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Investigating Perceived Ease-of-Use, Perceived Usefulness and Intention-to-Use of the Users of Augmented Reality Application among Parents and Teachers of Children with Autism Spectrum Disorder (ASD)

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Abstract

In recent years, there has been much research on the adoption and implementation of augmented reality (AR) applications in the learning and educational process to improve the various skills and engagement of typical children. Through immersive environments that create the illusion of physical presence in a non-physical world, AR has the potential to transform how students learn and engage with their surroundings by providing them with an interactive experience that lets the users superimpose digital information on the real. However, research on AR applications for children with special needs is still limited. A child with special needs is a person who has a disability that limits their quality of life in one or more domains, such as sensory, behavioural, developmental, or physical functioning. Therefore, the use of augmented reality applications incorporated with Picture Exchange Communication System (PECS) and Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) methods was conducted in the present study to investigate perceived ease-of-use, perceived usefulness, intention-to-use of the users of augmented reality application among parents and teachers of special needs children. Using the Technology Acceptance Model (TAM) as the theoretical framework, a set of questionnaires consisting of 33 items developed from the constructs of AR with PECS and TEACCH Approaches, Perceived Usefulness, Perceived Ease of Use, Intention to Use, Perceived Efficacy, and Training was randomly distributed among 381 parents and teachers of special needs children. The result of regression analysis using IBM-SPSS version 26.0 showed that the application of AR with PECS and TEACCH approaches can predict a satisfactory percentage of variance among parents and teachers of special needs children in terms of intention to use, perceived ease of use, and perceived usefulness. The results of the

regression analysis from this study could serve as the basis for future research in AR application.

Keywords: Special Needs, Autism Spectrum Disorder, Intervention, Regression Analysis.

Introduction

Children who have been diagnosed with several disabilities, including reduced physical function, visual, hearing, and learning, are considered as special needs children (Bari et al., 2016). These children are also differ from ordinary children in terms of their behaviour, social, sensory ability, physical, emotional skills, mental, communication and neurodevelopment or a combination of two or more of these factors (Hasugian et al., 2019). Due to the disabilities of special needs children, the special education administrators need to be aware that their role as special education instructors are beyond the typical classroom setting, therefore having a solid understanding and knowledge of the special needs education field is crucial (Mosbiran et al., 2020). Policymakers have paid more attention in the past two decades to advancing early intervention services for children with special needs (Lotstein et al. 2005). In recent years, children with special needs now have far more access to public education due to the improvement of special education system, which has also upgrade the infrastructure for the education of these children, aided in the early intervention program, and encourage greater integration of these kids with their classmates without disabilities (Kamble & Gaikwad, 2021). In Malaysia, all hospitals and District Health Centres provide medical and clinical interventions as part of the early intervention programme services for students with special needs, ages birth to three years (Bari et al., 2016). The early intervention programmes are implemented to support the educational needs of children who have been diagnosed as having special needs due to numerous physical, learning, hearing, visual, and hearing impairments (Bari et al., 2016).

Autism spectrum disorder (ASD), which is defined by challenges with social interaction and communication as well as a limited range of interests and repetitive behaviours, is one example of a special needs group (Sridevi & Arya, 2014). Based on the recent figures, the prevalence of ASD cases among children in Malaysia has reportedly increased (Bakar et al., 2021). ASD is characterised by widespread abnormalities in verbal and nonverbal communication as well as the appearance of stereotyped patterns of behaviour and interests (Gray & Tonge, 2001). Children with ASD also frequently exhibit disruptive behaviours such as aggression, lack of patience, screaming, yelling, self-harming behaviour, tantrums, meltdowns, property destruction, and general difficulty with emotion regulation (Dahiya et al., 2022). Due to the wide range of challenges and behavioural issues that these children experience, raising a child with an ASD causes parents to experience ongoing stress and strain (McStay et al., 2014). Lack of awareness and lack of educational support and effective teaching methods for special needs children at home, also contribute to parents' stress and emotional health issues as well as led to late intervention and therapy for children with special needs (Al-Farsi et al., 2016). Worldwide, there are many different types of people with physical and cognitive impairments such as ASD children that require for extra support during their learning process (Baragash et al., 2020).

