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Research Article

Enhancing mathematics education in the UAE: Elementary teachers' views on distance education methods

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ABSTRACT

The COVID-19 pandemic has brought about an unprecedented reliance on digital technologies in education, regardless of the pre-existing attitude of teachers. This study explores elementary school teachers' perceptions about teaching mathematics through distance education. Using a quantitative approach, an online questionnaire was administered to primary teachers in the UAE during the spring semester of 2020-2021. The results show teachers' readiness to adopt digital technology in teaching against increased workload. Difficulties emerged in optimizing student performance in online environments. While the institution supports digital integration, teachers prefer traditional in-person classroom instruction. Therefore, the research would inform some educational systems and curriculum planning worldwide on the best way to integrate digital technology within elementary mathematics education. The study aims to close the gap in mathematics education within a digital context to solve the emerging educational demands.

Keywords: distance education, elementary education, information and communication technology, mathematics education, United Arab Emirates

INTRODUCTION

Technology develops daily and is reflected in our society and our lives, specifically in education (Hinojo-Lucena et al., 2018). The educational system experiences a profound impact from information and communication technology (ICT), significantly influencing progress in the learning and teaching stages (Garrote Rojas et al., 2018). Using ICT can potentially transform both the classroom and the teaching process in schools, granting students and teachers access to a wealth of information across diverse locations and modalities (Salleh et al., 2019).

In March 2019, prompted by the pandemic, educational institutions in the UAE transitioned from conventional face-to-face classes to distance education (DE). Teaching practices using ICT have been well-documented in the past decades. However, this was no longer an option due to the pandemic, as all teachers had to shift their teaching mode and teach their subjects online. Before the pandemic, the application of digital technology in mathematics classrooms was noted for its inconsistency in quantity, quality, and

effectiveness (OECD, 2015). The education crisis brought about by the pandemic has compelled educators to embrace a diverse range of digital technologies as a primary resource for learning and teaching, irrespective of their pre-existing beliefs and practices concerning technology integration. However, this sudden and forced change may be viewed as an opportunity for a considerable shift in how technology is used by mathematic educators in future online, face-to-face, and/or blended classrooms (Attard & Holmes, 2020). Even though the use of digital technology for education is viewed as imperative by some, there are still several questions regarding when and how digital technology ought to be used and whether the use of it can transform and improve the experience of the students, particularly in mathematics education (Bower, 2017). Successfully incorporating digital technologies into teaching and learning mathematics is a multifaceted challenge that demands careful consideration of diverse elements, encompassing content, pedagogy, and student learning. Using digital technology for teaching mathematics can prove ineffective and distracting unless meaningfully integrated into the learning process (Becker et al., 2017).

As we strive to return to normalcy, we must delve into educators' perspectives gained during DE experience amid the pandemic. This exploration is essential for optimizing student outcomes in future teaching and learning endeavors. This research was conducted in the third semester of the 2020-2021 school year to investigate the views of elementary school mathematics teachers on using DE to teach mathematics to grade 1-grade 5. The study is significant, as the UAE always aims to be a leader in the industry and many sectors, especially the educational sector (Almarashdi & Jarrah, 2022). The UAE also seeks to be one of the first countries to use technologies and DE effectively (Alnaqbi, 2020). Hence, this research aims to contribute valuable insights to the field of education by elucidating teachers' perspectives, particularly those of mathematics educators in the UAE. These findings can be instrumental in enhancing DE teaching practices and addressing the challenges they encounter.

Research Questions

The study aimed to answer the following research questions:

1. How do teachers view the experience of instructing mathematics through DE model?
2. What challenges do elementary teachers face when delivering mathematics education through DE model?
3. What are the anticipated preferences of elementary teachers for utilizing DE model in teaching mathematics in the future?

