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Criteria for Selecting Effective Electronic Applications for Students with Autism Spectrum Disorder from a Teacher's Perspective in Saudi Arabia

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Abstract
This study identifies the criteria for selecting effective electronic applications for students with Autism Spectrum Disorder (ASD). In addition, it establishes the views of teachers in Saudi Arabia concerning the issues associated with the employment of these applications during lessons. The study employed the qualitative approach, with data collected by means of semi-structured interviews with nine teachers (male and female) of students with ASD, and thematic analysis utilised to analyse the data. The study revealed that the teachers generally held a positive view of electronic applications for use with students with ASD. The selection criteria for the applications under consideration consisted of: firstly, their acknowledgement of diversity; secondly, that they supported the educational process; thirdly, that they took individual differences into account; and fourthly, their level of acceptance by students. In addition, the research identified a number of issues associated with electronic applications, including students with ASD and their families and teachers. This study recommends that the Saudi Ministry of Education should develop factsheets focusing on effective educational applications for students with ASD, in addition to offering workshops and training for both families and teachers. Moreover, it encourages designers to create electronic applications capable of matching the characteristics of students with ASD, alongside supporting the Arabic language, and serving a number of further areas.

Keywords: autism spectrum disorder, electronic applications, teachers.

Introduction

Technology tends to promote ease of communication, including exchanges of experiences and information, and is currently helping to promote development, creativity, and scientific progress in all areas of life. One of the most important aspects is education, particularly with the success of e-learning, which has helped to reduce the effort and cost for the teacher, as well as facilitating the acquisition of information for learners (Fatiha, 2021). Thus, e-learning has enhanced self-learning, including for students with disabilities, resulting in the increasing use of educational technologies, i.e., computers and electronic applications (Muawad, 2020). Electronic applications are defined as programmes designed to interact with learners and implement the many services and tasks required by the user (Salih, 2020). This has enabled learning to move from being solely a method of instruction to one of development and creativity. In addition, these applications promote self-learning and have transformed many traditional educational patterns in ways that make them appropriate for use with students with Autism Spectrum Disorder (ASD).

Students with ASD are distinguished by several characteristics associated with their disability (i.e., language deficiencies, verbal and nonverbal communication, and social interaction), in addition to the presence of stereotypical behaviours, i.e., limited interests, some sensory disturbances, and perception difficulties. The individual abilities and needs of students with ASD tend to vary, depending on the severity of their disability and the early use of appropriate intervention (Aamir, 2019; Jadhav & Schaepper, 2021). Teachers therefore bear these characteristics in mind when selecting electronic applications to teach these students' academic, social and independence skills, and help them to solve problems, in order to achieve their educational goals in a tangible and effective manner.

This indicates the importance of examining the use of electronic applications capable of assisting students with ASD to achieve their desired goals. As confirmed by a number of previous studies, the current technical developments in education (in line with the Kingdom of Saudi Arabia's Vision 2030) have generated an increased use of electronic technologies and applications for teaching and learning (Umar and Alzuraikat, 2019; Attia, 2020; Fatiha, 2021; Law et al., 2017; Jiménez et al., 2021; Guseva, 2020; Cardon, 2016; Abidoğlu, 2017). Electronic applications have been shown to have a positive impact on people with ASD, particularly as they develop social, communication, and language skills. This allows such individuals to express and communicate their views, as well as reducing any inappropriate behaviours, and helping them master their educational goals. It is notable that electronic applications place considerable reliance on visual stimuli, i.e., a strength when teaching students with ASD. It is significant that a number of specialists, teachers, and those experienced in dealing with people with ASD, have confirmed that these individuals tend to possess distinctive cognitive abilities that favour the processing of visual rather than auditory information (Alzuhraiqat, 2021). This has been confirmed by Alzahrani and Maajini (2019), whose study indicated that most teachers of students with ASD use electronic applications during lessons.

The current study arose from the researcher's own experience of working with students with ASD, and focuses on the impact of using electronic applications to support the learning process, by improving both skills and behaviours. However, many teachers experience difficulties in identifying the electronic applications most effective for use with students with ASD, i.e., compatible with their students' abilities and characteristics. This highlights the importance of establishing information capable of assisting these teachers to choose appropriate and effective applications.

The examination of the existing educational literature, including Saudi Arabian, Arab and foreign literature, reveals a lack of studies demonstrating the best ways of choosing effective electronic applications for students with ASD. The current study therefore addresses this lack by seeking to identify: firstly, the teachers' criteria for selecting effective electronic applications for those with ASD and secondly, the issues they face when using electronic applications with their students.