In addition to having limited interests and repetitive behaviours, autism spectrum disorder is a neurodevelopmental condition characterised by difficulties in social communication (Hodges et al., 2020). For children with ASD, effective interventions are

necessary to stop the development of their behavioural issues as well as to give benefits to ASD children in terms of verbal and nonverbal skills, adaptive abilities, and quality of life (Colombi, 2017; Kodak & Bergmann, 2020). Most of the special needs schools and centres use Picture Exchange Communication System (PECS) as the most common communication-training tool for young children with autism spectrum disorders (ASD) as it uses visual cues for instruction and communication, PECS is an augmentative and alternative communication (AAC) system (Cubillos; Flippin et al., 2010). Originally created in the United States by Bondy and Frost, the Picture Exchange Communication System (PECS) is intended for autistic children who have minimal or non-existent functional communication abilities (Magiati & Howlin, 2003). The PECS system teaches the ASD kids the functional communication by employing pictures either colour or black-and-white drawing as the communicative reference in a Velcro-mounted notepad (PECS board). Using a PECS board, the child is instructed to construct a "sentence" by choosing picture cards (such as the "I want" card and the "juice" card) and presenting them to a communicative partner as a request for a desired object (Charlop-Christy et al., 2002). By selecting and showing the image on the physical card, PECS was also designed to provide children with ASD with an alternate mode of communication, replacing written and spoken forms of communication with a visual-based system that uses visuals to initiate requests and describe what they observe as well as to convey their messages (Sulzer-Azaroff et al., 2009).

Meanwhile, Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) is another autism intervention programme that is regarded as an emerging approach for ASD children to reduce the challenges of the ASD children have through alternate communication skills, environmental modifications, and systematic, ongoing intervention (Panerai et al., 2002; Virues-Ortega et al., 2013). TEACCH was designed by Professor Eric Schopler's research team at the University of North Carolina (USA) in the late 1960s with the intention of concentrating on the working communication, cognition, perception, imitation, and motor skills of children with ASD (Sanz-Cervera et al., 2018). It was formerly implemented in ASD classrooms that were segregated and self-contained. These days, inclusive settings are utilising it, demonstrating its potential to help both normal and ASD kids (Benton & Johnson, 2014). The primary strategy used by the structured teaching of TEACCH programme to increase abilities and decrease behavioural issues of ASD children are divided into four parts: (1) Individual work systems, which are visual instructions informing children of what is expected of them in a particular work session; (2) schedules, which are daily or weekly schemes showing children what activities will take place, when, and in what order; and (3) physical organisation, which is the arrangement of the teaching area, which provides boundaries for specific activities; and (4) visual organisation, which entails visual information depicting the purpose of learning a task (Zeng et al., 2021).

According to a survey on the facilities and services for ASD children in Malaysia, there is a significant difference between the facilities and services of early intervention programmes that are available in urban areas compared to rural ones (Chu et al., 2020). Due to the barriers faced by both groups and service providers in the relevant locations, there were some significant variations between the rural and urban groups' knowledge levels prior to therapy and parental efficacy following treatment, which led to the requirement to adopt new and effective methods of service delivery, including technology-based approaches among children with ASD (Dahiya et al., 2022).Technology-based approaches such as digital therapies may be

beneficial for autistic people because they are consistent and predictable as well as having the potential to be significantly less expensive than individually guided live therapy with a therapist (Sandgreen et al., 2021). Augmented reality (AR) is emerging as the next generation of display platforms for deeper human-digital interactions, thanks to the rapid advancements in high-speed connectivity and computation (Xiong et al., 2021). Numerous research have recently concentrated on using augmented reality (AR) to assist the children with autism in various developmental areas (Rega et al., 2018). The three characteristics that define augmented reality are the combination of virtual and real world elements, real-time interaction, and three-dimensional registration (Azuma, 1997; Schmalstieg & Hollerer, 2016). By superimposing or composing virtual things with their surrounding environment, augmented reality (AR) technology can display virtual objects in actual physical environments in the real world and give users a more natural and realistic sensory experience (Chiang et al., 2022). The different types of augmented reality applications that are currently available include marker-based augmented reality, marker-less augmented reality, projection-based augmented reality, and superimposition-based augmented reality (Adnan et al., 2018).