LITERATURE REVIEW

Teaching Mathematics

Teaching mathematics is a multifaceted and crucial endeavor in molding students' problem-solving abilities, logical reasoning, and overall cognitive growth (Forsström & Kaufmann, 2018). Central to teaching mathematics is the imperative for teachers to cultivate a profound comprehension of mathematical concepts instead of mere rote memorization of formulas and procedures. Encouraging students to delve into the underlying "whys" of mathematical principles empowers them to apply their knowledge to various real-world scenarios. This instructional approach aligns harmoniously with the constructivist philosophy of learning, which posits that students actively construct their understanding by engaging with mathematical ideas (Bature, 2020).

One primary challenge in teaching mathematics involves addressing the classroom's diverse learning styles and aptitudes. Teachers must deploy differentiated instructional techniques tailored to the specific needs of each student. This encompasses adapting innovative teaching methodologies, using various learning materials, and integrating technology.

The inclusion of technology has resulted in a significant transformation in mathematics education (Mukuka et al., 2021). Educational software, interactive applications, and online resources provide dynamic tools for visualizing and exploring mathematical concepts. These resources enhance the appeal of learning and facilitate personalized educational experiences.

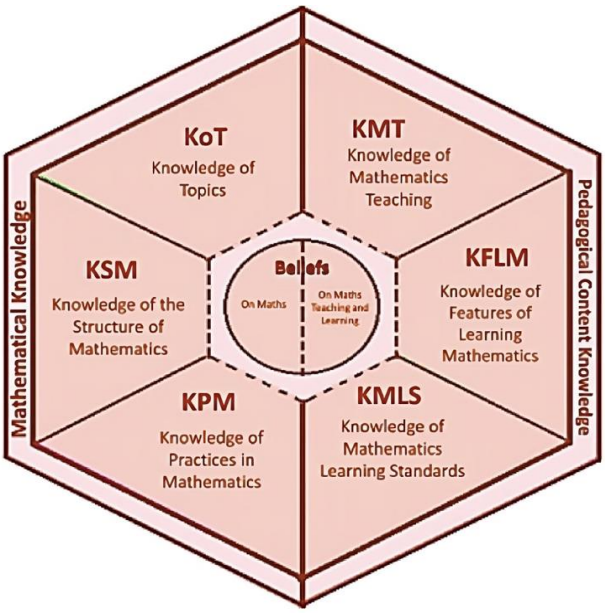

Figure 1. Mathematics teacher specialized knowledge–MTSK model (Carrillo-Yáñez et al., 2018, p. 241)

Moreover, the thoughtful integration of technology into mathematics teaching considers four pivotal dimensions: the teacher's role, student needs, the nature of mathematics, and the tools utilized in the instructional process. These interconnected dimensions play a critical role in shaping the effective integration of technology in mathematics teaching and learning.

As illustrated in **Figure 1** (Carrillo-Yañez et al., 2018), the teacher's beliefs occupy the focal point due to their intricate interplay with the two knowledge domains. In this context, "beliefs" encapsulate a less explicit collection of truths, notions, mental constructs, inclinations, and interpretations held by educators (McQuagge, 2020), which wield a significant sway over classroom dynamics and, consequently, students' learning outcomes.

Teachers' beliefs act as a mediator between knowledge and its application. In a study conducted by Fukawa-Connelly et al. (2016) at the tertiary level, a compelling contradiction was observed between faculty members' beliefs regarding mathematical teaching and their actual classroom practices. As an average pedagogical practice, 85.0% of the faculty used lectures, whereas 82.0% responded that the preferred way of teaching was "lecturing". However, 56.0% of faculty members agreed that students acquire a deeper understanding when engaging in mathematical activities during class beyond attending lectures and taking notes. This shows a disparity between the beliefs concerning student learning and the actual teaching practice.

Niess et al. (2009) suggested using the technology, pedagogy, and content knowledge (TPACK) model, which serves as an intersection and connection of content, pedagogy (teaching and student learning), and technology. Moreover, TPACK, relating to mathematics teachers, offers process strategy and thinking process guidelines. Niess et al. (2009) observed mathematics teachers for almost four years using spreadsheets and integrating them into classrooms. The findings indicated that faculty were able to progress and achieve targets using a five-stage development process:

(1) recognizing,

(2) accepting,

(3) adapting,

(4) exploring, and

(5) advancing.

