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Integrating educational technology into mathematics instruction for students with dyscalculia: Mathematics teachers' perspective

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Abstract

The present quantitative study examines the perspectives of mathematics teachers towards the benefits, uses, and challenges of incorporating educational technologies into mathematics teaching to aid primary school students with dyscalculia in Saudi Arabia's Al-Kharj province. Moreover, data in this study were collected by a survey from 160 mathematics teachers who taught students with dyscalculia. The findings indicate that there are many advantages of employing educational technologies and high usage of such technologies in real educational settings, but still, several challenges are associated with their implementation. Furthermore, no statistically significant differences could be identified regarding gender, academic qualification, and years of experience concerning the advantages, the realities of using technology, and the challenges. Nonetheless, a statistically significant difference was identified between the variables of advantages, realities of using technology, and challenges, and the number of educational technology training courses that the teachers had attended. Mathematics teachers who had attended at least one session demonstrated higher scores for the advantages and realities of using educational technology, whereas those who had not attended any courses highlighted more challenges with the implementation of educational technologies to help students with dyscalculia. This study offers valuable insights into educational technologies among primary school students with dyscalculia.

Keywords: Advantages of technology, Challenges of technology, Dyscalculia, Educational technology, Employment of technology, Mathematics teachers, Primary schools, Teaching mathematics.

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Contribution of this paper to the literature
This study contributes to the existing literature by highlighting the importance of integrating educational technology in teaching mathematics to students with dyscalculia. It addresses the gap in identifying its benefits, uses, and challenges faced by mathematics teachers through focusing on teachers' perspectives in inclusive educational programs.

1. Introduction

The term 'students with dyscalculia' is used to define learners who find it difficult to learn and understand arithmetic. This includes counting numbers, organizing numbers in ascending and descending order, learning mathematical facts, and performing calculations (Abeed, 2019). The focus on dyscalculia shifted at the start of the 21st century (in most developed countries) from diagnosing the condition to ensuring that students are provided with supportive learning contexts and suitable mathematical interventions that improve their academic outcomes in mathematics (Jitendra et al., 2017). Ran, Kasli, and Secada (2020) point out that computer technology (CT) has a statistically significant and positive impact on the mathematics performance of low-achieving students. The greatest CT impacts were found to be related to problem-solving, system tutoring, game-based interventions, and computerized practice, respectively. Meanwhile, Naveh and Shelef (2021) revealed that students employ technologies as learning tools and that they perceive technology to be more easily accessible. Students favor learning through systems that they use in their personal lives. In other words, they prefer mainstream and commercially available technologies to a greater extent than the technologies offered in their schools.

Over the last 10 years, Saudi Arabia has continuously implemented special education services in response to the rising prevalence of students with learning disabilities (LDs). Nonetheless, several factors, including government funding, Saudi special education specialists, and the absence of legislation, affect the quality of special education services provided to students with learning disabilities throughout the country (ALMedlij & Rubinstein-Ávila, 2018). According to the National Transformation Program 2020, the Saudi Ministry of Education is currently working on several educational policies to help students with learning disabilities. These include involving students with disabilities in general education settings in a proportionate manner and offering school support to students who are experiencing failure, as well as providing a suitable environment for conditioning and disseminating academic information using different approaches, including videos and mental maps (Ministry of Education, 2022). The Saudi Vision 2030 initiative emphasizes the importance of integrating technology into educational settings and providing teachers, particularly in the field of mathematics, with the necessary training to incorporate technologies into their teaching practices. Muhtadi, Wahyudin, Kartasasmita, and Prahmana (2017) explain that a technology-based learning environment is an effective approach to teaching students and enhancing their knowledge and understanding of mathematical content.

Students with dyscalculia experience significant difficulties in their ability to cognitively process mathematical problems. Nonetheless, technology could be an effective way to improve their mathematical skills (Cozad & Riccomini, 2016). Saudi special education teachers employ varied and supplemental technologies to help students with difficulties regarding facilitating instruction, knowledge expansion, content exploration, satisfying students' needs, and improving academic outcomes (Alsuwayl, 2020). According to Alsaluli (2023) technology helps Saudi primary school students experiencing dyscalculia to develop addition-focused mathematical skills. Meanwhile, Alabdulaziz and Higgins (2017) suggest that technology can help children with dyscalculia overcome their consistent misconceptions of mathematics whilst improving their practical skills and motivation to learn the subject.

2. Research Objectives

The following research objectives have been developed in this study.

- To explore teachers' perspectives regarding the benefits of using technological devices when teaching mathematics to students with dyscalculia.
- To explore the realities of using technological devices to teach mathematics to students with dyscalculia from the perspectives of teachers.
- To examine teachers' perspectives on the challenges associated with using technology to teach mathematics to students with dyscalculia.
- To examine the differences in teachers' perspectives based on gender, years of experience, academic qualification, and the number of training courses related to technology in education that the teachers had previously attended.