In terms of the use of augmented reality in special needs education, augmented reality (AR) is regarded as an advanced technology that holds great promise for education, particularly for the development of social and cognitive skills in children with autism spectrum disorder (Nincarean et al., 2013). Children with autism spectrum disorder (ASD) also can benefit from augmented reality application because it provides a secure and enjoyable environment in which encouraged numerous researchers to create a variety of mobile applications in the past few years to fulfil the needs of children with ASD, spanning from social development to emotion recognition, detection, and analysis (Williams & Chandramouli, 2021). Due to their difficulty in identifying and expressing their emotions, which might interfere with their ability to concentrate on a task, children with autism spectrum disorder could benefit greatly from the design of mobile augmented reality applications (Escobedo et al., 2014). Therefore, the aim of this study is to investigate perceived ease-of-use, perceived usefulness, intention-to-use of the users of augmented reality application with Picture Exchange Communication System (PECS) and Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) methods among parents and teachers of special needs children.

Literature Review

The term "augmented reality" refers to the addition of virtual things to a video stream view of the real world and this technology offers a distinctive interactive interface that enables simultaneous work and natural interaction between the real world and virtual objects (Lian & Sunar, 2021). Since numerous studies have demonstrated that augmented reality (AR) applications offer a richer environment that can ease communication and are more usable than other technologies, researchers and educators are becoming more interested in augmented reality as an intriguing alternative and engaging method of developing teaching and learning aids for children with autism spectrum disorder (ASD) (Rega et al., 2018). Additionally, most autistic children have superior visual memory than auditory memory, and they can learn and recall more by using visual learning or visual thinking (Taryadi & Kurniawan, 2018). To date, the Technology Acceptance Model (TAM) theory is the most used model to measure the effectiveness of mobile AR applications among ASD children by measuring the

user's perception of their usefulness and acceptance of their use of the application (Asiri & El Aasar, 2022).

In a research survey conducted by Yakubova et al (2022), among 257 school professionals who work with special needs children in 45 states of America and the Philippines, the findings of the research demonstrated that most of the respondents who used augmented reality applications (AR) received training or had knowledge of how to use the technology and had technical support available. In terms of age, most of the users of the augmented reality applications were significantly younger than those who reported that they did not use AR. However, the findings indicated that very few practitioners used AR (n = 26) in their practices. Additionally, Bai et al (2015), has established an interactive system that examines how Augmented Reality (AR) technology could potentially be used to conceptualise pretence in a play setting that is free-form. Through the comparison to a non-computer-assisted scenario, the results of the empirical study which include 4–7-year-old children with ASD, showed significant improvements in pretend play in terms of frequency, duration, and relevance after the implementation the AR system (Adnan et al., 2018).

Hashim et al (2021), has conducted a qualitative research study to get the opinions of stakeholders regarding the value of the created mobile application using augmented reality technology through interviews involving seven respondents from various backgrounds and field regions. Based on the findings, the result of the conducted research demonstrated that the developed mobile application has a great potential to assist children with autism spectrum disorder (ASD) in terms of their language learning of the English language. However, in order to improve the quality of alternative interventions for autistic children through the use of the PECS technique, Shminan et al (2017), created AutiPECS, a mobile-based learning programme, for parents of children diagnosed with autism spectrum disorder (ASD) in Malaysia in order to assists parents whose children have autism in reducing their dependency on therapists and the need for receiving expensive treatment at the private autism centres. Meanwhile, Escobedo et al (2012), used a smartphone to conduct an augmented reality study to examine the development of social skills in three schoolchildren with autism spectrum disorder (ASD) aged between 8 to 11 years old over the course of seven weeks. The results of the multiple conditions research design demonstrated an improvement in social engagement among the ASD children and a decrease in social and behavioural problems based on the behavioural observations, interviews, and transcript coding analysis.

