann, 2022).

The presence of technical equipment at schools only makes some teachers proficient in using them effectively, as they also need additional digital skills and knowledge in ICTs (Mishra & Koehler, 2006; Fraillon, Ainley, Schulz, Friedman & Gebhardt, 2014; Stinken-Rösner, 2020). These skills will help teachers improve their work and make teaching more straightforward and more accessible, and interactive. However, to achieve all these technological skills, teachers will need extra time to learn new techniques, and consequently, more effort to integrate these methods. This is not an easy process for educators as it puts them in front of new challenges and responsibilities. Thus, their steps toward professional development under technological development seem to be slow and small. Most of these problems became evident during online teaching because of the Covid-19 pandemic, which forced teachers and students to shift from traditional to online teaching and learning (Yadollāhi, Tavakoli-Torghe, Poorsālehi-Navide & Āzartāsh, 2021; Todd, 2020). Nevertheless, studies show that teachers seem to be positive and open toward digital teaching and absorption of technical skills (Sailer, Stadler, Schultz-Pernice, Franke, Schöffmann, Paniotova et al., 2021; Askar, Usluel & Mumcu, 2006) if suitable digital equipment and facilities are placed in their workplace (Akcil, Uzunboylu & Kinik, 2021; Teo, 2009; Shiue, 2007).

Studies show that educators in different countries illustrate different approaches to technological development for many reasons related to teacher motivation, expertise, and collaboration (Konstantinidou & Scherer, 2021). Moreover, the levels of teaching practices and the emphasis on developing digital literacy and computational thinking, along with the relations to the teacher and school-level variables, vary between countries. This observation necessitates taking an international perspective on teaching with technology. Research and educational policymakers are needed to account for the broader context in which teachers operate, such as the social, political, and economic infrastructures into which these new technology-based forms of work are embedded (Saikkonen & Kaarakainen, 2021).

The use of ICT by Albanian science teachers has been a topic of interest in recent years, but there is limited research focused explicitly on this topic. Based on our search, few studies have examined the use of ICT by teachers in general in Albania. Bushati, Gorishti, Vidacek-Hains and Baroll (2012) present reflections on learning and teaching through ICT in the Albanian and Croatian HEI-s as case studies examples Prenjasi, Allegra and Demkanin (2019) investigated the use of ICT by pre-service and in-service teachers of science in Albania. The study suggests that ICT can be used in science education to provide access to internet resources, make learning active and constructive, and increase the interest and motivation of learners and their involvement in classroom activities. A study by Prodani, Çobani, Bushati and Andersons (2020) explored the ICTs availability and use by students and by their teachers in the Korca region of Albania. The study found that while some teachers used ICT tools such as multimedia presentations and online resources, many faced challenges related to limited access to technology and a lack of digital training.

With this study, we aim to investigate the use of ICT among Albanian science teachers in a particular educational setting and assess how they incorporate technology into their teaching practices, the barriers they face, and the impact of technology on student learning outcomes. The study also explores teachers' attitudes toward ICT and their perceptions of the effectiveness of technology in enhancing their teaching and improving student engagement and achievement. By identifying the factors that influence teachers' adoption of ICT, this study seeks to provide insights that can inform policies and practices to promote the effective integration of ICTs in Albanian education.

2. Methods

2.1. Data Collection and Participants

The population of interest included science teachers teaching natural science subjects in secondary and high schools in Albania. The teachers were invited via email and SMS to complete an online survey with twenty-eight closed questions and one open question. The questionnaire was organized into four sections. The first section included questions on the teachers' demographic characteristics, e.g., subject and level of teaching, teaching experience, age, gender, and school characteristics. The second part included questions covering the school's digital infrastructure for teaching (equipment, internet connection) and teachers' training. The third section asked teachers about their digital competence and the use of ICTs in teaching processes. The last section covered the perception of the role of ICTs in teaching and learning processes and an open question where teachers gave extra opinions on the topic. The questionnaire questions were formulated based on the literature review (OECD, 2009) conducted on this topic and reviewed by two experts. The draft questionnaire was first sent to 25 teachers to validate it and to achieve the result reliably. After this step, the survey questions are finalized. The web-based survey was sent to teachers via email or SMS on 16 March 2022 and remained open until 30 September 2022. In total, 186 science teachers from different counties of Albania (i.e., Tirana, Durrës, Fier, Dibër, Vlorë, Korçë, Kukës, Elbasan, Lezhë) participated in the study. The response rate was 14.8 % (186 out of 1250 teachers invited).