3. Literature Review

3.1. Benefits of Using Technological Devices in Mathematics Education

There are several benefits of implementing technological devices into teaching, specifically in mathematics education. The benefits include improvements to students' learning outcomes, enhanced motivation, and increased lesson effectiveness (Cahyono & Ludwig, 2019; Gurevich, Stein, & Gorev, 2017). The use of technology in mathematics education promotes lifelong learning in students and facilitates positive learning interactions between students and teachers (Zakaria & Khalid, 2016). Moreover, interactive materials have been found to enhance students' mathematical understanding and self-assessment skills (Barana, Marchisio, & Sacchet, 2019). Fu and Hwang (2018) state that the use of collaborative learning via mobile phones strengthens the relationship between innovative mobile technology and collaborative learning. Technological tools are often used by mathematics teachers to enhance their understanding of students' academic needs and promote student-centered pedagogies. By using technology, students can actively engage with mathematics, which ultimately expands their knowledge of the subject (Attard & Holmes, 2020; Long & Bouck, 2022).

Furthermore, Saylan, Onal, and Onal (2018) point out that the application of technology renders mathematics classes more enjoyable and valuable, whilst also helping students to learn mathematics and promote lifelong

learning. It also allows students to share information that positively impacts teaching skills. Computer-based instruction has a positive impact on students experiencing difficulties with learning mathematics (Küçükalkan, Beyazsaçlı, & Öz, 2019). Technology improves the accuracy of arithmetic fact calculations, promotes the acquisition of mathematical knowledge, and prevents students from developing misconceptions about the subject. Brain-based learning programs positively impact mathematical skill acquisition in students with learning difficulties (Christopoulos, Kajasilta, Salakoski, & Laakso, 2020). Saudi teachers believe that using the Internet of Things can enhance student participation and help them understand mathematical concepts, which ultimately improves their academic performance in mathematics (Alshehri, 2023).

3.2. Employment of Technological Devices in Mathematics Education

Special education teachers believe they are proficient in using technology in their classrooms (Baglama, Yikmis, & Demirok, 2017). Mathematics teachers employ a variety of technologies, such as dynamic software, digital presentations, WhatsApp, and the school platform (Gurevich et al., 2017). Almashaqbeh (2016) concluded that using an iPad to teach mathematics is effective, while Alhumaidi (2018) discovered that mathematics teachers often have conflicting opinions regarding online assessments for several reasons, including limited teacher training, insufficient school policies, and a lack of funding and resources. Saudi researchers demonstrate different levels of employment of technological devices among mathematics teachers of students with dyscalculia. The use of technology is low among mathematics teachers in Saudi Arabia (Alanazy & Almousad, 2018). However, a moderate level of technology use was identified among teachers who educate students with mathematics difficulties (Almashageah & Almasaeed, 2021; Awali & Alasiri, 2022). Mathematics teachers in Saudi Arabia also reported a moderate to high level of evidence-based visible learning practices, which led to improvements in students' mathematics progress and achievement (Al-Abdullatif & Alsaeed, 2019).

The attitude of Saudi special education and general education teachers towards the use of technology when teaching students with mathematics difficulties is very positive (Alsuwayl, 2020). Although they understand the value of embracing new technologies, Saudi educators demonstrate positive attitudes towards video games, but they do not employ them in the classroom (Alsuhaymi & Alzebidi, 2019). Teachers in Saudi resource rooms who work with students experiencing difficulties in mathematics demonstrate positive attitudes while utilizing augmented reality technology (Al-Shummarani & Nasr, 2022). Saudi instructors have positive attitudes towards using interactive whiteboards in classrooms, but they do not employ this technology frequently (Alghamdi, 2015).

3.3. Challenges Associated with the Adoption of Technology in Mathematics Teaching

Several obstacles prevent teachers from adopting technologies in classrooms to assist students with dyscalculia. Teachers often lack the necessary knowledge of technology utilization, have minimal training for adopting technology, and receive limited technical support (Zakaria & Khalid, 2016). New teachers often struggle with lesson management and lack technical support. After teaching for three years, such teachers developed the self-confidence required to teach mathematics whilst using technological tools. Nonetheless, there was an evident increase in their classroom management issues (Stein, Gurevich, & Gorev, 2020). Several barriers affect the adoption of technology in school mathematics classes, such as a lack of opportunities for technological training, the attitudes of principals, and a lack of tangible resources (Tachie, 2019). Şahal and Ozdemir (2020) point out that teachers find it difficult to help students use computers for schoolwork when they are not granted access to computers in the classroom, and teaching using presentations and video processing is tedious and time-consuming (Saylan et al., 2018). Educational systems and accessibility are primary themes related to the challenges that teachers face (Alshehri, 2023).

