

Teachers' Perceptions on Using Educational Technology Applications for Mathematics in Special Education Classrooms

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Abstract

Utilizing the capabilities of technology applications can contribute to the creation of innovative educational interventions for students with special needs. However, their added pedagogical value in the learning practice of Mathematics depends on the planning of their utilization. In this context, empirical studies show that teachers are an important factor in the learning process, regarding their attitudes in using technology in the educational process of teaching Mathematics. Aim of this study was to determine the perceptions of special education teachers in using educational technology applications into their classrooms. Qualitative research method was conducted with semi-structured interviews to fifteen teachers working at special education schools in Greece. The content analysis method and certain constituted themes were used to analyze participants' answers. According to study's results, special education teachers acknowledge their competence in using technology applications and they have a positive attitude towards it despite the challenges they face.

Keywords: educational technology applications, mathematics, special education, teachers' perceptions

Introduction

Modern pedagogical and technological developments have led to the development of new educational practices, as well as to the renewal of the educational system in order to be able to support the effectiveness of rapid innovations. The understanding of the field, as well as the way of teaching Mathematics, is characterized by constantly changing approaches, which affect the learning practice in the classrooms. Mathematics school curricula include the need to cultivate and enhance mathematical skills and concepts, such as numbers, fractions, calculations, geometric shapes, problem solving, and measurement procedures, so that students can become independent in their daily lives (Baglama, Yikmis & Sakalli Demirok, 2017; Polat, Yavuz & Tunc, 2017). Students are able to develop these mathematical skills when they participate in an educational environment that is based and structured in their specific learning characteristics and needs. Certainly, students with special educational needs require support for developing academic skills, such as their reading ability, writing skills, basic math skills, social skills, and enhancing their behavioral and emotional skills (Florian & Hegarty, 2004). The development of mathematical skills plays a facilitating role in people with special educational needs and/or learning difficulties. In this regard, students in special education schools must acquire mathematical skills. In general, teachers tend to apply traditional methodological approaches and teaching practices to develop students' academic skills in

special education. However, the problems of teaching mathematical skills have led to the search and utilization of new alternative teaching methods (Goldsmith, Doerr & Lewis, 2014).

In teaching Mathematics, the use of appropriate educational technology applications can enhance the understanding of mathematical processes and the distinction between different factors and elements. At the same time, the promotion integrating educational technology resources in the learning process of Mathematics has led to the need to focus on learning outcomes rather than on students' mathematical activities (Moreno & Llinares, 2018). In general, research that studies and analyzes the introduction of technology in the teaching of Mathematics focuses on the digital tools used, their pedagogical suitability, the learning objectives they set, and the level of their integration in the teaching and learning process. However, there is a significant difference between the theoretical framework for designing educational applications and their empirical integration into the educational process (Trujillo-Torres et al., 2020). In this sense, teachers are necessary for the adequate introduction of technology applications in the teaching of Mathematics. It has been shown that the utilization of digital applications in teaching practices depends on various factors, such as the characteristics and the availability of relevant educational technology resources. Despite the advantages of these applications, teachers are usually distinguished for the low or medium level of their digital skills. Of course, the teachers' perceptions, attitudes, and methodological uses of the educational applications should be taken into account, as well as the differences observed in terms of their gender, age, and educational experience (Buabeng-Andoh, 2012; Trujillo-Torres et al., 2020).

The advantages and capabilities of educational applications can help students with special educational needs in a mathematics classroom and, above all, user-friendly technology applications for students with various types of disorders or learning difficulties (Cviko, McKenney & Voogt, 2014). Therefore, the integration of technology in the teaching of Mathematics for students with special needs is considered important. The present study is expected to enhance the existing overview of the perceptions and attitudes of special education teachers regarding the use of educational applications in teaching practice.

Literature Review

Recent research on the use of educational applications in special education highlights the value of integrating technology into special education classes to support the effectiveness of teaching and learning. Teachers are considered core parameters in integrating effectively technology applications in teaching and learning. However, this integration seems to be still limited, as there are many factors that impact teachers' role. The mere presentation of the educational technology applications in the special education classrooms does not demonstrate their efficacy if the teachers themselves do not adopt them in the learning practice. As a result, recent research studies have focused on addressing teachers' challenges in adapting relevant applications to Mathematics teaching (Buabeng-Andoh, 2012; Zhao, Tan & Mishra, 2001; Wen et al., 2020).