Although Tekinarslan (2008) focuses on the idea that teachers need to be equipped with adequate knowledge, most researchers agree that technology should only be used as a tool and not as an objective of education (Usta & Korkmaz, 2010).

Distance Education

Education systems face significant challenges from emerging ICT in today's global landscape. These technologies have exerted substantial influence on the global economy, corporate governance, and the trajectory of globalization. Furthermore, they possess the transformative potential to redefine educational landscapes, encompassing both traditional and remote learning institutions. ICT has often been referred to as the contemporary phase of DE. In 1989, Soren Niper introduced a pioneering analysis that categorized DE into three generations. The initial phase included correspondence teaching, followed by a second generation marked by multimedia instruction that integrated printed materials, broadcast media, cassettes, and, to some extent, computers (Guri-Rosenblit, 2005). According to Anderson and Dron (2011) the "third-generation DE introduced interactive technologies: first audio, then text, video, and then web and immersive conferencing." (p. 81) Over time, the terms 'distance education', 'e-learning' and 'online learning' have become interchangeable in the discourse of policymakers, scholars, and practitioners, underscoring the ongoing convergence between traditional and remote learning methods (Guri-Rosenblit, 2005). While there are instances of overlap between the terms, they are not synonymous in most cases. According to Babson survey research group report (Seaman et al., 2018), DE can be defined as "education that uses one or more technologies to deliver instruction to students who are separated from the instructor and to support regular and substantive interaction between the students and the instructor synchronously or asynchronously" (p. 5).

We are currently on the cusp of a fresh era in DE, potentially marking the birth of a new generation that combines the advantages of extensive media production, cooperative engagement, and personalized progress. This forthcoming era leverages the capabilities of widespread networked coordination and cooperation spread across the world, offering individuals the chance to connect, learn, and work together, offering mutual support and encouragement, all while preserving the essential freedoms of setting their own pace and determining start and finish dates (Anderson, 2009).

Using Distance Education for Mathematics Education

In a research conducted by Karr et al. (2003), the efficacy of three distinct delivery modes (face-to-face, online, and blended) was compared in a graduate-level engineering mathematics course. The study's results revealed that students exhibited notably better performance in the analytical component of the course when utilizing the online mode. The enhancement in performance was credited to the consistency of online materials and the emphasis on self-directed learning. Conversely, students in traditional classes exhibited slightly better performance on in-class exams, presumably due to instructor-provided hints. Furthermore, the on-campus test groups showed the highest performance when granted access to traditional and online modes, catering to diverse learning preferences. Overall, the disparities in performance across these groups were minimal, underscoring that students tended to excel in their preferred method of instruction. In summary, this research highlights the potential effectiveness of online learning, emphasizing that success depends on students' learning preferences and the adaptability of instructors to evolving educational methods. Additionally, in the study by Barlovits et al. (2021), pertinent criteria for online mathematics tasks were identified, encompassing factors such as individual control, material availability, performance assessment, structural elements, and feedback options. The noted shift toward digitization has prompted the creation and use of digital tools that align with the demands of mathematics instruction.

Toptas and Oztop (2021) investigated the opinions of primary school teachers regarding the factors contributing to students' challenges in learning mathematics. The findings revealed that teachers emphasized issues like limited interaction, problems in assessment, lack of feedback, maintaining student focus, individualized attention, accommodating diverse learning styles, and using digital tools effectively. Additionally, teachers emphasized the need for a student-centric approach in DE, promoting concrete and engaging materials, continuous reinforcement, real-life applications of mathematics concepts, and fostering students' digital skills and motivation (Toptas & Oztop, 2021). Another study about primary school teachers' experiences with DE from Yuzbasioglu et al. (2023) found that student absenteeism, lack of internet access and devices among students, and parental indifference negatively impacted the quality of remote learning. While two-thirds of the teachers could follow their annual teaching plans in DE, they faced challenges such as prolonged screen time, decreased motivation, and concerns about their student's academic progress.