Participants were teachers of biology, chemistry, mathematics, physics, and computer science. The respondents' average age was 38.59 ± 9.1 years, where 159 (85.5%) were females, and 27 (14.5%) were males. The teaching experience varied from 1 to 40 years of experience, with an average of 13.27 (± 9.35) years. About half of the respondents, 101 (54.3%), were teaching in urban area schools, and the rest, 85 (45.7%), were in rural area schools (Table 1).

Teacher characteristic	N	%	School	N	%
Gender			School status		
Male	27	14.5	Public	146	78.5
Female	159	85.5	Privat	40	21.5
Level of teaching			School area		
Middle school	39	21	Urban	101	54.3
High school	131	70.4	Rural	85	45.7
Middle & High	16	8.6			

Table 1. Participants and schools' characteristics

2.2. Data Analysis

The data preprocessing and analysis are performed in SPSS 28.0 and R Statistics software. The data exploration is based on frequencies, descriptive statistics, and graphical visualizations. The relationships between the teacher's characteristics and several selected nominal features in the survey are tested using the Chi-square test for independence. To test whether the distribution of cases in a single categorical variable was equal across categories, we used the Chi-square goodness-of-fit test.

3. Results

3.1. Equipment of the School with Digital Equipment and Teachers' Training

In this section, we explore the digital equipment of schools and the training provided to teachers. Based on teachers' statements, the internet access offered by schools seems to be related to the status of the school and the area. The level of internet access provided by schools to teachers and students was higher in private compared to public schools ($X^2_{(2)} = 49.6$; $p < 0.0001$). Schools in urban areas had higher levels of internet access compared to rural schools ($X^2_{(2)} = 54.5$; $p < 0.0001$). About thirty-six percent (67/186) of the teachers had no access to personal computers. Teachers with teaching experience of fewer than ten years were more likely to have a personal computer compared to older teachers with teaching experience of more than 20 years ($X^2_{(2)} = 8.14$; p = 0.017).

Table 2 gives a summary of the technological equipment accessed by teachers in their classrooms. Based on these results, the technological equipment available in the classrooms is less frequent in rural schools compared to urban schools, with $p < 0.05$ in all cases. In general, schools are equipped with computers, interactive whiteboards, projection systems, and audio/video equipment only in some classrooms, or digital equipment is provided at teachers' request. In addition, about 32.9% of teachers in rural schools do not have access to computers, and 51.8% do not have access to a projection system. Interactive whiteboards are absent in 90.6 % of rural and 48.5% of urban schools.

Most teachers, with the same rates in rural and urban areas ($X^2_{(1)} = 0.95$; p=0.33), state to have attended training mostly related to the use of computers and few other digital equipment in recent years. Nevertheless, only half of the respondents attended training concerning the integration of ICTs into the curriculum (Figure 1). Teachers teaching in schools based in urban areas were more likely to have attended this kind of training ($X^2_{(1)} = 38.29$; $p < 0.0001$).

Technological equipment available in the classrooms	In no classroom N(%)	In some classrooms N(%)	Upon request by the teacher N(%)	In all classrooms N(%)	$X^2(3)$ p-value*
Schools' Computers					
Rural	28 (32.9)	51(60)	1(1.2)	5(5.9)	16.05
Urban	28(27.7)	44(43.6)	16(15.8)	13(12.9)	0.01
Interactive whiteboards					
Rural	77(90.6)	6(7.1)	0(0)	2(2.4)	37.78
Urban	49(48.5)	31(30.7)	2(2)	19(18.8)	<0.0001
Video conferencing					
Rural	83(97.6)	1(1.2)	0(0)	1(1.2)	52.62
Urban	50(49.5)	26(25.7)	11(10.9)	14(13.9)	<0.0001
Audio equipment					
Rural	77(90.6)	7(8.2)	0(0)	1(1.2)	49.56
Urban	42(41.6)	32(31.7)	12(11.9)	15(14.9)	<0.0001
Digital camera					
Rural	84(98.8)	1(1.2)	0(0)	0(0)	27.32
Urban	71(70.3)	9(8.9)	9(8.9)	12(11.9)	<0.0001
Projection system					
Rural	44(51.8)	6(7.1)	34(40)	1(1.2)	32.66
Urban	34(33.7)	28(27.7)	21(20.8)	18(17.8)	<0.0001