Teachers in Saudi Arabia experience difficulties in teaching mathematics due to a shortage of technological devices, poor digital infrastructure, and frequent internet outages (Alwadani & Ghania, 2022). The challenges associated with using technology to help students with mathematics difficulties in resource rooms were low (Alanazy & Almousad, 2018) or moderate (Alnamer, 2018). On the other hand, the challenges faced by teachers when using digital applications for teaching mathematics to students with learning difficulties are significant (Almashageah & Almasaeed, 2021; Alqahtani, 2025). Teachers perceive the challenges of conducting distance learning with students who have learning difficulties as significant (Al-Daghim, 2022).

4. Research Methods

In the present study, a quantitative research approach has been adopted in the form of a survey. This research focuses on characterizing natural and social occurrences, and thus, a quantitative approach is suitable. This approach involved using the survey to collect data, respond to the research question, analyze data, and express the results depending on a quantitative research approach (Nardi, 2018).

4.1. Data Collection Tool

To develop the survey utilized in this study, the researcher conducted a comprehensive review of existing literature pertaining to the benefits of using technology in mathematics instruction, its realities, and the difficulties that mathematics teachers encounter when attempting to use it with primary school students in general, as well as those who have learning disabilities (particularly those who have dyscalculia). To examine the benefits associated with using technology to teach children with learning difficulties (particularly students with dyscalculia), surveys were conducted in primary schools (Alabdulaziz & Higgins, 2017; Alsaluli, 2023; Attard & Holmes, 2020; Long & Bouck, 2022; Ran et al., 2020; Zakaria & Khalid, 2016). Moreover, several studies have examined the realities of employing technologies to teach students with learning difficulties (especially students with dyscalculia) (Alanazy & Almousad, 2018; Almashageah & Almasaeed, 2021; Ateah, 2019; Awali & Alasiri, 2022; Kathem, Marhab, & Ali, 2023). Finally, several researchers have explored the challenges encountered by teachers when using technology to teach mathematics to students with dyscalculia (Al-Daghim, 2022; Almashageah & Almasaeed, 2021; Alnamer, 2018; Alshehri, 2023; Alwadani & Ghania, 2022; Tachie, 2019; Zakaria & Khalid, 2016). This detailed review enabled the researcher to create survey items related to the three areas of focus in the current study. In turn, the

researcher can examine the importance of technology in teaching students with dyscalculia. The areas of focus include the benefits of employing technology to teach mathematics (this domain included ten items), the reality of employing technology to teach mathematics (which includes nine items), and the challenges associated with using technology to teach mathematics (which includes ten items). A survey containing 29 items was developed, and participants were asked to respond to the items using a five-point Likert scale ranging from strongly agree to strongly disagree (Strongly agree=5 with score range 5-4.21=very high, agree=4 with score range 4.20-3.41=high, not sure=3 with score range 3.40-2.61=moderate, disagree=2 with score range 2.60-1.81=low, and strongly disagree=1 with score range 1.80-1=very low). If the participating teachers strongly agree on all items, this reflects a high level of benefits to employing technology, a high level of technology implementation, and a high level of challenges encountered by teachers attempting to employ technologies to teach students with dyscalculia. Conversely, selecting strongly disagree for all items indicates a low level of benefits, technology use, and challenges associated with technology use among mathematics instructors who teach students with dyscalculia. Furthermore, the participating teachers were asked to provide demographic information (gender, academic background, years of experience, and the number of educational technology training courses undertaken). The survey was accompanied by a cover letter that explained the purpose of the research and instructions for how to rate the items.

4.2. Validity and Reliability

The process outlined below was followed in this research to confirm that the survey tool was both valid and reliable.

4.2.1. Validity

4.2.1.1. Face Validity

After the survey was created in this study to explore teachers' perspectives on using educational technology in mathematics classrooms to help students with dyscalculia, it was administered to 13 educators specializing in educational technology and learning difficulties. These individuals were asked to provide feedback to ensure that items were clear and that the items measured the domains to which they belonged. They also evaluated the ability of the items to fulfill the objectives of the research and ensure that the survey was comprehensive. All the expert feedback was carefully considered and used to create the final study that would be used.

4.2.1.2. Internal Validity and Consistency

Once the validity and reliability of the survey tool had been confirmed, it was distributed to participants. To determine internal validity, Pearson's correlation coefficient was calculated. Furthermore, the correlation coefficient between the grades of each item in the survey, as well as the overall score for the domain to which they belong, was calculated. These values are presented in Table 1. The correlation coefficient between each domain's score and the overall survey score was also calculated, and these values can be seen in Table 2. Altogether, 160 teachers completed the survey, after 18 were removed due to outliers and duplicate values. Moreover, responses were removed in cases where participants chose the same answer for every item. The correction coefficient between each survey item's score and the overall score for the domain to which they belong can be seen in Table 1, where it is evident that the correlations are significant (reaching a significance level of 0.01). In turn, this indicates that the survey has high internal validity. Meanwhile, a significant correlation (at the significance level of 0.01) was identified for the correlation coefficient between each domain's total score, as well as the overall survey score. This implies that the survey's internal validity is high.