Table 1. Participants demographics

Variables	Variable items	Frequency	Percentage (%)
Years of experience	Less than five	31	34.4
	Six-10	34	37.8
	11-15	14	15.6
	More than 15	11	12.2
Educational level	Bachelor's	74	82.2
	Master's	14	15.6
	Doctorate	2	2.2
Gender	Male	15	16.7
	Female	75	83.3
Total		90	100

Previous research has shown that teacher motivation fluctuated during DE, likely due to their unpreparedness for this teaching mode (Yuzbasioglu et al., 2023).

According to Rice's (2006) observations, research in K-12 DE and adult DE is frequently initiated by evaluating student achievement compared to traditional face-to-face instruction. Media comparison studies within K-12 DE echo the "no significant difference phenomenon" noted in adult education. However, scrutinizing this domain poses challenges due to the lack of standardized experimental comparative methods to accommodate numerous variables. Studies in this field also face small sample sizes, disparate comparison groups, and instructor expertise and training discrepancies. Undeniably, some students thrive in virtual learning environments while others struggle, just as in traditional classrooms. For Rice (2006), the crucial factor is understanding the essential elements within an educational context that foster student success rather than the medium used for instruction. This author also underscores that the effectiveness of DE is more intricately linked to the instructor, the learner, and the methods of learning rather than the specific medium used. Supporters of DE have frequently emphasized that the quality of a course, rather than its delivery method, has the most significant impact on student learning. Xu and Jaggars (2011) assert that creating and delivering high-quality online courses with sufficient student support can pose more important challenges than traditional face-to-face courses. Also, according to these authors, if institutions aim to enhance academic achievement and progression in education through increased online course offerings, they may need to allocate considerably more resources to develop and assess programs and strategies explicitly tailored to enhance retention and learning outcomes for online students (Xu & Jaggars, 2011).

METHODOLOGY

Research Design

To investigate teachers' perceptions of teaching mathematics through DE, a quantitative study method was employed. An online questionnaire was distributed to gather data from primary teachers in the UAE during the spring semester of the academic year 2020-2021.

Participants

Our study encompassed a diverse group of 90 educators responsible for teaching mathematics in grade 1-grade 5 across private and governmental schools in Al Ain City, in the UAE. Among the participants, 75 were female educators, while 15 were male, all of whom volunteered to contribute to our research. To gather this cohort, we employed a convenience sampling approach, wherein we made questionnaire available online and allowed individuals to autonomously opt-in. This method was chosen due to its convenience and suitability for online research. Participants exhibited varying levels of education and years of experience (**Table 1**).

Data Collection

After finalizing the questionnaire and establishing the instrument's validity and reliability, the researchers started preparing the questionnaire using online Google Forms and launched it to receive responses. Specifically, a link to the questionnaire was sent to send to all primary teachers in government and private schools. The questionnaire remained accessible for nearly 30 days during which 90 replies were received.

Table 2. Cronbach's alpha

Domain	Cronbach's alpha
Perceptions of teaching mathematics	0.80
Obstacles of teaching mathematics	0.83
Teachers' preference for future	0.75

Table 3. Normality test

	Kolmogorov-Smirnov(a)			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Perceptions of teaching mathematics	0.077	90	0.200*	0.975	90	0.084
Obstacles of teaching mathematics	0.083	90	0.174	0.977	90	0.107
Teachers' preference for future	0.092	90	0.059	0.978	90	0.126

Note. *This represents a conservative estimate of actual significance

Instruments

After reviewing the current literature on teachers' perceptions of teaching mathematics using DE in elementary schools, the authors developed a questionnaire. The final version of the questionnaire consisted of 37 items with a Likert scale ranging from one (indicating strong disagreement) to five (indicating strong agreement). The questionnaire had four sections with five questions about demographic data, 15 about teachers' perceptions of teaching mathematics online, 13 about barriers to teaching mathematics online, and four about teachers' preferences for the future.