Literature review

There have been a number of studies examining the use of modern electronic technologies and applications with people with ASD. Altalhi (2019) undertook research in Saudi Arabia, with a population similar to that examined in the current study. The researcher developed a mobile application, based on the use of video modelling, to enhance the self-protection skills of Saudi children with ASD, by focusing on their preferences. A similar conclusion was drawn by Moreno et al (2020), who offered comprehensive recommendations for designing computer applications for people with ASD, aiming to strengthen their social, educational, and emotional skills. The study identified that computer applications can make a significant contribution to the process of developing social and emotional skills, as well as the teaching process itself. The current study partially agrees with Moreno et al. (2020), specifically when it comes to focusing on the involvement of educational technologies in the teaching process, although it differs in employing the qualitative approach to achieve its objectives.

Due to the varying outcomes experienced by researchers examining the use of technology with people with ASD, the goals of some previous studies were found to be similar, in an attempt to reach more accurate and comprehensive results. Attiyah (2020) sought to identify the impact of smart device applications on the development of social communication skills, social responsibility, and self-care for autistic children. The study revealed statistically significant differences between the pre- and post-applications of the experimental group in the development of social communication skills, in favour of the post application. Rehman et al (2021) also conducted a study identifying the most effective mobile applications using artificial intelligence techniques to help those with ASD, emphasising the need for software developers and healthcare professionals to consider a number of specific features. More recently, Montes et al. (2021) analysed the quality of free applications for people with ASD available in the Google Play Store, evaluating each according to its design, content, and educational style. The results indicated that only fourteen applications received significantly higher scores.

The above review has identified the importance of establishing the views of those teaching students with ASD when it comes to identifying beneficial electronic applications, along with highlighting the skills such applications are able to develop and improve. These previous studies have therefore revealed the importance of the current research, which conducts a qualitative study examining the perspective of teachers and providing an accurate description of their attitudes towards employing electronic applications with people with ASD.

Methodology

The current study adopted the qualitative approach to obtain sufficient information to clarify the most effective criteria for the selection of electronic applications, as well as any resulting problems facing students with ASD. The current study population consisted of teachers of students with ASD in Makkah, currently working in ASD programmes attached to general education schools, or centres affiliated with social affairs, and who were using electronic applications. Using data saturation, the chosen study sample consisted of nine specifically chosen teachers, all with between four and eight years' experience. The main data collection tool consisted of semi-structured interviews, ranging in length from thirty minutes to an hour, which permitted the participants to express their opinions by answering the set questions, while also giving them an opportunity to expand their views, if they wished. Mansur (2020) noted that the interview consists of a classified, structured, and purposeful dialogue that takes place between the researcher and the participants, with the aim of obtaining information related to the subject of study.

The participants all gave permission for their interviews to be recorded, and were reassured that their information would remain confidential. The interviews were analysed according to the subject analysis method, which included six steps, following the methodology of Braun and Clarke (2012). The first step was the saturation of data collection, with the process ceasing once duplication of information was achieved. Secondly, the collected data was written up and gathered in a Word file. Thirdly, the data was encoded, with the file read in a detailed and in-depth manner, and, after examining the data, the sentences

were also encoded, as well as being given appropriate titles for each separate interview. Fourthly, the researcher established the addresses formed from those symbols. Fifthly, the titles were then placed into appropriate main categories. Finally, the results were written up and discussed in a clear manner, to explain the data and clarify the perspective of the study participants.

Furthermore, the current study also used the audit trail strategy to ensure reliability, which consists of good planning and prior arrangement of interviews, by means of scheduling and organisation, in order to facilitate the effective application of study procedures (Cresswell and Booth, 1994/2019). The study also used peer review and information extraction, with several specialists in the field of qualitative research consulted from the initial procedures to the analysis of the results, in order to provide the current research with several independent observations, which were used to modify and improve the research.

In addition, the study followed several criteria to achieve confidence and stability, most notably reliability. This provides a comprehensive and clear description of the use of methodology, tools and data analysis methods that have previously achieved similar (Al Zahrani, 2020). Accordingly, the current study sought to describe in as much detail as possible the stages of building the tool employed for the research, along with the procedures used with the participants, and the method of data collection, Moreover, the issue of confidence was addressed by ensuring impartiality and removing self-bias when presenting ideas and interpreting the results.