Table 1. Correlation coefficients between the items of the developed survey and the scores on the corresponding dimension.

Benefits of employing technology to teach mathematics to students with dyscalculia		**Reality of employing technology to teach mathematics to students with dyscalculia**		**Challenges hindering the use of technology when teaching mathematics to students with dyscalculia**	
Item	**Pearson correlation coefficient**	**Item**	**Pearson correlation coefficient**	**Item**	**Pearson correlation coefficient**
1	0.807**	1	0.528**	1	0.657**
2	0.840**	2	0.527**	2	0.674**
3	0.870**	3	0.667**	3	0.647**
4	0.850**	4	0.606**	4	0.660**
5	0.862**	5	0.740**	5	0.679**
6	0.843**	6	0.833**	6	0.665**
7	0.816**	7	0.673**	7	0.671**
8	0.804**	8	0.776**	8	0.700**
9	0.710**	9	0.825**	9	0.674**
10	0.836**			10	0.665**

Note: **Significance at the level of (0.01).

Table 2. Correlation coefficients between the domains of the survey and the total score of the survey.

Domain	**Pearson correlation coefficient**
Benefits of employing technology to teach mathematics to students with dyscalculia.	0.689**
The realities of employing technology to teach mathematics to students with dyscalculia.	0.737**
Challenges hindering the use of technology when teaching mathematics to students with dyscalculia.	0.648**

Note: **Significance at the level of (0.01).

4.2.2. Reliability

To determine the reliability of the survey tool employed in this work, Cronbach's Alpha consistency coefficients were calculated for each domain (Table 3). The calculations reveal that there is a strong consistency coefficient (0.857-0.944). This is an acceptable consistency coefficient as it falls within the 0.80-0.89 range (Taber, 2018). In turn, this ensures that the survey is designed to address the unique research questions of this study.

Table 3. The consistency coefficients for each domain and for the overall survey.

Domain	Number of items	Cronbach's Alpha
Benefits of employing technology to teach mathematics to students with dyscalculia.	10	0.944
Reality of employing technology to teach mathematics to students with dyscalculia.	9	0.864
Challenges hindering the use of technology when teaching mathematics to students with dyscalculia.	10	0.857
The overall survey.	29	0.883

4.3. Participants

The research population consisted of male and female mathematics teachers who work with students with dyscalculia in primary schools that offer specialized dyscalculia programs in Al-Kharj. The population size was relatively small (258 teachers), and the survey was completed by 160 teachers, comprising both males and females, who work with students with dyscalculia in these schools. This indicates that 62% of the population participated in the survey. The demographic details of the sample can be seen in Table 4.

Table 4. Demographic Data for the Research Sample (160).

Classification	Category	Frequent	Percentage
Gender	Male	92	57.5
	Female	68	42.5
Academic qualification	Special education diploma	8	5.0
	Bachelor's degree	122	76.3
	Master and above	30	18.8
Years of experience	Below 5	6	3.8
	5-10	24	15.0
	Above 10	130	81.3
Number of technology-related training courses undertaken.	No attendance	32	20.0
	1-5	86	53.8
	Above 5	42	26.3

4.4. Data Collection and Analysis

The research process involved several steps:

1) obtaining official approval from the Al-Kharj Education Department to conduct the study with male and female primary-level mathematics teachers who are working with dyscalculic students in the province of Al-Kharj.

2) The researcher acquired the schools' contact numbers from the Al-Kharj Education Department, which they then used to contact the school principals. The researcher then asked the latter if they could have their mobile phone number so that they could send a Google Forms link and subsequently distribute it to all math teachers who are working with students with dyscalculia in their schools.

3) Information pertaining to the research purpose, duration, privacy, confidentiality, and that participants were voluntary and they had the right to withdraw at any time was presented on the first page of the Google Form.

4) The process of collecting data from the sample lasted around five weeks.

Finally, the statistical packages for Social Sciences (SPSS v 25) software were employed to input the survey data onto a computer, after which the results could be extracted, tested, and interpreted.

5. Results

5.1. Teachers' Perspectives Regarding the Benefits of Employing Technologies in Mathematics Classrooms

Descriptive statistics were employed in this work to calculate the mean and standard deviation scores for individuals' responses. The mean scores reflect differences in participants' perspectives regarding the adoption of technological devices in mathematics classrooms to help dyscalculic students. The results show that the standard deviation values were accurate in determining the perspectives implied by the teachers' responses. The survey items were presented in descending order of the mean scores for each item to understand the teachers' perspectives on the benefits of using technological devices for each item and for the overall average score for the teachers' perspectives.

