

Use of Digital Technology in Online Mathematics Teaching during COVID-19 in Kosove

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Abstract

Coronavirus COVID-19 has brought major changes to higher education worldwide. Due to COVID-19, the e-learning methodology has started to be used in learning processes. However, online teaching has proven to be not always an appropriate solution in education especially for teaching mathematics. While some support online learning, others oppose it by offering arguments that teaching online mathematics has not been proven to be successful. This study examines selected two Universities and one College in Kosovo, as a case study, to see the effectiveness of online learning for the subject of mathematics. Further, consequently, makes a comparison between the online with traditional method of teaching in addition to examining the ways teachers in higher education in Kosova universities apply and integrate technology into teaching mathematics. This study employed questionnaires with the professors. The results show that Professors are satisfied with the online teaching of Mathematics, leading so to the conclusion that teaching online is an effective educational method.

Keywords

Online Teaching, Digital Technology, Mathematic Course, Software, Coronavirus COVID-19

1. Introduction

Online teaching requires certain knowledge mainly in the organization and creation of learning environments with the help of information technology. Some of the main difficulties reported by university professors regarding online courses come from the complexity of the learning situation and shortcomings in planning and organization. Thus, professors are trying to find the most appropriate and stimulating online learning methods for their students. These challenges are

closely related to the existing difficulties related to the proper use of technology, especially in the subject of mathematics, namely the conceptual understanding of ideas and mathematical communication. In the subject of mathematics there are some challenges that are specific to its online learning.

In Kosovo, Universities have found the transition from classroom to online classrooms very challenging (Morina, Uka, & Raza, 2021). There are many reasons to start learning online, especially at the University and College level. Online learning enables a higher level of professor interaction with students living in different countries. Interaction and online learning is provided through human-computer interaction information technology tools such as Microsoft PowerPoint, Google Meet, Moodle, Zoom, forums, blogs, online and media discussion groups, face-to-face conversations and live visual communication (Beldarrain, 2006). Oza (2022) discusses the skills and competencies that teachers must possess to learn effectively in online learning contexts. These information technology devices may not be sufficient to ensure the interoperability and effectiveness of learning in online mathematics teaching (Maclaren, 2014). Various information technologies, as well as pen-based technology, have begun to be widely used in recent years to facilitate interaction and increase effectiveness, particularly in distance-based online courses (Mehlhorn, Parrott, Mehlhorn, 2011).

This is also happening due to the flexibility in terms of location, time, work and different costs of transportation and accommodation (Qian, 2018). Additionally, given the dynamics of contemporary life, work and study at the same time, travel expenses, the cost of accommodation for classrooms, etc. online learning and teaching is seemingly an adequate option. However, the most current ground behind having to teach and learn online is the rise of the Covid-19 worldwide pandemic situation.

Schools around the world are already using a wide variety of extant digital technologies for mathematics teaching. According to (Clark-Wilson, Oldknow, & Sutherland, 2011) existing tools that are based on innovation include dynamic graphing tools, dynamic geometry tools, algorithmic programming languages, spreadsheets, data loggers (motion detectors and GPS), and computer algebra systems (CAS). Furthermore, CASs such as Mathematica, Maple, MuPAD, MathCAD, Derive and Maxima can facilitate active learning approaches, which enable students to become active participants in the discovery process and consolidate their personal knowledge, thereby enhancing their theoretical and geometrical comprehension and providing a more on-depth learning strategy (Kumar & Kumaresan, 2008).

Recently, the world has been facing with the COVID-19 for more than a year now, which has greatly affected the education field as well (Mian & Khan, 2020). Students conclude they don't support learning Mathematics online as much as they do learning it in traditional way. Practically, the online learning of Mathematics is not as successful as one might have thought. More precisely, the COVID-19 has brought the need to switch from traditional to online learning

and teaching to a great extent (Çerkini, Zejnullahu, & Hyseni, 2022). This urgent need to learn and teach online, caused by the recent COVID-19 pandemic, has added to the problems and workloads of university staff who try hard to balance their teaching obligations. Access to technology in the classroom alone is not enough; the professor and the syllabus should play a critical role in mediating the use of information technology equipment.

The challenges of switching from traditional to online learning have also been felt in Kosovo. Thus, this study investigates closely whether there has been any positive impact in switching from traditional to online learning in Kosovo selected universities from the professors' perspective.