Table 2. Technological equipment available in the classrooms in rural and urban schools
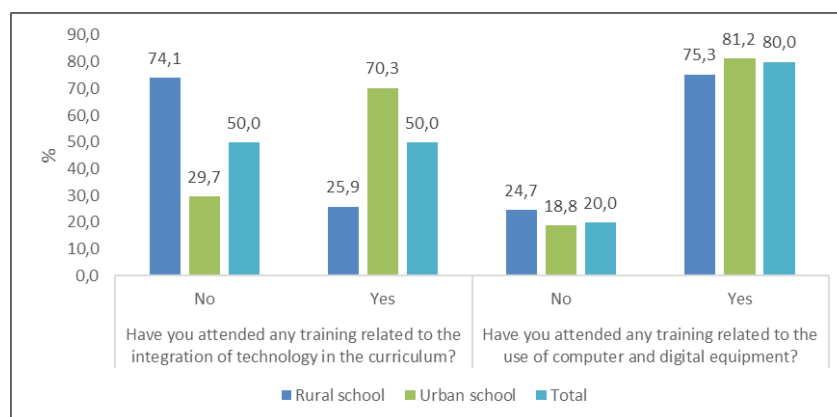

Figure 1. Frequency of training attended by teachers in rural and urban areas related to using digital equipment and integrating ICTs in the curriculum

3.2. The Use of ICTs By Teachers and Their Skills

The most frequent technological equipment used by teachers to support teaching and learning is the computer, with 29% of teachers using them, followed by smartphones and projector systems, with the level of use 19% and 17%, respectively. About 20% of teachers state they do not use technological equipment to teach and rely on the blackboard only. When asked about the frequency of performing basic computer operations such as folder management, printing, and Windows operating system, 8.1% stated that they do not have any experience, and 29.6% used it always (Figure 2). More than half of the teachers are familiar with Microsoft Office applications such as MS Word, MS Excel, and MS PowerPoint and use them always or from time to time. About 17.7 % of respondents perform photo editing frequently, 39.2% state to have used it before, and 17.7% did not have any experience with this task.
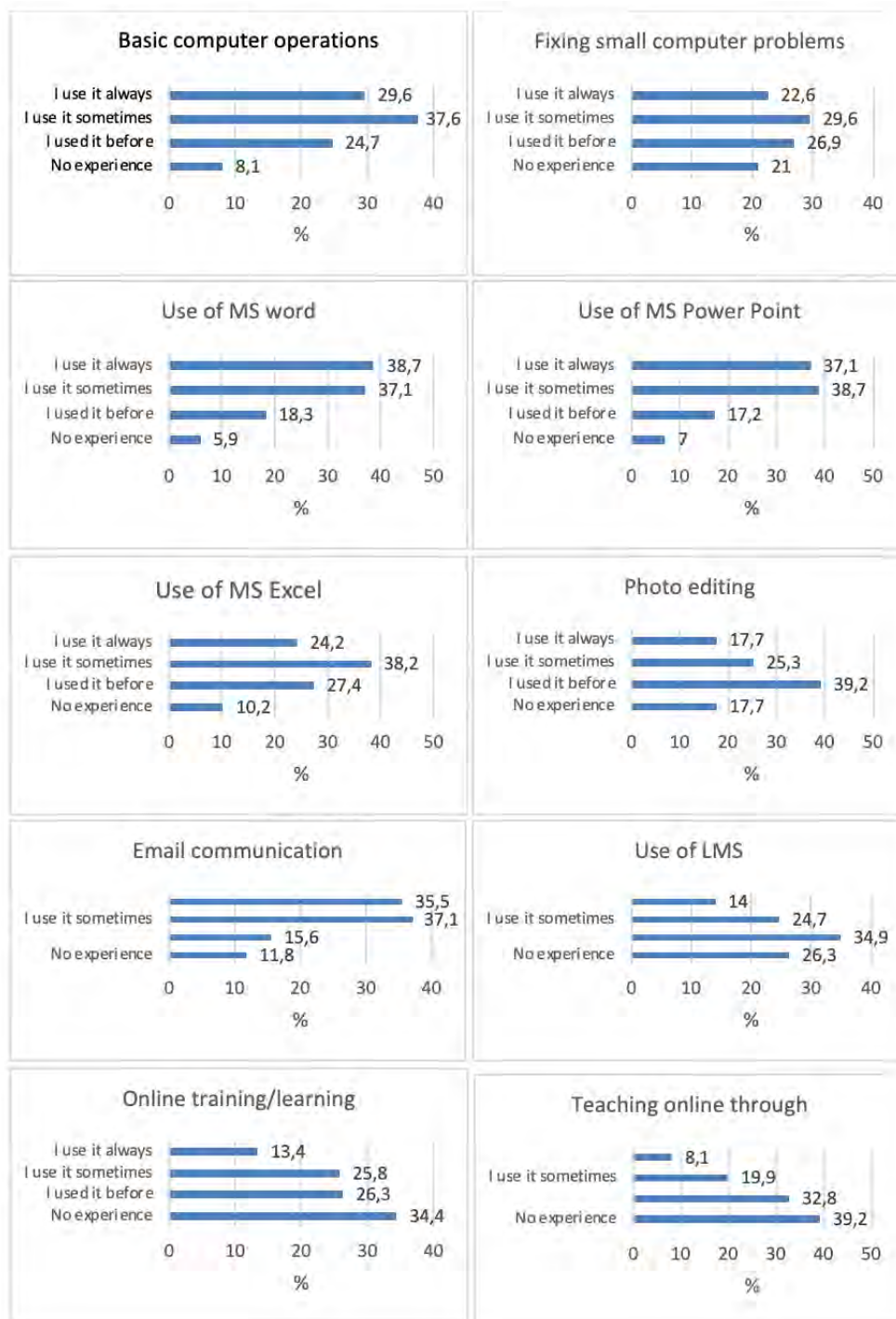