Meanwhile, a study by McMahon et al (2016), on three students with intellectual disabilities (ID) and one ASD student to examine the development of literacy skills in the special needs group discovered that these students performed correctly on vocabulary tests more frequently after using iPads with augmented reality apps. In addition, a study by Keshav et al (2017), conducted a research using Google smartglasses with augmented reality applications among 21 ASD-afflicted children and adults to evaluate the acceptability and utility of a novel smartglasses system created as a social communication tool. The findings of the conducted research indicated that the proposed gadget is well tolerated and useful by people with ASD who range in age and severity, and that it could eventually serve as an assistive technology for those with ASD. In a study conducted by Pasalidou & Fachantidis (2021), 206 Greek primary school teachers were involved as research participants, and their opinions of the potential educational applications of mobile augmented reality were

investigated. Using written questionnaires that based on the technology acceptance model (TAM) theory, the research findings on the three primary variables; perceived usefulness, perceived ease of use, and behavioural intention showed high factor loadings for each construct which indicated positive intention among the teachers to utilize the educational AR application in future. Meanwhile, in order to reduce sensory overload in autistic children, Mikropoulos et al (2020), looked into the acceptance and user experience of an augmented reality system. The TAM-based questionnaire used in this study was updated and altered to include the six variables of Interface Style (IS), Perceived Usefulness (PU), Perceived Ease of Use (PEU), Perceived Situation Awareness (PSA), Attitude Towards Using (ATU), and Intention to Use (ITU). The results showed high internal consistency (>.70) and high mean scores for all six variables, which supported the idea that using an AR device allowed participants to experience sensory overload like ASD persons.

Research Method

The current research used a 5-point Likert scale adapted survey questionnaire ranging from 1, which means “strongly disagree,” to 5 which means “strongly agree”. Based on Technology Acceptance Model (TAM) theory, the survey questionnaire consisted of 33 question items grouped under six constructs. By using the population of ASD children ranged between 6 to 12 years old issued by the Ministry of Education Malaysia (MOE) as in Special Needs Data Book Year 2021, 381 respondents were selected according to Krejcie and Morgan table. To ensure the data representativeness, the respondents were randomly selected from 4 divided region of Peninsular Malaysia which were northern, southern, eastern, and central states. Using a proportionate stratified random selection technique, the respondents were selected proportionally from each location. Without revealing the respondents' identities, a set of self-administered questionnaires were given to the respondents and the respondents were given enough allotted time to complete the survey without interruption. By using IBM-SPSS version 26.0 regression analysis and assessment on the correlation between the variable of the present study was conducted to examine the relationship between the perceived usefulness, perceived ease of use of the augmented reality with PECS and TEACCH approaches and intention to use of the application.

Results

The descriptive statistical results of this study showed that female respondents had a higher frequency than male respondents, with 269 (70.6%) respondents compared to 112 (29.4%), based on the demographic data in Table 1. Regarding the race category, the results showed that 374 respondents (98.2%) of the total respondents were Malays, followed by 1 (0.3%) Chinese respondent and 6 (1.6%) respondents from other races. The age group of respondents who were between 30 and 40 years old had the largest frequency, representing 157 survey participants and a cumulative proportion of 41.2% of all respondents, according to the demographic data. With only 2 (0.5%) responses, the group of respondents 60 years of age and older had the lowest frequency rate. The results of the current study show that, of the 381 respondents, 256 (67.2%) were parents of children with special needs and 125 (13.0%), teachers of children with special needs. Regarding education, 169 respondents (44.4%) had only completed secondary school as their highest academic qualification, followed by 73 respondents (19.2%) with a diploma, 119 (31.2%) with a bachelor's degree, 15 (3.9%) with a master's degree, and 5 respondents (1.3%) with a Doctor of Philosophy (PhD).

Meanwhile, the mean score and standard deviation of the items for each construct were presented in Table 2.