2. Methodology

In this paper the representative research model was used and the quantitative method for data collection was selected using as a research questionnaire with structured questions. The questionnaire was distributed to 8 mathematics professors in the from two public Universities and one College in Kosove: University of Prishtina (UP), University of Applied Sciences in Ferizaj (UASF) and AAB College. University professors were elected from the group of Professors who have taught Mathematics in online form and physical form in advance. Data are analyzed, interpreted and presented with Statistical Package for the Social Sciences (SPSS) program. The results are presented in tabular form to provide a clear understanding. Students are not included in the questionnaire because the study was conducted only from the perspective of professors at the University level.

3. Data Analysis

In this paper, two types of analysis of the results of the questionnaire have been done:

- Descriptive analysis and
- Comparative analysis

The responses given by the selected respondents indicated that they consider the online learning of mathematics as successful during the time of COVID-19. They claimed to support online teaching of mathematics more than the traditional method. The results have been carefully elaborated and presented in the text below.

3.1. Data Analysis with SPSS

SPSS program is used for data analysis. We first did a descriptive analysis and then proceeded with the comparative analysis.

3.2. SPSS Descriptive Analysis

As already shown in **Figure 1** for research a sample of 8 professors was deliberately selected from two Universities: UASF, UP and AAB College, with the

composition presented in the chart below (3 from UASF, 2 from UP and 3 from AAB).

Table 1 shows that 50% of respondents indicated that they have less than five years of experience in teaching mathematics, while 50% of respondents indicated that their experience is 6-20 years.

Regarding the participation of students in mathematics lessons in the virtual form, compared to physical participation, 62.5% of respondents said that the participation was the same, while 37.5% estimated that the online participation of students was not level same as physical participation in classes as it is further illustrated in **Table 2** below.

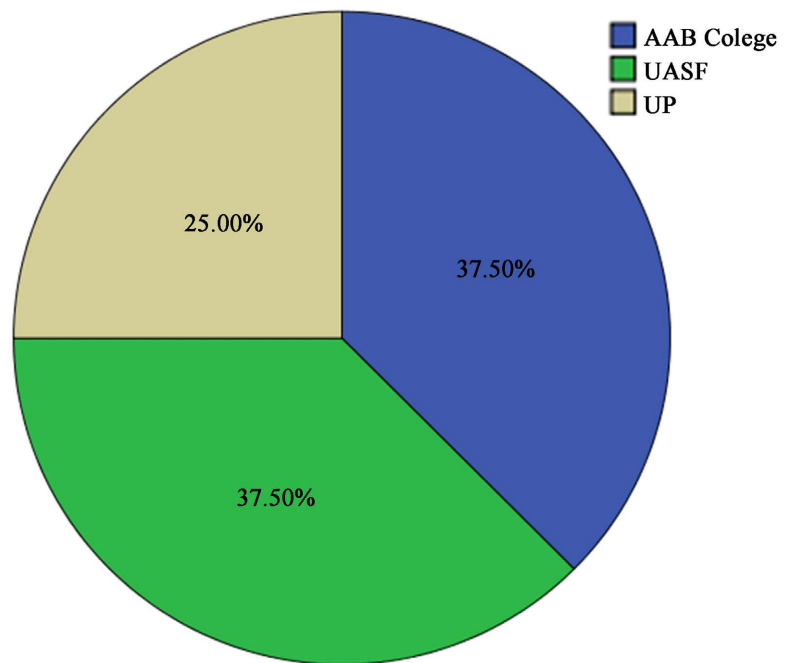


Figure 1. At which University/College do you teach?

Table 1. How many years of experience on mathematics teaching do you have?

		Frequency	Percent	Valid Percent	Cumulative Percent
	1 - 5 Year	4	50	50	50
Valid	6 - 20 Year	4	50	50	100
	Total	8	100	100	

Table 2. Has the level of student participation in the subject of online mathematics been the same as with the teaching in the classroom?

		Frequency	Percent	Valid Percent	Cumulative Percent
	Yes	5	62.5	62.5	62.5
Valid	No	3	37.5	37.5	100
	Total	8	100	100	

Table 3 demonstrates that most of the surveyed professors (75% of them) indicated that they faced challenges during teaching in mathematics, mainly in the technical aspect which made the teaching difficult and the way of realization of the practical part as well as the student evaluation process. Whereas 25% of the respondents did not say that they had any challenges during online teaching, compared to that of physical presence.