Validity of questionnaire

Concerning the instrument's validity, a panel of two educators and three university professors conducted a review. This evaluation aimed to ascertain the questionnaire's pertinence and appropriateness in alignment with the study's objectives. The panel members were requested to offer detailed feedback concerning the selection of words, the types of questions, and the quantity of inquiries. After the revision was complete and approved, the researchers pilot-tested the questionnaire by distributing it to 30 elementary mathematics teachers. Educators who participated in the pilot testing were excluded from the final sample of the questionnaire.

Reliability of questionnaire procedures

As was mentioned earlier, the researchers applied the instrument in a pilot sample and used Cronbach's alpha coefficient method to measure the reliability of the current study instrument. The instrument' overall Cronbach's alpha value was found to be 0.79. Cronbach's alpha for each questionnaire field was also calculated (**Table 2**). **Table 2** displays Cronbach's alpha values for each domain of the questionnaire as well as the overall questionnaire. Cronbach's alpha values fell within the range of 0.75 to 0.83. Hence, the researchers established the questionnaire's validity, reliability, and readiness for distribution among the targeted population sample (Gay et al., 2012).

RESULTS

Normality Test

The survey focused on three fundamental questions. Hence, a normality test was conducted for the variables of these three questions, as indicated in **Table 3**. It is evident from **Table 3** that all the statistical significance values were greater than the level of statistical significance (α=0.05), which indicates that these variables follow a normal distribution, so parametric tests were used to show the effect of the independent variables (p-value<0.05).

Question 1: What are Teachers' Perceptions of Teaching Mathematics Using DE Model?

To address this question, the means and standard deviations of teachers' perceptions were calculated and subsequently arranged in descending order, as illustrated in **Table 4**. **Table 4** shows that the item "I'm able to use different digital technologies for teaching mathematics" receives the highest mean 4.43. In contrast, the

Table 4. Means (M) & standard deviations(SD) of teachers' perceptions

Rank	Statement	M	SD
1	I'm able to use different digital technologies for teaching mathematics.	4.43	0.835
2	I'm able to adapt my lessons to online teaching to improve student learning.	4.39	0.760
2	I'm able to use digital technologies to represent mathematical ideas.	4.39	0.817
2	I'm able to use technology to support students' learning for the lesson.	4.39	0.870
5	I'm able to use digital technologies to solve mathematics questions.	4.37	0.800
6	I can integrate mathematical content, digital technologies, & teaching approaches to support students' learning of mathematics.	4.27	0.872
7	Online teaching has increased my skills with technologies for teaching mathematics.	4.21	0.954
8	Online teaching helped me use more methods of teaching mathematics than face-to-face teaching.	4.14	0.943
9	Online teaching requires more time and availability than traditional teaching.	4.11	1.116
10	Online teaching increased my workload compared to traditional teaching.	3.97	1.175
11	I am more effective in the face-to-face classroom than in online sessions.	3.91	1.242
12	Online teaching is more stressful than traditional teaching.	3.84	1.271
13	Online teaching has a positive effect on student's achievements.	3.37	1.166
14	Online teaching made me more confident in teaching mathematics than face-to-face teaching.	3.33	1.324
15	Online teaching is more suitable for teaching mathematics to elementary students than face-to-face.	2.89	1.361
Average		4.00	0.549

Table 5. Means (M) & standard deviations(SD) of obstacles encountered by elementary teachers when teaching mathematics using DE, ranked in a descending order