The fieldwork dataset was analysed using the bivariate correlation of the Pearson correlation coefficient to measure the strength of the linear relationship between two random variables of the current study, and the findings are shown in Table 3. The Pearson product correlation of perceived ease of use and perceived usefulness was found to be strongly positive and statistically significant (r = 0.716, p<.001). Hence, H1 was supported. This shows that an increase in perceived ease of use would lead to a higher perceived usefulness among the users. The Pearson product correlation of augmented reality application with PECS and TEACCH methods and perceived usefulness was found to be moderately positive and statistically significant (r = .367, p<.001). Hence, H2 was supported. This shows that an increase augmented reality application with PECS and TEACCH methods would lead to a higher perceived usefulness among the users. The Pearson product correlation of augmented reality applications with PECS and TEACCH methods and perceived ease of use was found to be moderately positive and statistically significant (r = 0.348, p<.001). Hence, H3 was supported. This shows that an increase in Augmented Reality applications with PECS and TEACCH would lead to a higher perceived ease of use among the users. However, the Pearson product correlation of perceived usefulness and intention to use was found to be strongly positive and statistically significant (r = .738, p<.001). Hence, H4 was supported. This shows that an increase in perceived usefulness would lead to a higher intention to use among the users. In addition, the Pearson product correlation of perceived ease of use and intention to use was found to be strongly positive and statistically significant (r =. 649, p<.001). Hence, H5 was supported. This shows that an increase in perceived ease of use would lead to a higher intention to use among the users. Meanwhile, the Pearson product correlation of augmented reality application with PECS and TEACCH methods and intention to use was found to be moderately positive and statistically significant (r = .310, p<.001). Hence, H6 was supported. This shows that an increase in augmented reality application with PECS and TEACCH methods would lead to a higher intention to use among the users.

The simple linear regression was presented in Table 4 to evaluate the relative impact of a predictor variable on a particular outcome. To test H1, simple linear regression analysis was conducted to determine the effect of perceived ease of use on the perceived usefulness. The results revealed that the independent variables, perceived ease of use was predictors of users' perceived usefulness. A significant regression equation was found (F(1,379) = 398.238, p<0.000), with an R^2 of 0.512. To test H2, simple linear regression analysis was conducted to determine the effect of augmented reality application on the perceived usefulness. The results revealed that the independent variables, augmented reality application was predictors of users' perceived usefulness. A significant regression equation was found (F(1,379) = 58.974, p<0.000), with an R^2 of 0.135. To test H3, simple linear regression analysis was conducted to determine the effect of augmented reality application on the perceived ease of use. The results revealed that the independent variables, augmented reality application was predictors of users' perceived ease of use. A significant regression equation was found (F(1,379) =52.135, p<0.000), with an R^2 of 0.121. To test H4, simple linear regression analysis was conducted to determine the effect of perceived usefulness on the Users' intention to use. The results revealed that the independent variables, perceived usefulness was predictors of users' intention to use. A significant regression equation was found (F(1,379) = 453.521, p<0.000),

with an R^2 of 0.545. To test H5, simple linear regression analysis was conducted to determine the effect of perceived ease of use on the intention to use. The results revealed that the independent variables, perceived ease of use was predictors of users' intention to use. A significant regression equation was found ($F(1,379) = 276.373$, $p<0.000$), with an R^2 of 0.422. To test H6, simple linear regression analysis was conducted to determine the effect of augmented reality with PECS and TEACCH methods on the Users' intention to use. The results revealed that the independent variables, perceived usefulness was predictors of users' intention to use. A significant regression equation was found ($F(1,379) = 40.351$, $p<0.000$), with an R^2 of 0.096.