It is understood that the presentation of teaching practices through appropriate methods and strategies in differentiated educational environments, would help both students and teachers to achieve the expected learning outcomes. The development of mathematical skills can be enhanced by guiding students through certain and innovative methodological approaches and offering instruction with effective technological tools (Krawek et al., 2013). Educational technology applications can include any tools, resources, or educational practices that are integrated into the learning process to facilitate the achievement of learning outcomes. It is worth mentioning that these categories include, but are not limited to, the use of computers or mobile devices by students with special educational needs, the use of interactive whiteboards by special education teachers, and various digital learning tools (Okolo & Diedrich, 2014; Parkman, Litz, & Gromik, 2018).

Mathematical knowledge is a tool for solving real-world problems that students experience in their daily lives. Mathematical skills prove to be useful for completing many activities that require a specific display of talent and skills. Also, the cultivation of mathematical knowledge is a necessary condition for the effective professional orientation of students. The skills of measuring, identifying arithmetical units of time, making payments, understanding simple graphs and geometrical shapes, and completing basic arithmetic calculations are some examples of applying mathematical knowledge in daily life. For students with special educational needs, it is necessary to engage in the learning of Mathematics, as their peers of formal development, to develop skills of independent living, conceptual understanding, and knowledge transfer (Akpan & Beard, 2014; Baglama et al., 2017; Okolo & Diedrich, 2014; Wen et al., 2020). Specific educational interventions can facilitate the enhancement of the mathematical skills of students with special educational needs. Such an educational strategy is the multimodal teaching approach, in which teachers present the content, utilizing multiple sensory methods and offering students the opportunity to express their understanding in multiple ways. The second form of educational intervention is differentiated teaching, in which teachers adjust the content, level of difficulty, and duration based on the educational needs of students. Also, the communication and analysis of teachers' thinking is a strategy that benefits the guidance of students with special educational needs to solve problems and transfer knowledge. All of these teaching approaches can be supported by the use of educational technological applications (Wen et al., 2020). The introduction of technological applications in the classrooms of students with special educational needs has a positive impact on students' academic performance, their emotional development, the achievement of their behavioral goals, and the enhancement of their learning motivation. On the other hand, teachers often seem to perceive difficulties in integrating educational applications into the educational process, especially when there is a lack of appropriate training, insufficient time frame, lack of availability of technological resources, and lack of technical support (Buabeng-Andoh, 2012; Trujillo-Torres et al., 2020; Wen et al., 2020).

Aim and Research Questions

The aim of this study was to investigate special education teachers' perceptions on using educational technology applications in their classrooms. Prior research studies have focused on the potential of integrating technology applications into the curriculum of Mathematics to support the learning process of students with special educational needs. To address the aim of the present study and determine teachers' views and attitudes towards using educational applications in teaching Mathematics, the following research questions were asked:

- What are the perceptions of special education teachers about their competence level regarding the use of educational technology applications in teaching Mathematics?
- How do special education teachers evaluate the efficacy of educational technology applications for students with special educational needs?
- What are the challenges faced by special education teachers in terms of utilizing educational technological applications in teaching Mathematics?

Research Method

In the present research study, a qualitative research approach was used to investigate the perceptions of special education teachers in utilizing educational technology applications in math classrooms. The research was conducted with semi-structured interview technique to collect data from teachers' answers. Qualitative approach is considered most fitting for revealing teachers' views and competences in a realistic and holistic way (Creswell, 2016).