Results and Discussion

Knowledge and Background

This study found that the participants generally agreed on the criteria for selecting effective electronic applications for students with ASD. Most of the answers focused on the question relating to the respondents' understanding of electronic applications, i.e., software downloaded onto electronic devices. Participant T2 described these as: "…electronic programmes on a mobile phone, iPad or computer", while participant Z identified them as: "… multimedia that includes motion and sound effects, various enhancements, colour, animation, still images, and video". Participant R added: "They are applications that are on electronic devices. I mean, these applications benefit - in general – everyone… in all respects, whether they are in the social and educational fields, everything is comprehensive, I mean". These responses indicate that the participants demonstrated a clear understanding of the concept of these applications, along with their background, and facilities.

In addition, the participants were questioned about their experience of activating electronic applications. The answers varied, being divided into positive and negative experiences. There were a number of positive experiences, including that the applications could be reassuring, and a source of pleasure. Thus, Participant A noted: "In social situations, frankly, the action was very positive. I mean, it was impressive, to the extent that I was happy at the end of the result, I mean, allowing us to understand the results". Furthermore, Participant R2 stated: "We achieved the goals, most of them academic, using both academic and linguistic methods". When it came to the negative experiences, Participant T highlighted issues related to students with low cognition: "He is just playing, but he is not communicating the meaning of the application, which means that he is just stuck on the iPad or stuck on the mobile phone". This drew attention to a significant problem related to the need for teachers to be familiar with the characteristics of their students, and thus able to establish whether the applications achieve the desired goals, or if students fail to receive any benefit. It also highlighted the need for the teacher to introduce the students and their families to the application prior to initiating its use, in order to clarify its benefits, so encouraging the family to accept its use, including at home, in order to achieve the desired goal. The study findings therefore reinforced the need for family participation, particularly the response of Participant S who, when asked about the most effective electronic applications for students with ASD, stated: "Like the Pix board applications, I have not used it, but I hear that it is good, especially for families when traveling. I mean, the mother can have it on her phone, and if she does not have a Pix file, she can do it daily with her child". This demonstrated that the participants confirmed the teachers' emphasis on the need for family participation, even if this requires a change of application.

Variety of Options

Several respondents' answers indicated that one of the most important criteria should be a programme's ability to access a variety of options, and be capable of adjusting the sound, image, or serial gradient of the objectives, while the subtopics could be addressed in some detail. The current study calls for the need to follow standards suitable for students with ASD, due to their unique needs, with characteristics of the autistic disorder including a negative reaction to loud voices and sounds. This indicates that such issues need to be taken into account if a teacher wishes to use an application with a group with ASD, and stresses the necessity of a variety of options being available, as highlighted by Participant A: "Yes, one of the characteristics that I pay attention to is the sound in the application and its method. Will it be suitable with the student or not, if there is rhythm or music in the same application? Because they can be disturbed by loud voices". In the same context, Participant W noted: "For example, if a student becomes nervous around sounds, I remove them from the software or the application. On the other hand, if the student enjoys the sounds, I add them and increase the volume". This result is consistent with the findings of Gallardo-Montes at el. (2022), who indicated that, despite the benefits, people with ASD continue to experience issues in relation to electronic applications, resulting in a need to improve the available options. The study also highlighted that the most important aspect is whether the application is intended for entertainment or educational purposes, followed by its reliability and characteristics, including the facility to control the sounds, lighting, or content. This current study placed used most of the applications at the recommended level for those with ASD, but highlighted a margin for improvement to increase their functionality.

Alongside the issue of the ability to modify sound, a number of participants raised the need for an image editing system, due to some applications lacking the ability to add external images, or using unrealistic pictures, which would have only a limited attraction for with students with ASD. In addition, they highlighted that those with ASD experience difficulties with generalisations, and an unrealistic shape (i.e., of a lion) would prevent students from distinguish its characteristics when seeing a similar animal on television or in a zoo. Participant A stated: "The image needs to be clear and closer to its natural form. For example, if you present pupils with a strange-looking crocodile, can they detect that it is a crocodile?" Participant R2 further noted that: "…this can let me control the photos, and I can upload photos myself. This enables me to use questions related to the photos." This result is consistent with Rehman at el. (2021), whose study employed artificial intelligence techniques in electronic applications supporting people with ASD.

However, a review of the electronic applications available on the Google Store indicated that, despite the importance of dealing with, and recognising images, the majority of these applications do not support many such features. It is significant that the study of Hernández at el. (2022) confirmed the effectiveness of the image upload feature in the E-Mintza application, as it allows users to upload pictures of family members for children with ASD to use to create sentences, particularly if they wish to communicate with a family member (E-Mintza, 2022).