Figure 2. The frequency of use of some important ICTs tools by science teachers

Most teachers, 72.6%, use email to communicate occasionally or continuously, and 38.7 use a learning management system (LMS). Regarding online training and learning, about 34.4% of teachers state they do not have any experience, and only 13.4% use it always. Teachers who always apply the use of webinars for their teaching process make up 8.1%, while 39.2% have no experience with this tool (Figure 2). Younger teachers with teaching experience of fewer than ten years and 11 to 20 years are more likely to be comfortable using ICTs in teaching processes (see Figure 3). However, this relationship was not statistically significant (Kendall's tau-c = 0.044, p=0.453), which shows a non-meaningful difference between young and old teachers.
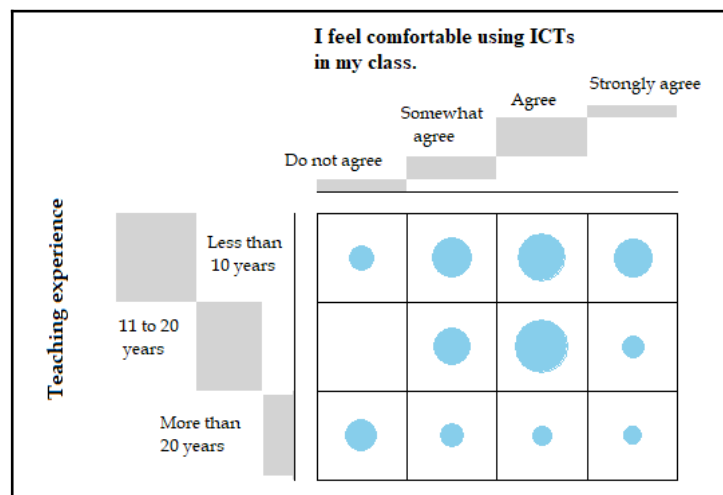

Figure 3. Relationship of teaching experience and commodity to use ICT in their classroom

3.3. Teachers' Perceptions of the Role of ICT In Teaching Science

In this part of the survey, teachers were asked to share their perceptions on the use of ICT in science education. Many teachers mark as important and very important the use ICTs for communication and networking, to support continuous teachers training, to facilitate the teaching of difficult concepts, to support students' creativity and critical thinking, and find and prepare teaching materials (Figure 4). To increase the use of technology in teaching, most of the respondents (78%) consider access to digital equipment as important to very important ($X^2_{(1)} = 24.6$; $p < 0.0001$), about 86.1% state that training and courses on the use of ICTs are important to very important ($X2(1) = 35.8$; $p < 0.0001$). Other important factors which could stimulate teachers to use ICTs more in their classes are the inclusion of ICT in the curriculum, time to explore and improve ICT skills, and stimuli related to work, such as salary and promotion (Table 3).