Rank	Statement	M	SD
1	School resources were available during online teaching	4.13	0.824
2	As a teacher, I had enough training from my school to teach mathematics online	4.07	0.946
3	Tools that are used for online teaching are flexible	4.04	0.911
4	Tools that are used for online teaching are easy to understand.	3.99	0.841
5	As a teacher, instructional preparation time has increased due to online teaching.	3.74	1.186
6	As a teacher, I need to learn new teaching methods to teach mathematics online.	3.70	1.213
7	As a teacher, teaching mathematics online makes me more stressful	3.68	1.225
8	Students' ways of communication have not improved due to online teaching.	3.58	1.199
9	Student's learning of mathematics has become harder in online classes than in traditional classes.	3.57	1.209
10	Students have learned less during online teaching than in traditional classrooms.	3.57	1.307
11	Student's motivation in mathematics has decreased due to online teaching.	3.50	1.318
12	Students' participation in mathematics classes has declined because of online teaching.	3.43	1.350
13	As a teacher, I faced difficulties using online resources while teaching mathematics.	2.93	1.347
Average		3.69	0.671

item "Online teaching is more suitable for teaching mathematics to elementary students than face-to-face" was ranked last with a mean of 2.89. The average mean of perceptions regarding the teaching of mathematics (4.00) is also presented in **Table 4**.

Question 2: What Obstacles are Elementary Teachers Encountering When Teaching Mathematics Using DE Model?

In addressing this question, the mean and standard deviation of elementary teachers' challenges when instructing mathematics online were calculated and subsequently arranged in descending order, as outlined in **Table 5**. **Table 5** shows that the item "school resources were available during online teaching" receives the highest mean of 4.13. In contrast, the item "As a teacher, I faced difficulties in using online resources while teaching mathematics online" was ranked last with a mean of 2.93. **Table 5** also shows that the average mean for obstacles to teaching mathematics was 3.69.

Question 3: What are Elementary Teachers' Future Preferences for Teaching Mathematics Using DE Model?

To address the third question, frequencies and percentages reflecting elementary teachers' preferences for teaching mathematics online in the future were calculated and subsequently arranged in descending order, as depicted in **Table 6**. **Table 6** shows that the item "school administration provided me with needed support during online teaching" receives the highest frequency of 79 with a percentage of 87.8%, while item "I enjoy teaching mathematics online" was ranked last with a frequency of 58, with a percentage of 64.4.

Table 6. Frequencies (n) & percentage (P) of elementary teachers' preferences for future for teaching mathematics using DE model

Rank	Statement	n	P (%)
1	School administration provided me with needed support during online teaching.	79	87.8
2	School administration provided me with the training needed to teach online.	77	85.6
3	If I had a choice, I would prefer to teach mathematics face-to-face more than online.	69	76.7
4	I enjoy teaching mathematics online.	58	64.4

Table 7. t-test results of educational level

	Educational level	n	Mean	SD	t	df	Sig. (2-tailed)
Perceptions of teaching mathematics	Bachelor's	74	4.00	0.554	-.094	88	0.925
	Graduate	16	4.01	0.541			
Obstacles of teaching mathematics	Bachelor's	74	3.62	0.685	-1.996	88	0.049
	Graduate	16	3.99	0.517			

Note. *Significant at 0.05 level & SD: Standard deviation

Table 8. t-test results of gender

	Gender	n	Mean	SD	t	df	Sig. (2-tailed)
Perceptions of teaching mathematics	Male	15	3.91	0.505	-0.725	88	0.470
	Female	75	4.02	0.559			
Obstacles of teaching mathematics	Male	15	3.91	0.659	1.436	88	0.155
	Female	75	3.64	0.668			

Note. *Significant at 0.05 level & SD: Standard deviation

Table 9. One-way ANOVA results of years of experience

		n	Mean	Standard deviation	F	Sig.
Perceptions of teaching mathematics	Less than five	31	4.12	0.652	2.427	0.071
	Six-10	34	3.92	0.435		
	11-15	14	3.75	0.580		
	More than 15	11	4.22	0.370		
	Total	90	4.00	0.549		
Obstacles of teaching mathematics	Less than five	31	3.62	0.698	0.226	0.878
	Six-10	34	3.70	0.611		
	11-15	14	3.80	0.757		
	More than 15	11	3.71	0.729		
	Total	90	3.69	0.671		

Note. *Significant at 0.05 level

1. To investigate potential statistically significant differences, a t-test was conducted to address the following questions: Are there any statistically significant differences (α=0.05) in elementary teachers' perceptions and obstacles to teaching mathematics online due to educational level?