A further viewpoint concerned the sequential gradation of the objectives and the ability of the teacher to determine the method best suited to each student. The participants noted that this forms the skill gradation in the application compatible with the hierarchical gradation required by the teacher. For example: if the teacher wishes to set an educational goal of teaching the letter alif (A), then he/she creates an educational plan. Firstly, the teacher pronounces the letter to the students; secondly, he/she shows them the letter; thirdly he/she asks them to point to the letter alif (A) and extract it; and finally, the students are asked match the letter with an occurrence in a separate location. This enables the application to have multiple options assisting the teacher in delaying some objectives and emphasising others, as well as arranging the objectives in the application according to the educational plan. This was confirmed by Participant A as follows: "I mean, for example, the letter alif, we use matching or extracting, classifying, naming and writing. The application needs to be graded in the same sequence."

This result is supported by the findings of Moreno et al. (2020) concerning the need to modify the design of computer applications used with students with ASD. The importance of this result was also confirmed by Voss et al. (2019), who emphasised the need to use electronic applications to enable those with ASD to achieve specific goals. The study indicated that the AutisMate application helps people with ASD to learn mathematical counting skills in a simple manner by dividing the process into simple stages and steps. This was confirmed by the study of Anupama et al. (2022), which supported Voss et al.'s (2019) study, adding that the AutisMate application was found to develop verbal communication and flexible thinking in children with ASD.

Supporting Educational Processes

The second main topic emerging from the participants' responses concerned the need for the applications to support the educational process. It was divided into strategies for achieving educational goals, with some considering that effective applications assist the educational process by presenting the lesson to students. However, the presentation of the lesson formed only one of the five stages discussed by the participants. The first stage was to attract attention; the second concerns the preparation of the lesson; the third consists of the presentation of the lesson; the fourth stage is that of feedback; and the final stage is reinforcement. The participants were cognisant of the benefits of these applications, as well as the variety of strategies involved in achieving educational goals.

This view was confirmed during the data analysis by the answers obtained from some of the participants. Participant A said of the focus phase: "The first thing about electronic applications for children is that they are intended to draw their attention". These are the first characteristics and advantages of effective applications, particularly as, before starting the lesson, it is vital to attract the attention of students, particularly those with ASD. This is followed by the preparation for the lesson, with Participant S noting her use of effective applications as follows: "I tend to use electronic applications during my preparation", while Participant T2 mentioned the benefits of information delivery through effective applications, by saying: "I mean, if I explained the information using the board, its effect would remain for two days, but when using an application on an iPad, it remains for more than a week". When discussing the feedback stage, Participant S stated: "I can also benefit from this (stage) to review the lesson, or to give as feedback to children who answered correctly or incorrectly". When it came to the final stage (i.e., reinforcement) Participant A concluded by saying: "I make it a point of reinforcement, because this continuity in showing responses promotes enthusiasm from the inside".

The results of the current study agree with those of Hashim at el. (2022), which confirmed that the use of smartphone applications with people with ASD help them to enjoy acquiring language, as well as being capable of prompting their attention and increasing their interest in education. The current study also indicated that these applications serve as a platform to instil the habit of learning at home, as well as stimulating speech and language skills for people with ASD. The results are also supported by the study of Elicin and Kaya (2017), which found that electronic applications proved effective for teaching academic, communication, and social and emotional skills. In addition, it concurs with Almeida et al. (2019), whose study concluded that effective applications can enhance the learning of children with ASD, i.e., social interaction, motor skills, and linking facial expressions to feelings and logical thinking.

A number of participants raised the issue of whether the applications were the optimal investment of time, money and effort when working with people with ASD. Participant R2 said: "…electronic applications help me with this, as they show me an example, and I do not have to waste time, effort, and material costs". In addition, Participant Z noted: "And it makes it easier for the teacher, so instead of using a particular method, I replaced it with an application, so saving time, effort and money". This demonstrates that the teachers preferred to be guided by their eagerness to invest time, money, and effort to benefit from everything that contributes to the realisation of the educational process. This result agrees with the conclusions of Sutton (2022), whose study indicated that teachers preferred to use electronic social story interventions to save resources, particularly as this demonstrated purely positive outcomes with students with ASD, including in relation to their behaviour.