According to 88.7% of teachers, the motivation of students to use ICT for learning purposes is medium to high, and for 69.9% of them, the students' use of ICTs to learn their subject is medium to high. Overall, teachers state that students like technology-based learning (Table 4).

When asked if it is difficult for them to integrate technology into teaching processes, 45.7% stated the difficulty is medium, and 18.8% rated it as high. Technology-based teaching is highly valued by 37.6% of teachers, while 51.1% gave moderate importance to technology-based teaching. The ICTs have helped teachers significantly during the COVID-19 pandemic online teaching. During this period, teachers state to have highly improved their digital skills (Table 4).
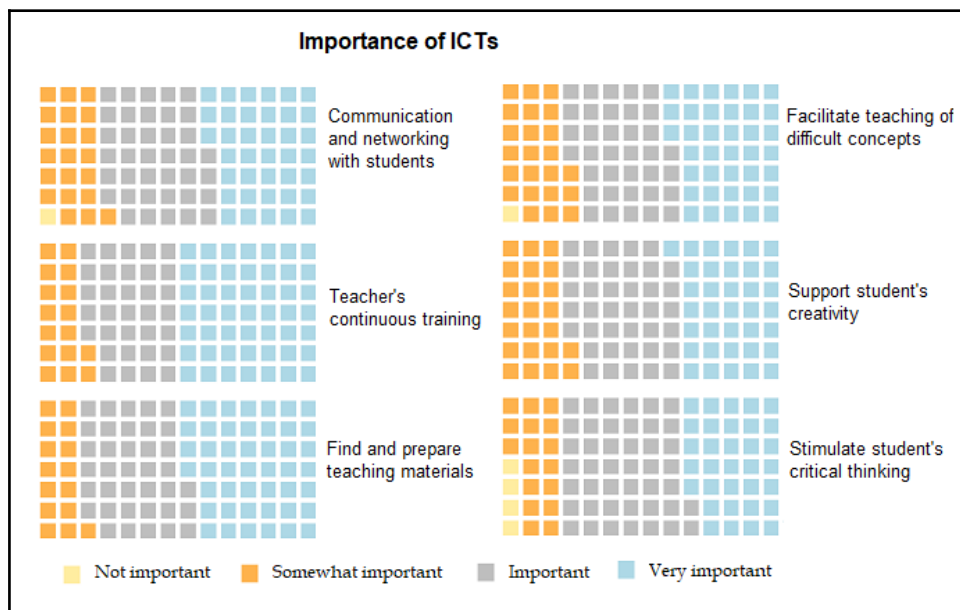
Figure 4. Teachers' perceptions of the role of technology in teaching processes

How important are the following to increase the use of ICT in teaching processes?	Not important	Somewhat important	Important	Very important	p-value
Access to digital equipment	4(2.20)	37(19.9)	53(28.5)	92(49.5)	<0.001
Training and courses on the use of ICT	4(2.2)	22(11.8)	47(25.3)	113(60.80)	<0.001
Inclusion of ICT in the curriculum	2(1.1)	28(15.0)	85(45.7)	71(38.2)	<0.001
Time to explore and improve ICT skills	0(0)	28(15.0)	66(35.5)	92(49.5)	<0.001
Stimulus related to work, such as salary, promotion	6(3.2)	27(14.5)	46(24.7)	107(57.5)	<0.001

Table 3. Factors that could stimulate teachers to increase the use of technology in teaching sciences

Answer the following questions	None	Low	Moderate	High	p-value
Are students motivated to use ICT for learning purposes?	9(4.8)	12(6.5)	119(64.0)	46(24.7)	<0.001
Do students use ICT to study your subject?	8(4.3)	48(25.8)	91(48.9)	39(21.0)	<0.001
Do students like ICT-based learning?	5(2.7)	15(8.1)	103(55.4)	63(33.9)	<0.001
Is it difficult for you to integrate technology into the teaching processes?	15(8.1)	51(27.4)	85(45.7)	35(18.8)	<0.001
How much do you value the technology-based teaching	7(3.8)	14(7.5)	95(51.1)	70(37.6)	<0.001
How much has ICT helped you during the pandemic?	3(1.6)	10(5.4)	68(36.6)	105(56.5)	<0.001
How much has the COVID-19 pandemic affected ICT skills?	0(0)	17(9.1)	85(45.70)	84(45.2)	<0.001