In Table 5, the mean scores, standard deviation values, teachers' perspectives regarding the benefits of adopting technological devices, and the ranking of each item in the survey are presented. The table also shows that there are ten items related to the domain of teachers' perspectives regarding the benefits of using technology to teach mathematics to children with dyscalculia. The mean value of the data is 4.49, and the standard deviation is 0.527.

This demonstrates that teachers have high-level perspectives regarding the benefits of adopting technologies to teach mathematics to students who have dyscalculia. Furthermore, the research data indicate that teachers' perspectives towards the benefits of utilizing technology to teach mathematics to dyscalculic students varied significantly across all ten items. The standard deviation of the perspective on the benefit of employing technology gadgets ranged from 0.528 to 0.770, while the mean value varied between 4.31 and 4.65.

Table 5. The mean values and standard deviation for the survey responses (The benefits of employing technological devices).

N	Items	M	SD	The benefits	Rank
1	Technology makes mathematics teaching approaches more effective.	4.65	0.528	Very high	1
2	Technology enhances children's desire and motivation to learn mathematics.	4.55	0.570	Very high	4
3	Technology plays a critical role in teaching different mathematics learning skills.	4.53	0.593	Very high	5
4	Technology makes teaching mathematics more interactive.	4.60	0.646	Very high	3
5	Technology increases students' ability to learn mathematics.	4.45	0.671	Very high	7
6	Technology enhances students' mathematics outcomes.	4.33	0.687	Very high	9
7	Technology improves the professional development of mathematics teachers.	4.49	0.634	Very high	6
8	Technology helps teachers to accurately assess students in mathematics.	4.31	0.770	Very high	10
9	Technology facilitates collaborative learning.	4.34	0.760	Very high	8
10	Technology saves teachers a great deal of time and effort.	4.61	0.561	Very high	2
	The benefit of using technological devices	4.49	0.527	Very high	

Note: SD= Standard Deviation.

5.2. The Reality of Employing Technologies to Teach Mathematics to Dyscalculic Students

Descriptive statistics were employed to calculate the mean and standard deviation scores for the participants' responses. The mean value enabled the researcher to identify any differences in respondents' perspectives regarding the reality of employing technological devices in mathematics classrooms to help children with dyscalculia. The standard deviation scores provided accurate values that can help to understand the perspectives of the teachers. The survey items were organized in descending order of the mean scores for each item. In turn, this highlights the teachers' perspective regarding the reality of employing technological devices. The mean scores, standard deviations, teachers' perspectives regarding the reality of using technology devices, and the rankings of each survey item can be seen in Table 6. There are nine items in this table related to teachers' perceptions of the realities of employing technology in mathematics classrooms to help students with dyscalculia. The mean value for the data is 4.08, and the standard deviation is 0.635. This indicates that teachers view the practicalities of employing technology to teach mathematics to children with dyscalculia as high-level. The survey results also revealed that teachers' perceptions of the realities of using technology to teach mathematics to children with dyscalculia ranged from very high to high across all nine items. The standard deviation ranged between 1.053 and 0.672, while the mean scores for teachers' perspectives regarding the realities of utilizing technological devices varied between 3.81 and 4.55.

Table 6. The means and Standard Deviation for the survey responses (The reality of using technological devices).

N	Items	M	SD	The reality	Rank
1	I use educational videos to teach mathematics to students.	4.34	0.672	Very high	2
2	I use digital educational games in my mathematics classes.	4.14	0.740	High	3
3	I use smart devices (Such as iPads) to teach mathematics.	4.09	0.980	High	4
4	I use a data projector in my mathematics classes.	4.55	0.759	Very high	1
5	I use smart boards in my mathematics classes.	4.05	1.027	High	5
6	I use e-books to enrich mathematics topics.	3.88	0.957	High	7
7	I use email and/or social media (WhatsApp, Telegram) to receive mathematics assignments from students.	4	0.978	High	6
8	I use virtual classrooms (distance learning) to deliver mathematics lessons.	3.85	1.053	High	8
9	I use digital educational applications to create homework.	3.81	1.004	High	9
	The reality of using technological devices.	4.08	0.635	High	

Note: SD= Standard Deviation.

5.3. Teachers' Perspectives Regarding the Challenges

Descriptive statistics were employed to calculate the mean and standard deviation scores for the participants' responses. The mean value enabled the researcher to identify the differences in respondents' perspectives regarding the challenges associated with employing technological devices in mathematics classrooms to help children with dyscalculia. The standard deviation scores provided accurate values that helped the researcher understand the perspectives of the teachers.

The survey items were organized in descending order of the mean scores for each item. In turn, this highlights the teachers' perspectives regarding the challenges associated with employing technological devices. The mean scores, standard deviations, teachers' perspectives on the challenges associated with using technological devices, and the rankings of each survey item can be seen in Table 7. There are ten items in this table related to teachers' perceptions of the challenges associated with employing technology in mathematics classrooms to help students with dyscalculia.