The results of t-test are presented in **Table 7**.

Table 7 indicates no statistically significant differences at (α=0.05) in the perceptions of teaching mathematics based on the educational level variable. Conversely, there are statistically significant differences at (α=0.05) in the obstacles faced in teaching mathematics due to the educational level variable, favoring graduates.

2. Are there any statistically significant differences (α=0.05) in the perceptions of elementary teachers and obstacles to teaching mathematics towards teaching mathematics online due to gender?

The outcomes of t-test are presented in **Table 8**.

Table 8 shows no statistically significant differences at α=0.05 in the perceptions of teaching mathematics based on gender variables.

3. Are there any statistically significant differences (α=0.05) in the perceptions of elementary teachers and obstacles to teaching mathematics towards teaching mathematics online due to years of experience?

The outcomes of t-test are presented in **Table 9**. **Table 9** shows no statistically significant differences at (α=0.05) in the perceptions of teaching mathematics based on the years of experience variable.

DISCUSSION

The research findings on the experiences and thoughts of primary mathematics teachers regarding using DE and the additional information from the literature offer a comprehensive outline of teachers' perceptions, obstacles, preferences, and the influence of technology in online mathematics teaching.

The normality test confirms that the variables related to teachers' perceptions, obstacles encountered, and preferences for future teaching methods all follow a normal distribution, allowing for parametric tests. The teachers generally held positive perceptions of teaching mathematics online. Notably, they felt confident using digital technologies to teach mathematics and adapting lessons for online learning. However, there was skepticism about online teaching's suitability for elementary students, as indicated by the low ranking of "online teaching is more suitable for teaching mathematics to elementary students than face-to-face."

Teachers reported encountering various obstacles when teaching mathematics online, with school resource availability being the most prominent. While some obstacles were identified, such as increased instructional preparation time and the need for new teaching methods, the overall perception of obstacles was moderate.

Most teachers will prefer to teach face-to-face rather than DE in the future. Although teachers have reported receiving adequate support and training from the school to teach mathematics online, 76.7% still prefer face-to-face teaching. While traditional classrooms rely on face-to-face teaching through conventional methods of instruction, online teaching demands significantly more effort. This includes converting all content into digital formats and using various technologies and multiple channels tailored to the relevance of the subject matter. Nevertheless, a significant percentage of teachers enjoyed teaching mathematics online, reflecting some level of satisfaction.

According to the literature, teachers' perception of computer technology is a crucial factor influencing its utilization (Liu et al., 2020). Even though teachers can perceive that DE could allow them to learn more digital skills, there are challenges such as limited interaction, assessment problems, student motivation, and the significance of using concrete materials. The quality of a course significantly impacts student learning in DE, and creating high-quality online courses with adequate support can be demanding and may require additional resources. While teachers perceived that online teaching allowed them to learn and use digital tools in this study, their views on its impact on student achievements were mixed, with only 50.0% agreeing that it had a positive effect. Teachers noted that student communication did not improve in online classes, likely because of the lack of direct interaction. This is supported by Almarashdi and Jarrah's (2021) study, which found that students studying mathematics online during the pandemic negatively perceived the loss of interaction with teachers and peers.

The importance of teachers' computer skills, the support they receive, and training opportunities were highlighted in the literature as factors affecting their integration of technology into teaching. Despite support and training, some teachers still favored face-to-face teaching over online instruction, citing the increased effort and the need to convert content into digital formats. This aligns with the study's findings regarding the extra work and stress associated with online teaching. Training teachers is another crucial factor that can influence perceptions regarding integrating technology and digital media into teaching mathematics and other subjects (Sánchez-Prieto et al., 2019). The literature also underscores that technology should be regarded as an instrument, not an educational objective.

The study indicated that many teachers believed that students perceived online mathematics learning as more challenging, less effective, and less engaging. However, there was a mixed perception regarding the impact of online teaching on student motivation, possibly due to measurement limitations.