Participants

A total of fifteen special education teachers were recruited via e-mail and social media notifications to participate in the present empirical study who had been working as Math teachers in special education schools in Greece on the current academic year of 2021 – 2022. A letter of informed consent was given to all participants, to obtain approval and to express their voluntary willingness to participate. Teachers had to have a degree in special education and with experience in teaching Mathematics in primary and secondary special education schools. The demographic and professional characteristics of the participants are shown in the following Table 1. More specifically, eight male and seven female special education teachers participated in the present empirical study, of which ten teachers work in secondary special education school unit and five teachers work in a primary school unit. Ten special education teachers have one or more Master’s degrees in different academic fields, three of the participants have their Bachelor’s degree in special education and only two participants have a PhD. The majority of special education teachers are in an age between 25 and 45 years old (n=10) and four of the participants are over 55 years old.

Table 1. Demographic and Professional Characteristics of Special Education Teachers

Participants	Age	Gender	Educational level	Type of special education school
P1	31	Male	Master’s degree	Secondary education
P2	36	Female	Bachelor’s degree	Primary education
P3	32	Male	Master’s degree	Secondary education
P4	28	Female	Master’s degree	Secondary education
P5	42	Female	Bachelor’s degree	Primary education
P6	55	Male	Master’s degree	Secondary education
P7	59	Female	Master’s degree	Secondary education
P8	62	Male	Bachelor’s degree	Primary education
P9	29	Male	Master’s degree	Primary education
P10	30	Male	Master’s degree	Secondary education
P11	32	Female	Master’s degree	Secondary education
P12	36	Female	PhD	Primary education
P13	41	Female	PhD	Secondary education
P14	46	Male	Master’s degree	Secondary education
P15	54	Male	Master’s degree	Secondary education

Semi-structured interview design

The study was conducted using a semi-structured interview in order to collect the data relevant with the aim and the research questions. The semi-structured interview form of questions was developed as the result of a systematic and analytical overview of previous theoretical and empirical relevant studies. The interview form included six open-ended questions prepared to ask participants about their perceptions, experiences and attitudes on utilizing educational technology applications for teaching Mathematics in special education classrooms. At first, the researcher asked the special education teachers about their age, their educational level, their years of educational experience with students with special educational needs and the type of their current school. The questions in the semi-structured interview were as follows:

1. In which competence level do you evaluate your utilization of educational technology applications in your Mathematics classroom? Are you confident about your digital skills?
2. Which are the most common technology applications that you integrate in teaching Mathematics?

3. What challenges or difficulties have you encountered when integrating educational technology applications in your Mathematics classroom?
4. What was your purpose for utilizing educational technology applications?
5. What are the features and concepts in which using educational technology applications is more effective in math classrooms?
6. What recommendations do you have for a more effective utilization of educational technology applications in teaching Mathematics in special education?

Data Collection and Analysis Procedure

Each interview lasted approximately 40 to 60 minutes and it was conducted face-to-face via teleconference software (Skype) after the researcher had set an appointment with each participant. The interviews were completed during the period of January and February 2022. The researcher recorded and transcribed all fifteen interviews and then, proceeded with content analysis and coding the transcriptions based on comparative techniques to find common themes and sub-themes. The researcher expressed also the number of the special education teachers who gave the answers agreeing with the constituted themes. The suitability and intelligibility of the questions included in the semi-structured interview form were resulted by the opinions of 3 experts in the field of special education, consisting of math teachers working as special education teachers for more than fifteen years. The supervisory team of experts reviewed the open-ended questions pertaining their language, wording and relevance to the aim of the study. Following the initial experts' reviews, the researcher conducted a pilot study with two math teachers working in special education schools; one from primary education and the other from secondary education, who did not participate in the main study. The reviews and the pilot study did not provide any major improvements or modifications, but the researcher was facilitated in practicing the conversation flow, and also one question was modified due to its initial leading character.

Results

Perceptions of special education teachers on their level of competence

As it shows in Table 2, special education teachers think that they are competent enough with developed digital skills to integrate educational technology applications in math classrooms (n=11). Only 4 teachers reported incapable of utilizing various technology applications in their educational interventions with students with special educational needs.