Table 4. Students' motivation to use ICT and the role of the COVID-19 pandemic on teachers' ICT skills

3.4. Teachers' Open Comments On the Use of ICT In Teaching

The last last question of the survey was an open question where teachers were invited to drop their free opinions and comments on the topic in general. Many comments were related to the absence of digital equipment in their classrooms. Teachers state that every educational institution must have virtual

environments with the necessary technological tools, such as a computer in each class and good internet. Teachers mention that an ICT laboratory should be created in each school, and training for teachers and students should be provided frequently. Teachers say: "Students do not have technological equipment, and the school does not provide them. If the classes do not have their computer and projector, it is pointless to discuss technology. Teachers want to use technology, but the school has no conditions."

The pandemic and modern times have made teachers understand how important technology is to their students and themselves. They state that ICTs should be given more attention by the teacher and used as much as possible. Older teachers state that, for them, it is challenging to adapt to technology, and they prefer a much better blackboard. There are also teachers that have created their digital schoolbook and do not feel any difficulty in using ICTs in their teaching. Teachers state that students are passionate about technology, so we must teach them how to use their passion to learn valuable things that will benefit them in the future.

4. Discussion

The integration of ICTs in science education has been a topic of interest in the global research community for several decades. In particular, the use of ICT by science teachers has been identified as a critical factor in enhancing science teaching and learning in schools. In this study, we aimed to explore the integration of ICTs in teaching processes by Albanian science teachers and their perceptions of the role of ICT in science education.

Our findings show that access to the internet and the technological devices provided are limited and related to the school's status (public/private) and location (urban/rural). In many cases, teachers tend to resolve this issue by using their laptops or other personal devices, but this is mainly considered a solution by younger teachers having less than ten years of teaching experience. A recent study by Miço and Cungu (2022) highlighted the need for acquiring digital knowledge for teachers according to different age groups. The study found that the difficulties teachers encountered in acquiring digital knowledge were not only due to deficiencies in teacher training but also other issues, such as lack of infrastructure. Another study by Ates and Garzon (2021) concluded that younger teachers tend to enjoy the use of mobile applications in science teaching more than older science teachers and are more comfortable in using ICT to facilitate their everyday work. Ktona, Paparisto, Kika, Çuka, Çollaku and Koroveshi (2019) found that "Bring Your Own Device" policies in combination with learning technologies would solve the lack of digital devices and would be feasible in Albania.

Most of the respondents admit that the most frequent technological equipment used by them to support teaching and learning are simple devices such as computers, smartphones, and projector systems. Smart boards and other sophisticated devices and ICT methods are rarely used also because they are not accessible by teachers. About 20% of teachers state they do not use technological equipment to teach and rely on the blackboard only. These results are related to the teachers' technological skills. Many teachers admit to lacking experience in basic technological operations such as folder management, printing, and other Windows operating system actions. In contrast, a small percentage (29.6%) admit to always using these skills (Figure 3).

Studies have shown that there is a positive correlation between the frequency of ICT use and teachers' teaching approach, their ICT skills, and professional commitment (Voogt, 2010). ICT-based activities must be integrated into the curriculum to complement other traditional activities. However, the use of ICT is challenging for teachers because it requires logistics, technical expertise, and needs to update pedagogical skills. The successful use of ICTs depends on the ability to use them and the purposeful application of the software tools, which would increase learning benefits. To help teachers improve their ICT skills, it is crucial to combine essential experience with collaboration and support from specialized colleagues (Rogers & Twidle, 2013).

Interestingly, most teachers mark using ICTs as very important for communication and networking, supporting continuous teacher training, facilitating the teaching of complex concepts, supporting students' creativity and critical thinking, and finding and preparing teaching materials (Figure 5). Consequently, many of the respondents admit that ICT methodology in the teaching and learning process will be highly improved if the teachers will have more access to digital equipment, the inclusion of ICT in the curriculum, time to explore and improve their ICT skills, and stimulus related to work, such as salary and promotion (Table 3). Other studies (Koroshi, Roseni & Kërbizi, 2022) also show that most pre-service teachers respond positively to the need for improvements in the teaching process and acknowledge the importance of incorporating ICT. Nevertheless, most of them continue to be traditional in their teaching methodology.