Table 1
Demographic Information of Respondents

Items	Details	Frequency	Percentage (%)
Gender	Male	112	29.4
	Female	269	70.6
	Total	381	100.0
Race	Malay	374	98.2
	Chinese	1	.3
	Indian	0	0
	Others	6	1.6
	Total	381	100.0
Age Group	20-30 years	39	10.2
	30-40 years	157	41.2
	40-50 years	137	36.0
	50-60 years	46	12.1
	60 years and above	2	.5
	Total	381	100.0
Respondent Category	Parents	256	67.2
	Special needs teachers	125	32.8
	Total	381	100.0
Education	Diploma	73	19.2
	Bachelor's degree	119	31.2
	Master	15	3.9
	Doctor of Philosophy (PhD)	5	1.3
	Others (Sijil Pelajaran Malaysia (SPM)/ Malaysian Certificate of Education or below)	169	44.4
	Total	381	100.0

Table 2
The Mean Score and Standard Deviation of Items for Each Construct

Item statement		Mean	Std. Deviation
	Augmented Reality with PECS & TEACCH methods (AUG)		
		(Average mean score: 3.125)	
AUG1	I have enough experience in the special needs education	2.98	1.088
AUG2	I have dealt with children with special needs other than autism before	2.96	1.327
AUG3	I have received training to deal with children with special needs	2.83	1.324
AUG4	I plan by myself the daily activities of children with special needs	3.17	1.109
AUG5	I prepare the daily activities for the children with special needs whether by handwriting, computer software or both	3.13	1.126
AUG6	I already knew about TEACCH and PECS methods for children with special needs	3.14	1.137
AUG7	There is similarity between augmented reality mobile application with the current methods I use for the children with special needs	3.62	.972
AUG8	I would be able to use the augmented reality mobile app in the daily activities with the children with special needs	3.17	.933
	Perceived Usefulness (PCU)		
		(Average mean score: 3.723)	
PCU1	The mobile augmented reality application with PECS and TEACCH methods is easy to use	3.71	.884
PCU2	Learning to use the mobile augmented reality application with PECS and TEACCH methods is not a problem	3.72	.865
PCU3	The operation of mobile augmented reality application with PECS and TEACCH methods is clear and understandable	3.73	.848
PCU4	Generally, I consider that the mobile augmented reality application with PECS and TEACCH methods is easy to use	3.73	.843
	Perceived Ease of Use (PEOU)		
		(Average mean score: 3.488)	
PEOU1	The use of mobile Augmented Reality (AR) application with PECS and TEACCH approaches among children with special needs increases their performance in learning	3.49	.896

PEOU2	The use of mobile Augmented Reality (AR) application with PECS and TEACCH approaches among children with special needs improves their productivity in learning	3.44	.867
PEOU3	The use of mobile Augmented Reality (AR) application using PECS and TEACCH approaches among children with special needs improves their learning effectiveness	3.51	.919
PEOU4	Generally, I consider that the mobile Augmented Reality (AR) application with PECS and TEACCH approaches can be useful in the learning process of children with special needs	3.51	.931
	Intention to Use (INTU)		
		(Average mean score: 3.585)	
INTU1	I intend to use the mobile Augmented Reality apps with PECS and TEACCH approaches	3.56	.909
INTU2	I will try to use the mobile Augmented Reality apps with PECS and TEACCH approaches	3.61	.866

Table 3
The Pearson Correlation Analysis

	Perceive ease of use	Perceived usefulness	Intention to use
1. Augmented reality	.348**	.367**	.310**
2. Perceive ease of use		.716**	.649**
3. Perceived usefulness			.738**
4. Intention to use			

**P < 0.01

Table 4
Simple linear regression results

Hypothesis	Dependent Variable	Independent Variable	β	R^2	P
H1	Perceived Usefulness	Perceived Ease of Use	0.716	0.512	0.000
H2	Perceived Usefulness	Augmented Reality with PECS & TEACCH methods	0.367	0.135	0.000
H3	Perceived Ease of Use	Augmented Reality with PECS & TEACCH methods	0.348	0.121	0.000
H4	Intention to Use	Perceived Usefulness	0.738	0.545	0.000
H5	Intention to Use	Perceived Ease of Use	0.649	0.422	0.000
H6	Intention to Use	Augmented Reality with PECS & TEACCH methods	0.096	0.310	0.000