Table 2. Perceptions of special education teachers on their level of competence

Perceptions	Participants (n)
I am confident in my competence to use educational technology applications in teaching Mathematics	11
I am not confident in my competence to use educational technology applications in teaching Mathematics	4

Perceptions of special education teachers on most common educational technology applications in teaching Mathematics

The following Table 3 shows that the teachers who participated in this qualitative study reported various technology tools, resources, and educational technology applications which can and are being used in math classrooms in special education schools. The results showed that most teachers stated that educational digital games (n=12) are frequently used in enabling math skills between students with special educational needs. Teachers also indicated that drill-and-practice websites (n=9) are a common educational tool for Mathematics. Mobile apps (n=7), interactive smart whiteboards (n=4), projection devices (n=5) and digital calculators (n=10) are among the other educational technology applications stated by special educational teachers.

Table 3. Most common educational technology applications in teaching Mathematics

Educational technology applications	Participants (n)
Educational digital games	12
Drill-and-practice websites	9
Mobile apps	7
Interactive smart whiteboards	4
Projection devices	5
Digital calculators	10

Perceptions of special education teachers on the challenges with using educational technology applications in teaching Mathematics

The following Table 4 shows that the teachers who participated in the current empirical study described five main and critical implications that they encountered when integrating educational technology applications in math classrooms in special education schools. As the following results show, teachers indicated five different problems when introducing and dealing with the aforementioned technology applications in teaching Mathematics. Almost half of the participants (n=8) reported that there are significant possibilities of students' learning performances' deterioration and also, they observed difficulties in keeping track of students' performance and mistakes. Six of the special education teachers reported that they faced challenges in supporting maintenance, and resolving various technical issues of the applications and the devices. A total number of four participants indicated that students' involvement with the educational technology applications obtained fragmented, rather than complete results. Furthermore, disconnections or no connection to the internet were reported by some special education teachers (n=4) in this study.

Table 4. Perceptions of special education teachers on the challenges with integrating educational technology applications

Perceptions	Participants (n)
Possibility of students' deterioration	8
Insufficient or incomplete feedback about students' performance	8
Challenges with adjusting to setup and maintenance demands	6
Disconnections in the internet – No internet connections	4
Achievement of fragmented results	4

Perceptions of special education teachers on their purpose for utilizing educational technology applications

As it shows in Table 5, all special education teachers (n=15) think that the integrated educational technology applications enable teachers to support students with special educational needs and give them the chance for a more independent math work and learning course. Also, many participants (n=12) observed that students find Mathematics more engaging and less intimidating and feel less anxious and more confident in engaging in math problems solving. Seven special education teachers reported that the technology applications serve as a unique report of students' strengths, needs and learning results and a few (n=3) stated that some educational digital games are more efficient than typical homework formats to track students' performance in tasks and activities.

Table 5. Perceptions of special education teachers on their purpose for utilizing educational technology applications

Perceptions	Participants (n)
Enhancing students' independent practice and course of learning	15
Making students more motivated and engaged to educational process	12
Enabling a more effective assessment	7
Possibility of tracking students' learning performance	3

Perceptions of special education teachers on mathematical concepts and features in which using educational technology applications are more effective

As it shows in Table 6, the participants of the present study provided five different perceptions of key mathematical concepts and features that are taught more effectively through educational technology applications. All special education teachers (n=15) respond that students practice and have the chance to enhance their skills in identifying and using numbers and their counting skills. Also, fourteen teachers indicate that mathematical problem solving skills can be introduced and taught more effectively by utilizing various applications. According to special education teachers, basic calculations (n=13), and geometrical shapes (n=10) are easily visualized in the educational technology applications, so students with special educational needs experience more simplified steps for completing simple, or more complex, calculations and practicing in geometry.

Table 6. Mathematical concepts and features in which using educational technology applications are more effective

Perceptions	Participants (n)
Counting	15
Numbers	15
Problem solving	14
Basic Calculations	13
Geometrical shapes	10

Perceptions of special education teachers on the recommendations for an effective utilization of educational technology applications in teaching Mathematics

The following Table 7 shows that the teachers who participated in the current empirical study provided four different categories of recommendations for enhancing technology applications' effectiveness in math classrooms for children with special educational needs. Most participants (n=12) recommended the development of in-service training programs for teachers on using technology in classrooms. In addition, five special education teachers suggested a quicker and more easy process to set up the technology applications in order to help students organize their time. Another five participants recommended that designers should give them the ability to adjust the difficulty level in order to develop personalized kai differentiated math work for individual teachers. Two participants did not indicate any recommendations, stating that they only use technology applications as a reinforcement for students' engagement.