The mean value for the data is 4.13, and the standard deviation is 0.654. This reflects how teachers view the challenges associated with employing technology to teach mathematics to children with dyscalculia as high-level challenges. The results of the survey also revealed that teachers' perceptions regarding the challenges associated with using technology to teach mathematics to children with dyscalculia varied from very high to high across all ten items. The standard deviation ranged between 1.199 and 0.725, while the mean scores for teachers' perspectives on the realities of utilizing technological devices varied between 3.65 and 4.48.

Table 7. The mean scores and SD of the survey responses (The challenges associated with using technological devices).

N	Items	M	SD	The challenges	Rank
1	Increased workload for mathematics teachers.	3.65	1.199	High	10
2	Lack of technology training courses for mathematics teachers.	4.21	0.961	Very high	7
3	Insufficient ability of mathematics teachers to employ educational technologies.	3.66	1.154	High	9
4	No availability of educational software for teaching mathematics.	4.30	0.860	Very high	4
5	Lack of technological resources (i.e., computers, projectors, iPads).	4.30	0.944	Very high	5
6	Poor internet connection in the school.	4.48	0.777	Very high	1
7	Lack of technical support staff.	4.45	0.725	Very high	2
8	Limited class time.	3.69	1.183	High	8
9	Poor maintenance of available equipment.	4.25	0.971	Very high	6
10	Lack of incentives for teachers to use technology.	4.35	0.992	Very high	3
	The challenges associated with using technological devices	4.13	0.654	High	

Note: SD= Standard Deviation.

5.4. The Differences in the Perspectives of Teachers Based on Gender, Years of Experience, Academic Background, and the Number of Technology-Related Training Courses Attended

A Mann-Whitney test was performed to determine whether there were any significant differences in the participants' responses regarding the benefits, realities, and challenges of employing technological devices to teach mathematics to students with dyscalculia based on the variable of gender. In Table 8, there are no statistically significant differences (i.e., a significance level of 0.05) between the participant responses relating to the benefits, realities, and challenges of employing technologies to teach mathematics to dyscalculic students based on the variable of gender.

Table 8. The Mann-Whitney test was used to identify any significant differences between genders in the survey responses.

Domains	Gender	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	Sig.
Benefits	Male	92	77.13	7096.00	2818.000	-1.093	0.274
	Female	68	85.06	5784.00			
Reality	Male	92	77.50	7130.00	2852.000	-0.957	0.339
	Female	68	84.56	5750.00			
Challenges	Male	92	81.15	7466.00	3068.000	-0.208	0.836
	Female	68	79.62	5414.00			

A Kruskal-Wallis test was performed in this study to determine whether there were any significant differences influenced by academic qualifications and years of experience. In Tables 9 and 10, it is evident that there are no statistically significant differences (i.e., differences reaching a significance level of 0.05) between the participant responses regarding the benefits, realities, and difficulties of using technological devices to teach mathematics to students with dyscalculia.

Table 9. The Kruskal-Wallis Test was used to identify any differences based on the variable of academic qualification.

Domains	Academic Qualification	N	Mean Rank	Chi-Square	Sig.
Benefits	SED	8	91.50	0.582	0.748
	BD	122	79.39		
	M&A	30	82.10		
Reality	SED	8	84.00	5.539	0.063
	BD	122	84.66		
	M&A	30	62.63		
Challenges	SED	8	96.75	1.435	0.488
	BD	122	80.81		
	M&A	30	74.90		

Note: SED=Special Education Diploma; BD=Bachelor's degree; M&A= Masters and above.

Table 10. The Kruskal-Wallis Test was used to identify any differences based on the variable of years of experience.

Domains	Years of Experience	N	Mean Rank	Chi-Square	Sig.
Benefits	<5	6	99.50	1.343	0.511
	5-10	24	84.00		
	>10	130	78.98		
Reality	<5	6	80.17	0.150	0.928
	5-10	24	77.17		
	>10	130	81.13		
Challenges	<5	6	71.17	0.285	0.867
	5-10	24	79.33		
	>10	130	81.15		

Nonetheless, there are statistically significant differences presented in Table 11 (at a significance level of 0.01) between the participant responses regarding the benefits, realities, and challenges of employing technological devices to teach mathematics to students with dyscalculia based on the number of technology-related training courses undertaken. The Mann-Whitney test was used to calculate the differences between the two groups with respect to the attendance number of technology-based training courses, and the findings are shown in Table 12. According to the results, teachers who do not take any educational technology training courses (M=31.13) and teachers who take more than five courses (M=42.36) have statistically different opinions about the benefits of using technology to teach mathematics to students with dyscalculia. Teachers who take more than five training courses are more likely to believe that employing technology to teach mathematics is beneficial. Moreover, a statistically

significant difference (at the 0.000 level) was identified between teachers who attend one to five educational technology-based training courses (M=54.64) and those who attend more than five courses (M=84.69) regarding teachers' perspectives on the benefits of employing technology to teach mathematics to dyscalculic students. The findings favored teachers who attended more than five training courses.