Research shows that by applying personalized learning, and having strong ICT support, Albanian math teachers can ensure students' success in math (Starja & Shyti, 2020). This study showed that using Smart board teachers was associated with increased interest and activation of students, creating happy students who believe in their abilities and are motivated to be successful. The integration of ICTs in teaching processes increases flexibility, students can access learning resources, develop creative knowledge, and get prepared for lifelong learning. Teachers should demonstrate multiple competencies, the ability to adapt to new technological developments, and on the other hand, keep their commitment and vocation to teaching. They must have theoretical knowledge, teaching skills and vocation, interprofessional knowledge, and lifelong learning ability to succeed (Yao, Han, Qiu, Pi, Wang, Meng, 2023).

The COVID-19 pandemic revealed the need for digital competence and the necessity to teach in an online or hybrid mode was apparent, and science educators, as well as students, had to improve their digital skills (Miço & Cungu, 2022; Koçiaj, Dhoqina, Revani & Brahimaj, 2021; Xhelili, Ibrahimi, Rruci & Sheme, 2021). Schools in some countries seemed better prepared than others, and teachers were more comfortable and prepared to handle the situation (Klusmann, Trippenze, Fokkens-Bruinsma, Sanderman & Schroevers, 2022). Limaj (2021) reports that Albanian teachers faced significant challenges adapting to online ICT teaching. This study found that teachers used traditional and modern teaching methods and faced challenges related to a lack of access to technology and inadequate training. This indicates that support is needed for teachers facing online teaching and ICT-based due to social emergencies. An effort needs to be made by institutions and other instances to support teacher education, considering pedagogical and professional development (Crompton, Burke, Jordan & Wilson, 2021; Avidov-Ungar & Forkosh-Baruch, 2018).

Our results show that about 34.4% of teachers do not have any experience with online training and learning, and only 13.4% use it often. Interestingly, face-to-face learning was preferred to online learning, even by Swedish teachers, who have a long tradition of online education and great digital equipment (Tarchi, Brante, Jokar & Manzari, 2022).

However, implementing the technology required for teaching is time and energy-consuming for teachers, who must learn new ICT-based methods and prepare materials such as presentations, quizzes, websites, etc. In addition, ICT-based teaching can lead to a digital gap among students. Those more experienced with ICT will have more advantages and progress faster than others. Another issue is that not all teachers are good ICT users, and they may not regularly update the content of courses. The use of ICT can also increase plagiarism levels as students can use copy-paste information from other sources without developing their skills (Bushati et al., 2012).

Overall, our findings suggest that while Albanian science teachers recognize the potential benefits of ICT use in science education, they face several challenges related to the lack of access to technology, insufficient training and support, and limited resources. To address these challenges, it may be necessary to provide more training and support for teachers and increase access to technology and resources. Several studies have shown that science teachers who use ICT effectively can promote student engagement, motivation, and achievement in science. Science teachers who used ICT to support student-centered learning were more successful in promoting critical thinking and inquiry-based learning, positively

impacting student motivation and attitudes towards science. ICT can also support science teachers in developing and delivering more effective science lessons through simulations, virtual experiments, and interactive animations that could facilitate the development of conceptual understanding and higher-order thinking skills among students.

Finally, the report on intelligent education in Albania (Kraja, 2023) identified the challenges to developing innovative education. It recommended that Albania invest and pay attention to the digitization of education and the integration of ICTs in education. The development of digital education resources, the professional development of in-service teachers, and the initial training of future teachers with digital competencies should also be the focus of the government and other influential factors.

5. Conclusions and Remarks

Our research and existing literature indicate that the utilization of ICT by science educators has the potential to enhance the teaching and learning of science in schools. Nevertheless, despite the potential advantages of incorporating ICT into science instruction, science teachers encounter various challenges when employing ICT in the classroom. These challenges include limited access to technology, insufficient training and support, and difficulties integrating ICT into established science curricula. For science teachers to effectively incorporate ICT, they must have access to digital equipment, appropriate ICT resources and receive adequate training and support. The COVID-19 pandemic has accelerated the adoption of ICT tools and resources among science teachers in Albania, suggesting a potential increase in the use of ICT in science education in the future. To facilitate this, it is necessary to implement favorable policies that support teachers in enhancing their digital skills and provide guidance on how ICT can enhance their teaching methods and students' learning capabilities.

Declaration of Conflicting Interests

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