Discussion

Based on the demographic information in Table 1, there were 269 (70.6%) female respondents involved in this research compared to male respondents with the frequency of 112 (29.4%) respondents. Meanwhile, 256 (67.2%) of the respondents were parents of special needs children and 125 (32.8%) were teachers. 374 (98.2%) respondents were Malays, and 41.2% of the total respondents aged between 30 to 40 years old. Regarding the level of education, most of the respondents received minimum high Sijil Pelajaran Malaysia (SPM) or known as Malaysian Certificate of Education with 169 (44.4%) respondents followed by the bachelor's degree holders with 119 (31.2%) respondents. Table 2 shows the mean score of the items for each construct. For the construct of augmented reality with PECS and TEACCH methods, the average mean score was 3.125. Most of the respondents had knowledge of the PECS and TEACCH methods, with a mean score of 3.14. However, most of the respondents had no experience in special education (M = 2.98) and had not received training on how to deal with children with special needs (M = 2.83). For the construct of perceived usefulness, the average mean score was 3.723. Most of the respondents considered the mobile augmented reality application with PECS and TEACCH methods easy to use, with a mean score of 3.73. The respondents also agreed that the operation of mobile augmented reality with PECS and TEACCH methods was clear and understandable (M = 3.73) and had no problem learning to use the mobile augmented reality application (M = 3.72). For the construct of perceived ease of use, the average mean score was 3.488. With a mean score of 3.51, respondents considered that the mobile augmented reality application with PECS and TEACCH

methods can be useful in the learning process of children with special needs as well as improving their learning effectiveness. Meanwhile, for the construct of intention to use, the average mean score was 3.585. Most of the respondents intend to use the mobile augmented reality application with PECS and TEACCH methods (M = 3.56) and will try to use the mobile augmented reality application with PECS and TEACCH methods (M = 3.61).

The acceptance of augmented reality applications with PECS and TEACCH methods in this study was based on the Technology Acceptance Model (TAM), in which the intention for the users to use the new technology or application comes from their perceived usefulness and perceived ease of use (Mikropoulos et al., 2020). Based on Table 4, perceived usefulness (PCU) and perceived ease of use (PEOU), were the two constructs of TAM that had high scores, leading to the high score for the Intention to Use (INTU). According to the results of simple linear regression, the users' intention to use of the Augmented Reality with PECS and TEACCH methods was positively affected by perceived usefulness (β = 0.738) and perceived ease of use (β = 0.649). The results of correlations and simple linear regression were consistent with TAM model (Davis et al., 1989). Due to the lack of familiarity with the augmented reality with PECS and TEACCH methods and practical learning experience, users' intention to use was not significantly affected by Augmented Reality with PECS and TEACCH methods (β = 0.096). It was supported by the mean score in Table 2, in which most of the respondents had knowledge of the PECS and TEACCH methods (M=3.14), had no experience in special education (M = 2.98), and did not receive training on how to deal with children with special needs (M = 2.83). The current study's findings are consistent with the studies conducted by Kaya & Bicen (2019), which indicated that in order for users to experience the good effects of attitudes towards the use of augmented reality (AR) application, they must use AR more frequently and for longer periods of time.

Conclusion

The results of this study indicate that children with special needs, particularly those with ASD, may benefit from the usage of an augmented reality (AR) application that combines TEACCH and PECS methods as an educational intervention tool. According to the TAM theory, users' intention to use the augmented reality application with PECS and TEACCH procedures was highly influenced by their perceived usefulness and perceived ease of use. The results of this study also highlight the importance of providing users with sufficient information, training, and time to fully influence their intention to utilise augmented reality applications. Hence, the Ministry of Education needs to put in place better strategies and directives that would encourage teachers and parents to use the Augmented Reality applications among ASD children as one the intervention strategies. By transforming the traditional and conventional PECS and TEACCH methods into augmented reality applications, as in the present study, this strategy will make social cues, social behaviour, and learning more engaging and enjoyable for special needs children, as well as assist teachers and parents in providing better educational intervention to these children.

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Author Contributions

The present study provides contribution on the special needs education by integrating and transforming the conventional Picture Exchange Communication System (PECS) and Treatment and Education of Autistic and Related Communication Handicapped Children (TEACCH) methods into an augmented reality application based on the Technology Acceptance Model (TAM).

Conflict of Interest

The Author(s) declare(s) that there is no conflict of interest.

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