CONCLUSIONS

In conclusion, this study delved into primary school teachers' perceptions, obstacles, and future preferences regarding using DE for teaching mathematics. The findings revealed that, on the whole, primary school teachers expressed a positive disposition toward integrating digital technologies into their mathematics instruction via DE. They felt confident in their ability to employ various digital tools, adapt

lessons for online teaching, and represent mathematical concepts digitally. However, it is essential to note that teachers also acknowledged challenges associated with DE, including increased workload, concerns about student achievement, and the belief that face-to-face teaching remained more effective. The study highlighted the need for adequate support and training to help teachers navigate the intricacies of online instruction effectively.

The obstacles encountered by teachers in DE landscape were multifaceted. While school resources and training were generally available and flexible tools were employed, teachers reported heightened preparation time and increased stress when teaching mathematics online. Furthermore, maintaining effective student communication and motivation and ensuring positive learning outcomes posed substantial challenges.

Looking to the future, the study found that most teachers preferred traditional face-to-face teaching over DE, if given the choice. Nevertheless, a significant proportion of teachers reported enjoying teaching mathematics online, showcasing a nuanced perspective on the potential of DE in education.

Overall, this research underscores the importance of tailored support and training for educators engaged in DE. It also highlights the need for ongoing efforts to address the challenges associated with online instruction, particularly in mathematics education. Understanding teachers' perceptions and concerns is pivotal in successfully crafting effective strategies to integrate DE into primary school mathematics education as the educational landscape evolves.

Recommendations & Suggestions for Further Research

In light of the findings of the current study, the recommendations below are presented:

- Schools and educational institutions should allocate resources to comprehensive professional development programs, ensuring teachers acquire the skills and strategies to implement DE effectively. Training should focus on using digital tools, managing the increased workload, and addressing the unique challenges of online instruction.
- Educational institutions should establish robust support systems for teachers engaged in DE. This includes providing access to resources, technical support, and a collaborative environment, where educators can share best practices and overcome challenges.
- Explore innovative methods for enhancing student engagement in DE. Strategies to boost motivation, participation, and student interaction should be a priority.
- Test hybrid teaching models that combine the strengths of face-to-face instruction with online elements. These models may alleviate some of the challenges faced in fully online environments while retaining the benefits of DE.
- Explore effective assessment methods and feedback mechanisms tailored to DE. Research should concentrate on preserving the integrity of assessments while adapting to the digital learning environment.

From the responses of the present study, it is clear that there are several obstacles to teaching mathematics online, especially when it comes to keeping students motivated and interested and ensuring that they have learned the concepts. Since online teaching is being increasingly used after the pandemic, it is essential to investigate online education further by listening to students' voices and examining their overall requirements and preferences.

Further research is warranted, particularly in teacher professional development, encompassing training in digital media utilization. Additionally, exploring methods for sustaining student engagement throughout lessons and implementing a systematic feedback mechanism from students is imperative (Bakker et al., 2021).

Another research avenue is comparative studies between DE and traditional face-to-face instruction, considering various subjects and grade levels. Analyzing differences in student outcomes, teacher experiences, and resource utilization can inform educational policy decisions. Additional studies can explore how DE practices and perceptions vary across different cultural contexts by investigating the influence of cultural factors on DE effectiveness and acceptance among teachers and students. Finally, conducting longitudinal studies to assess the long-term impact of DE on student achievement and teacher practices may help understand the sustained effects of online instruction and can inform future educational strategies.

Limitations

In this study, some limitations are noteworthy:

- The survey amassed responses from a relatively modest sample size, totaling 90 participants. A broader participant base might yield divergent outcomes.
- The scope of survey responses is confined to individuals who enjoyed abundant support, essential resources, and training for online mathematics instruction. This does not encompass scenarios, where educators lack such vital elements.
- The study was conducted when online teaching was obligatory due to pandemic lockdown measures, leaving room for varied implications under circumstances of choice or in tandem with face-to-face instruction within a hybrid model.

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