Table 4 shows that learning mathematics in the online form for a considerable part of the respondents (75%) is considered to be successful or very successful, while 25% of the respondents had a neutral attitude. None of the respondent does not perceive that online learning was not successful.

As to what electronic devices the surveyed professors had used in the online teaching of the subject of mathematics. Most were used computers/laptop and white board followed by Tablet, whereas only one respondent had used X Pen Pro Artist as it is further illustrated in **Table 5** below.

The distribution of the use of these devices by universities is given in Cross-tabulation presented in **Table 6** below.

Table 3. Have you faced challenges in teaching mathematics online during the pandemic?

		Frequency	Percent	Valid Percent	Cumulative Percent
	Yes	6	75	75	75
Valid	No	2	25	25	100
	Total	8	100	100	

Table 4. How successful has the online learning of mathematics during the pandemic been from your perspective?

		Frequency	Percent	Valid Percent	Cumulative Percent
	Neutral	2	25	25	25
Valid	Successful	4	50	50	75
	Very Successful	2	25	25	100
	Total	8	100	100	

Table 5. Digit devices frequencies.

		Responses		Percent of Cases
		N	Percent	
What digital devices have you used to teach	White Board	5	31.20%	62.50%
	Laptop/Computer	6	37.50%	75.00%
	Tablet	4	25.00%	50.00%
	X Pen Pro Artist	1	6.20%	12.50%
Total		16	100.00%	200.00%

a. Dichotomy group tabulated at value 1.

Table 7 shows that the use of equipment for online learning, the above was not difficult for 62.5% of respondents, while 37.5% of them said that they had difficulty in using technologies in the implementation of online learning of mathematics.

Regarding the realization of exercise part of online mathematics tasks, from the Crosstabulation given below, it can be seen that most of the respondents from UASF and AAB indicated that they performed them with whiteBoard and tablet, while the respondents from UP said that the practical part was realized with tablet and X Pen Pro, as it is further illustrated in **Table 8** below.

Student assessment most of the respondents (50%) had done the physical presence of students in the test, 37% of the surveyed professors had done the

Table 6. Digit Devices * University Cross Tabulation.

			At which University/College do you teach?			Total
			AAB College	UASF	UP	
What digital devices have you used to teach mathematics online? ^a	White Board	Count	2	3	0	5
	Laptop/Computer	Count	3	2	1	6
	Tablet	Count	1	2	1	4
	X Pen Pro Artist	Count	0	0	1	1
Total		Count	3	3	2	8

Percentages and totals are based on respondents. a. Dichotomy group tabulated at value 1.

Table 7. Have you faced difficulties using the technology for online learning of mathematics?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	3	37.5	37.5	37.5
	No	5	62.5	62.5	100
Total		8	100	100	

Table 8. Online Exercise * University Cross tabulation.

			At which University/College do you teach?			Total
			AAB College	UASF	UP	
How have you accomplished the exercise part of online mathematics tasks? ^a	Exercise with white board	Count	3	3	0	6
	Exercise with tablet	Count	1	1	1	3
	Exercise with X Pen Pro Artist	Count	0	0	1	1
Total		Count	3	3	2	8

Percentages and totals are based on respondents. a. Dichotomy group tabulated at value 1.

online student testing and only one respondent (12.5%) had done the student assessment of had done by observing the activity of students and giving them various tasks to perform during class and at home which is shown in **Table 9**.

3.3. SPSS Comparative Analysis

To understand whether the experience of professors in teaching mathematics had an impact on three other measured factors such as: 1) facing teachers with challenges during online mathematics teaching, 2) the level of perceived success of online teaching and 3) in the difficulties encountered in using technology for online learning of mathematics, in this research we conducted the correlation analysis.

From the correlation matrix presented in **Table 10** below, it can be seen that

Table 9. How have you examined mathematics' students knowledge?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid With Online test	3	37.5	37.5	37.5
By their physical presence	4	50	50	87.5
By observation and giving different kind of tasks.	1	12.5	12.5	100
Total	8	100	100	

Table 10. Correlation.