Furthermore, there were statistically significant differences (at the 0.048 level) between teachers who do not attend any educational-technology training courses (M=55.71) and those who attended one to five courses (M=69.69) in terms of teachers' perspectives about the realities of employing technologies to teach mathematics to dyscalculic students. The results favored teachers who attended between one and five training courses. Additionally, a further statistically significant difference (at the 0.000 level) was identified between teachers who attend one to five educational technology training courses (M=55.24) and those who attend more than five courses (M=83.45) regarding their perspective on the realities of employing technologies to teach mathematics to dyscalculic students. The findings favored teachers who attended more than five courses. Lastly, a statistically significant difference (at the 0.008 level) was observed between teachers who had not attended any educational technology training courses (M=73.13) and those who had attended one to five courses (M=54.43) concerning teachers' perspectives on the challenges associated with employing technology to teach mathematics to dyscalculic students, with results favoring those who had not attended any training courses.

Table 11. The Kruskal-Wallis Test was employed to identify differences in the number of technological training courses taken by the participants.

Domains	Training Courses	N	Mean Rank	Chi-Square	Sig.
Benefits	None	32	81.69	19.560	0.000
	1-5	86	67.83		
	>5	42	105.55		
Reality	None	32	86.19	17.247	0.000
	1-5	86	67.45		
	>5	42	102.88		
Challenges	None	32	98.94	6.749	0.034
	1-5	86	74.13		
	>5	42	79.50		

Table 12. The Mann-Whitney Test was employed to identify differences between the two groups regarding the number of technological training courses taken by the participants.

Domains	Training Courses	N	Mean Rank	Sum of Ranks	Mann-Whitney U	Z	Sig.
Benefits	None	32	67.06	2146.00	1134.000	-1.482	0.138
	1-5	86	56.69	4875.00			
	None	32	31.13	996.00	468.000	-2.374	0.018
	>5	42	42.36	1779.00			
	1-5	86	54.64	4699.00	958.000	-4.388	0.000
	>5	42	84.69	3557.00			
Reality	None	32	55.71	4791.00	1050.000	-1.982	0.048
	1-5	86	69.69	2230.00			
	None	32	33.00	1056.00	528.000	-1.585	0.113
	>5	42	40.93	1719.00			
	1-5	86	55.24	4751.00	1010.000	-4.055	0.000
	>5	42	83.45	3505.00			
Challenges	None	32	73.13	2340.00	940.000	-2.648	0.008
	1-5	86	54.43	4681.00			
	None	32	42.31	1354.00	518.000	-1.687	0.092
	>5	42	33.83	1421.00			
	1-5	86	63.20	5435.00	1694.000	-0.570	0.569
	>5	42	67.17	2821.00			

6. Discussion

It is evident from the results that the mean values for each survey item and generally pertaining perspectives among teachers on the benefits of employing technologies to teach mathematics to students with dyscalculia *were* very high. This result confirmed the benefits of employing technologies to teach students with dyscalculia, with a particular focus on learning, academic outcomes, and motivation (Alsuwayl, 2020; Cahyono & Ludwig, 2019; Gurevich et al., 2017). This highlights the importance and benefits of technologies in teaching students with dyscalculia and indicates that technology use renders teaching more effective, saves time and energy for teachers, and promotes interactive learning (Şahal & Ozdemir, 2020; Saylan et al., 2018; Zakaria & Khalid, 2016) respectively, the use of technology in teaching mathematics increases students' motivation to learn mathematics (M Alabdulaziz & Higgins, 2017; Alsaluli, 2023; Attard & Holmes, 2020) teaching different mathematics skills (AlAkayleh & Al-Zoubi, 2023; Aljuhani, 2023; Christopoulos et al., 2020) improving teachers' professional development (Almulla & Almulla, 2024) increasing students mathematics skills (Alsaluli, 2023; Barana et al., 2019; Long & Bouck, 2022) promoting collaborative learning (Fu & Hwang, 2018) and mathematics outcomes (Alshehri, 2023; Alsuwayl, 2020; Çetinkaya, 2019). Finally, technology helps teachers to accurately assess students' mathematics performance (Martin, Polly, Wang, Lambert, & Pugalee, 2016). Nonetheless, more training is required to help teachers effectively employ technology to assess their students (Hendri, Helsa, Kenedi, & Anita, 2019).