Individual Differences

A variety of perspectives were expressed concerning individual differences, in particular that the most prominent characteristic of effective special education, including for students with ASD, is the need to consider individual capabilities and characteristics, as well as the most suitable aspects in terms of goals, means, and methods. There are many individual differences between students, including academic and behavioural, on which the educational process generally focuses, particularly in classes attached to public schools. This acknowledgement of differences can start from understanding each student's academic level and behavioural capabilities, followed by setting goals that are both appropriate and achievable, in order to avoid failure for the students and psychological burnout for the teachers. This was confirmed by the responses of the participants, including Participant S, who noted: “Also, if the student has a particular language level, I can use an application that has an appropriate level of vocabulary and sentence structure, so I know that this application is at the student’s level”. Furthermore, Participant Z stated: “For me, the use of electronic applications depends on the level of awareness and the behaviour of the child”.

This study therefore believes that the consideration of individual differences is not limited to an understanding of the level of the student and his/her capabilities, along with the setting of goals. Instead, it includes a gradation in achieving goals, known as the skill sequence, during which the teacher ascends from the students’ lowest level to the most challenging. Participant Z described this as follows: "It involves progressing from easy to difficult, until the child feels that he isn't helpless from the first stage. He starts with the easy, then moves onto the difficult". The participants highlighted that they tended to prefer English applications, as these generally include many features capable of achieving educational goals. However, some teachers could fail to consider the students’ language proficiency when inserting English applications into a lesson, which could hinder the achievement of their goals. Participant F said: “…it should be in Arabic, and this is the most important thing”. This thus confirms the need to consider the individual differences of students when choosing effective applications. Caralsson et al. (2018) studied a sample of students with ASD, alongside a further sample with learning difficulties, revealing differences between the two in favour of people with ASD. They concluded that this indicates the need to choose the applications used in teaching students with ASD based on their abilities and characteristics, and it should be not assumed that the same application will produce equally positive results for all students. In addition, the study of Arinta and Emanuel (2019) indicated that many of these applications and technologies are not suitable for all types of groups with ASD, with most being unsuitable when dealing with some related problems.

The interviewees generally recognised that their students should be receptive to the applications they employed, and that this demanded a consideration of the nature of each student, including his/her individual interests. Therefore, the emphasis should not be placed on the wishes of the administration or educational supervisors. Participant A mentioned: "I can also use it for someone whose goal is to enter electronic applications or the electronic side, but some children do not accept this topic ". Participant R stated: “It depends on the student. For example, if I have a student who loves electronics, then I consider this is a very strong entrance point”. The result of the current study accords with Altalhi (2019) in considering that applications should be compatible with the wishes and preferences of students.

Electronic Applications and Related Problems

The data from the interviews identified several issues related to electronic applications, including students, families, schools, and the applications themselves. However, it should be noted that the teachers generally recognised the complex issues arising during the education of people with ASD. Thus, this discussion does not focus on any negative aspects of the applications, but seeks to overcome any related problems faced by teachers in selecting one they find effective. All of these are reviewed below, with an explanation for each one, alongside the opinions expressed in the participants' responses.

This study found that, although they were enthusiastic about the use of electronic applications with their students, many of the teachers were hindered by various problems. Firstly, there was the issue of

impulsiveness, with Participant A explaining: “If the student suffers from impulsiveness and the inability to wait, it is possible that using applications is not easy … she just wants to own this thing and wants to grab it and take it from my hand”. This indicates the need for teachers to work with students in order to train them to overcome such traits. In addition, the teachers faced problems relating to students’ attachment to these devices, as highlighted by Participant A2 This study considers that, should such a situation arise, the teacher needs to cease the use of these devices with a student, apart from those strictly related to the educational process. This result is consistent with Al Otaibi and Ba Salim (2021), who confirmed that students with ASD face many challenges when employing technology for educational purposes. The results also confirm the most prominent of these problems as being the difficulties associated with teaching these students the necessary skills to deal with technological applications and tools during lessons, accompanied by their struggles to concentrate and pay attention.

The study identified that families of pupils with ASD generally lack sufficient free time to assist with the education of their children, as well as their anxieties relating to the use of electronic devices. This focus on the role of the family is due to it being most important influence on a student’s life, with considerable potential to support the work of teachers. Participant B stated: “For example, I used to send the mother the name of a specific application that she could download for her child. But she would say that she did not have the time”. This demonstrates that it is vital to both appreciate the concerns, and the work of the family, while at the same time recognising that teachers are not fully responsible for all aspects of pupils’ education. In the same context, Participant W emphasised that: "Some families refuse to use devices”, due to believing that they can cause ASD. This highlights the fact that some families hold misconceptions that need to be clarified and addressed by specialists in the field. This result is consistent with that of Al Adawi (2020), whose study confirmed the presence of many challenges faced by families when attempting to educating students with disabilities through educational platforms and electronic applications. This current study therefore recommends the need to ensure both the student and the family are informed about the importance of learning using technologies and distance learning, as well as to develop their abilities in the use of modern technology.