		How many years of experience on mathematics teaching do you have?	Have you faced challenges in teaching mathematics online during the pandemic?	How successful has the online learning of mathematics during the pandemic been from your perspective?	Have you faced difficulties using the technology for online learning of mathematics?
How many years of experience on mathematics teaching do you have?	Pearson Correlation	1	0	-0.707*	0.258
	Sig. (2-tailed)		1	0.05	0.537
	N	8	8	8	8
Have you faced challenges in teaching mathematics online during the pandemic?	Pearson Correlation	0	1	0	0.447
	Sig. (2-tailed)	1		1	0.267
	N	8	8	8	8
How successful has the online learning of mathematics during the pandemic been from your perspective?	Pearson Correlation	-0.707*	0	1	-0.365
	Sig. (2-tailed)	0.05	1		0.374
	N	8	8	8	8
Have you faced difficulties using the technology for online learning of mathematics?	Pearson Correlation	0.258	0.447	-0.365	1
	Sig. (2-tailed)	0.537	0.267	0.374	
	N	8	8	8	8

*. Correlation is significant at the 0.05 level (2-tailed).

the experience of professors in teaching mathematics does not correlate with any of the three factors mentioned above, so it did not affect the difficulties or challenges faced by professors in teaching mathematics during the pandemic, this is probably with this form of teaching they were attacked for the first time and it was an experience unexplored by the respondents.

4. Discussion

The specific field of study in this paper has not been studied before in Kosovo and I think this paper completes this field of study. The findings revealed that online teaching of mathematics is successful under the pandemic circumstances if the adequate methodology and technology is applied. Most of the surveyed professors indicated that they faced challenges during teaching in mathematics, mainly in the technical aspect which made the teaching difficult and the way of realization of the practical part as well as the student evaluation process. According to the professors, the technology used for online teaching mathematics course is white board, Laptop/Computer, Tablet and X Pen Pro Artist. The use of these technology for online learning was not difficult for most of the professors. Regarding the realization of exercise part of online mathematics tasks, most of the respondents from UASF and AAB indicated that they performed them with white Board and tablet, while the respondents from UP said that the practical part was realized with tablet and X Pen Pro. Most professors had done student assessment on their physical presence on the test, while a few professors had done student testing online. The findings further show that teachers' tendency to use Information and Communication Technology (ICT) integration is associated with the teacher's age, gender, level of study, and participation in vocational learning activities. Older professors still use the whiteboard and younger ones have started to use digital technologies more. Professors have faced the challenge of having adequate tools available and utilizing technology in the online teaching of mathematics. The study also showed that teachers who have access to online learning resources have higher levels of confidence in teaching mathematics than teachers who do not use the Internet for teaching purposes. Also in this paper it can be seen that the experience of professors in teaching mathematics has not affected the difficulties or challenges faced by professors in teaching mathematics during the pandemic, it was probably with this form of learning they were first confronted and it was an unexplored experience by the respondents.

5. Conclusion

In Kosovo, during the COVID-19 pandemic, some mathematic professors viewed online teaching practices as an experiment as a learning experience or technology test. During this time, while Kosovar society was involved in the fight against the virus, the education community took on the responsibility of attending online classes at all levels of education. Although difficult at first, the professors

eventually became accustomed to teaching online. Online teaching Mathematics course in Kosovo and broader are a modern topic nowadays related to e-learning. The increasing use of the Internet divides users into two basic groups based on their understanding: the pros and cons of ICT integration. To date, studies focusing on the impact of the Internet on the knowledge and skills of teachers and students have not yielded clear results. If teachers try to use ICT in their classrooms, after a certain period they will find that using them does not give better learning process results, but neither does it make them look worse. However, this ICT can provide valuable information to teachers about other ways that motivate and interest students, increasing the effectiveness of explanation and including proactive methods in their classrooms.

Based on the questionnaires results, professors are satisfied with the online learning and do not notice any difference with the physical classroom learning. So online education is an effective way of education in the field of mathematics. In this paper the challenges of teaching from the perspective of professors are explored, we did not examine the responses and engagement of students. Despite identifying the various challenges, we found that some professors developed effective teaching strategies to cope with the difficulties that arise during online teaching. This study aims to focus on specific online teaching guidelines as well as the digital technology used and to provide unique online teaching experiences in Kosovo. Our results are limited to only three universities in Kosovo, but they provide a direction for future research. A more detailed paper will help us better understand the nature of online teaching especially for the subject of mathematics.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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