The results indicate that the mean values for the survey items rated each item related to teachers' perspectives on the employment of technology use in mathematics classrooms among students with dyscalculia were between high to very high. The results suggest that teachers' perspectives towards employing technology are generally high. This is due to the recent focus on technology adoption in classrooms (as per the National Transformation

Program 2020). This may account for the improvements in technology implementation. The Saudi Ministry of Education is committed to developing and implementing policies to help students with learning difficulties, such as imparting knowledge through technologies and different teaching strategies (Ministry of Education, 2022). Furthermore, the technological proficiency of Saudi mathematics teachers has increased in line with recent opportunities for online and in-person workshops and courses on the subject (Aseeri, 2015). This confirms that Saudi teachers have positive attitudes towards implementing educational games (Alsuhaymi & Alzebidi, 2019; Awali & Alasiri, 2022) and understand the effectiveness of using smart devices such as iPads (Almashaqbeh, 2016) and the use of e-books to teach mathematics (Albalaw, 2017), distance learning (Alabdulaziz & Alhammadi, 2024) and using digital educational applications to create homework (Alhumaidi, 2018). In turn, this demonstrates the significance of online assessments in mathematics education. Nonetheless, there are also several obstacles, including training and school policies. Although Saudi mathematics teachers exhibit positive attitudes towards employing technologies in their classrooms, they may encounter obstacles when attempting to use them in real life (Al-Shummarani & Nasr, 2022; Alamry, 2017; Alghamdi, 2015).

The findings highlight the means for the survey items regarding challenges associated with using technologies to teach mathematics to students with dyscalculia. The challenges are generally high. The highest level of challenges related to using technology to teach mathematics to students with dyscalculia are associated with several factors, such as poor internet connection (Alwadani & Ghania, 2022; Şahal & Ozdemir, 2020), insufficient training (Tachie, 2019; Zakaria & Khalid, 2016), lack of educational software (Alwadani & Ghania, 2022), insufficient technical support (Stein et al., 2020), insufficient technological resources (Şahal & Ozdemir, 2020), and poor maintenance (Zakaria & Khalid, 2016). According to Şahal and Ozdemir (2020), short class time could be a challenge for teachers to implement technology during teaching mathematics, as well as poor efficiency of mathematics teachers (Buentello-Montoya, Lomelí-Plascencia, & Medina-Herrera, 2021), and increased workloads as imparted by the school system (Alshehri, 2023) are the challenges associated with using technologies to teach mathematics to students with dyscalculia.

The results of this study indicate that there are no statistically significant differences (at a significance level of 0.05 or less) between the teachers' responses pertaining to benefits, realities, and challenges of employing technological devices to teach mathematics to students with dyscalculia according to teachers' gender, years of experience, and academic qualification. This is because the Saudi educational system prioritizes gender equality and requires teachers to impart knowledge to pupils without requiring them to utilize technology in the classroom (Alshehri, 2023). In addition, most Saudi teachers have academic qualifications due to the professional development programs offered by Saudi universities, which equip them with the necessary knowledge, teaching strategies, and skills to work in the educational sector (Alshehry, 2018). Alabdulmenem (2019) claims that providing Saudi policymakers with recommendations regarding the standards of teacher certification and licensure will be critical in Saudi Arabia. The variable of years of experience is a significant predictor of occupational competency for teachers, as is the variable of teachers' positive opinions about educational technology. Yet, using technology necessitates prior experience with educational technology (Varank, 2013), highlighting the need to attend training courses on how to use educational technologies rather than relying solely on years of experience (Alzahrani, 2017).

However, the results showed statistically significant differences between teachers' responses regarding the benefits, realities, and difficulties of using technological devices in teaching mathematics to students with dyscalculia at a significance level of 0.05 or less. These significant differences are based on the number of training courses in educational technology, favoring teachers who attended more training courses. These findings highlight the importance of training educators on how to use technology in the classroom, as well as the impact this has on the implementation of such technologies (Alzahrani, 2017). Teachers who took more training courses on technology in the classroom assigned the highest scores to the benefits and realities of using technology in mathematics classrooms (Ardıç, 2021; Awali & Alasiri, 2022), respectively. Moreover, Al-Daghim (2022) confirms this study's finding that teachers who do not receive any training courses in educational technology are assigned the highest scores on challenges associated with using technology in classrooms.

7. Conclusion

The findings of this study indicate that primary school teachers have excellent knowledge of the benefits of using educational technology in mathematics classrooms to help students with dyscalculia. They frequently employ such technologies, particularly educational videos and projectors, when teaching mathematics. Nonetheless, they encounter significant barriers that prevent them from using educational technology effectively, and this ultimately limits the use of such technologies in their professional practice. Furthermore, no statistically significant differences could be identified between teachers' responses based on gender, years of experience, and academic qualification. On the other hand, there are statistically significant differences identified for the number of educational technology courses that they had attended. The highest scores for the domains of 'benefits of using educational technologies' and 'realities of using educational technologies' were obtained for teachers who attended one or more courses. Meanwhile, the highest scores for the domain of 'challenges faced by teachers when implementing educational technologies' are related to teachers who do not attend any courses. In turn, this highlights the importance of training in the implementation of educational technology to improve educators' teaching skills and effectiveness (Alzahrani, 2017).

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