Among the most prominent concerns raised by the participants were those related to the school, in particular the failure of the administration to provide electronic devices. Participant B stated: "They may make promises to provide devices, but this does not happen, and if I buy the devices myself, they can make things difficult for me". This indicates the potential for confusion, as the school administration is assumed to wish to create an educational environment that is attractive to students, and capable of achieving the required goals with minimal effort and time. However, this study found that financial concerns tended to be prioritised over the provision of equipment. The schools recognised that teachers generally tend to take the initiative and pay for the provision of electronic devices for use with their students. This then raises the issue of the teachers’ lack of knowledge (in particular those working with pupils with ASD) concerning the most appropriate applications for the capabilities and capabilities of their students. Participant Z stated: “One of the reasons is also that the teachers do not search and do not have a background in the educational applications currently available in Saudi Arabia”. This result concurs with the study of JadAllah (2021), which identified a number of obstacles to using applications with students with ASD.

The above discussion has focused on human-related problems, including the student, the family, and the school (i.e., management, as well as teachers). The final issue concerns the electronic applications themselves, and the need to continue to implement improvements and rectify any problems. Several participants mentioned that electronic applications, and in particular Arabic versions, tend to focus on academic skills, to the detriment of other aspects. Participant S noted that: “The applications cover the linguistic or social aspects, except for one or two”. Several participants also raised the issue of cost, and the expense of monthly or annual subscriptions, with participant R stating that “Most applications are expensive”. The current result is supported by the conclusion of Montes et al. (2021) that there are few applications specifically for students with ASD, with only fourteen being identified out of a total 155. This indicates an urgent need to design appropriate electronic applications for students with ASD.

Conclusion

This study has recognised that teachers can benefit from the use of educational applications for teaching students with ASD, including the ability to diversify the methods of delivering information to their pupils, and create an attractive and supportive school environment. It also emphasises that educational applications can help students benefit from electronic devices, not only for entertainment purposes, but also to improve their educational outcomes in a more enjoyable manner.

The results of the current study thus contribute to providing teachers and specialists with a background knowledge of effective applications, including the most important criteria involved in their selection, as well as any potential issues. In addition, the study recommends the need to hold educational workshops and courses in the appropriate use of electronic applications for both the teachers and families of students with ASD. This study also emphasises the need to support families, whose role is considered complementary to that of teachers and specialists. Furthermore, it highlights the need for the Ministry of Education to develop a file including a list of applications appropriate for the abilities and characteristics of students with ASD, and ensure that this remains updated, in order to help teachers and families choose beneficial applications capable of helping students achieve their goals. The study also recommends encouraging designers to develop further electronic applications suited to the characteristics of students with ASD, as well as supporting the Arabic language, and serving a variety of fields.

Furthermore, the study further recommends several future areas for research, including to consult with families, in order to establish the most effective electronic applications for use with students with ASD and to undertake a qualitative study of the practical advantages and disadvantages of special education programmes. The study additionally recommends studying the use of effective applications by families, including comparing the use of such applications with other groups, i.e., students with intellectual disabilities, or hyperactivity disorder and attention deficit hyperactivity disorder.

This study confirms the importance of developing educational applications for delivering information to students with ASD and recommends the need to hold workshops and training courses for both families and teachers. It has also highlighted that the Ministry of Education should create information concerning beneficial educational applications for students with ASD. The study also recommends encouraging designers to design electronic applications commensurate with the characteristics of students with ASD, as well as a number of other functions, including supporting the Arabic language.

This study has concluded that its participants demonstrated a good background knowledge concerning the participants in relation to the concept of electronic applications, along with their selection criteria and the potential problems arising during their use. Finally, the current study recommends a number of subjects for future research, including studying the families' views of practical issues concerning the effective use of electronic applications with students with ASD. It also recommends studying the practical issues when choosing effective electronic applications with students with ASD, including listening to the views of teachers in several different cities in the Kingdom of Saudi Arabia, as well as other groups of students with intellectual disabilities, or hyperactivity disorder and attention deficit disorder.

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