Table 7. Recommendations for an effective utilization of educational technology applications in teaching Mathematics

Perceptions	Participants (n)
In-service training for teachers on using technology applications	12
Enabling a quick and more easy set up for classroom use	5
Allow teachers to adjust the difficulty level	5
I cannot make a recommendation	2

Discussion

Students with special educational needs need to have sufficient mathematical knowledge and developed mathematical skills to maintain their independence in everyday life. At this point, the role of teachers in special education becomes more important, as they are the ones who provide guidance and support to their students for the development of academic and social skills. Of course, the decisive guidance of teachers should coexist with the effectiveness of the use of technological applications in the teaching of students with special educational needs, as evidenced in the relevant literature. Therefore, the present research study aimed to determine the perceptions and attitudes of special education teachers on the utilization of educational technology applications in teaching mathematics. Fifteen teachers currently working in primary and secondary special education schools in Greece participated in the study and their answers are being presented and analyzed in order to draw specific conclusions concerning the aim of this research.

According to the findings of the present study, special education teachers report that they use a wide range and variety of educational applications, such as digital applications, the Internet, digital games, projectors, and interactive whiteboards. The effectiveness of the use of most of these technological tools is supported by data from the existing literature. In particular, the role of computers and other technological tools (e.g. smart mobile devices, interactive whiteboards) is particularly emphasized in terms of enhancing learning motivation, but also in achieving learning goals (Baglama et al., 2017; Wen et al., 2020; Wiest, 2001).

In addition, previous research has examined the perceptions of teachers, especially those employed in primary education, regarding their ability to introduce the use of technological applications in teaching practice. The findings of the studies show that teachers understand the need for training to enhance their digital skills, despite teachers' beliefs about the possibility of integrating technology into the learning process (Baglama et al., 2017; Demir & Bozkurt, 2011; Wen et al., 2020). The above findings seem to be consistent with the present results. Teachers also believe that there are several challenges and various obstacles that need to be addressed to improve the process of integrating educational technology applications into the classroom (Pierce & Ball, 2009). This is similar to the results of the present study in which special education teachers report that the use of technology helps on the one hand in teaching various mathematical concepts and skills. On the other hand, the possibility of students' engagement and difficulties deteriorating, the incomplete feedback about students' performance, the fragmented results, the disconnections in the internet, and the challenges with setting up and technically maintaining the technology tools are specific problems in integrating educational technology applications.

In general, the present study showed that special education teachers consider that they can satisfactorily use technological applications in the teaching of mathematics. The study also provides important educational conclusions regarding the importance of integrating applications into special education classrooms and the development of mathematical skills in students with special educational needs. Teachers must follow new trends and practices to fully meet the needs and difficulties of their students. Hence these general conclusions, it is proposed that in-service training programs and courses should be designed for teachers to enhance their competency and skills in using technology into classrooms. Also, it seems important to overview and study teachers' perceptions on the integration of technology in addressing other academic and learning difficulties, such as in reading and writing skills. Educational policy should improve teachers' opportunities to develop their knowledge, understanding and attitudes towards the importance of using educational technology applications in teaching Mathematics.

One of study's main limitations regards the analyzed themes and sub-themes of the content analysis, and the nature of open-ended questions. Certain educational technology applications or mathematical concepts and features were absent from participants' answers.

In this case, a quantitative research with a close-ended questionnaire could provide an inter-dimensional analysis of data. In addition, a quantitative correlation analysis of teachers' perceptions and their characteristics could be useful for making specific recommendations for future practices in implementing technology in mathematical special education. As with qualitative studies similar to the present study, the findings cannot be used to generalize the patterns and perceptions of the entire population of special education teachers, but can be used more to provide insight into the current situation and to strengthen the planning of possible future research redirects. Similar studies with a quantitative or experimental methodological approach may be carried out in the future for more generalized conclusions.

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