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Teachers' Behavioral Intention and Acceptance of Technology-Based System Intervention Among Children with Autism Spectrum Disorder (ASD)

Mohammad Shadab Khan[1], Noor Azizah Mohamadali[1], Asadullah Shah[1,*]

[1] Department of Information Systems, Kulliyyah of Information and Communication Technology, International Islamic University Malaysia, Kuala Lumpur, Malaysia

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ABSTRACT

The fourth pillar of the United Nations Sustainable Development Goals is 'Quality education' to provide peace and prosperity to the world population; in addition, Special Education Reforms under the Malaysian government scope are influenced by the 'Shared Prosperity Vision 2030'. Special needs education underlines the importance of technological integration in the learning environment to support the communication, teaching, and learning needs of neurodiverse learners. The teachers are an intermediatory link between the learners and their parents and caregivers. Technological advancements assist educators in transforming the educational needs of neurodiverse learners at all academic levels. The early intervention-based teaching and learning process is advocated worldwide, as it has shown positive cues toward neurodiverse learners, especially those with Autism Spectrum Disorder (ASD). However, very little is known about the perception and behavior of teachers toward acceptance of technology-based intervention. Therefore, to bridge the identified gap in academic literature, this study explores the teachers' behavioral intentions concerning technology for teaching children with ASD. A conceptual framework has been developed based on the Unified Theory of Acceptance and Use of Technology 2 model (UTAUT2) and other recent studies to address the problem and identify possible stakeholder solutions. The developed hypothesis will be tested later through a survey-based self-administered questionnaire among the special education teachers in different parts of Malaysia and after the data analysis is performed using SmartPLS 3.2.6. The pre-test and pilot study results affirm the positive viability of the study for continued future work.

1. Introduction

Information and communication technology (ICT) evolution in the 21st century has taken giant strides and has become an indispensable part of human life. The sophisticated, engaging, and interactive advancements have enriched the learning process, immensely benefiting teachers and

* *Corresponding author.*
E-mail address: asadullah@iium.edu.my

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students. The simplification of technological interfaces impacts people's lifestyles in numerous ways, such as healthcare, business sector, communication, and education.

Hence many educational reforms have emphasized on adoption and integration of new technology all across the educational sector [1]. ICT is promoted as an academic and technological tool among teachers and students. Early intervention is effective among children on the autism spectrum [2]. If children with autism spectrum disorder (ASD) are given intervention in the early stages, it could prove beneficial and create substantial recovery chances, although the emphasis is very firmly on the neurodiversity affirmation, not assimilation [3]. According to Jimenez and Besaw [3] and Sandbank *et al.,* [4], technology as an intervention tool in special education is deemed significant. The educational and technological integration within special needs learners and teachers' teaching space could develop provisions for teaching, learning, and communicating [5,6]. Even though many individuals can support neurodiverse learners' teaching process, for example, parents, family members, teachers, and caregivers. Teachers' role is of utmost importance in teaching because of their educational pedagogy, training, and experience [6].

However, inadequate attention is given to the special education teachers' perspective in the Malaysian social science research setting. The constructs such as teachers' preparedness, behavioral intention, and use behavior for technological adoption is an understudied avenue. In the closest proximity to the current research, Yusof *et al.,* [7] measured special education teachers' perception using a conceptual model for blended learning while using a mobile-based edutainment application. Kung-Teck *et al.,* [8] used the Technology Acceptance Model (TAM) to measure behavioral intention and the use of technology for teachers and neurotypical students. Nizar *et al.,* [9] measure Use behavior using the Unified Theory of Acceptance and Use of Technology (UTAUT) for the augmented reality adoption among pre-service teachers at one single public university in Malaysia. None of the above studies explored special education teachers' behavioral intention and Use behavior using the most recent technology-based acceptance theories such as UTAUT2. UTAUT2 has the upper hand regarding the predictive ability compared to the UTAUT theory, which is explained using the variance value on behavior intention to be 74% and the variance value for technology usage to be 54% [10]. Therefore, it is essential to understand the antecedents and mechanisms influencing special education teachers' behavioral intention towards technology using the latest theories [11].

Current research will fill this knowledge gap for teachers' behavioral intention, which could later be combined with parents' and students' perceptions, develop constructive and stable reforms for technology-based intervention, and provide the stakeholder's ques to help decision-making. A quantitative study will be undertaken to create a proposed framework using the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model. To validate the integrated framework and some external variables, construe the behavioral intention and use of technology [12]. UTAUT2 model is preferred because of its higher explanatory power over other technology-based acceptance models with lower values. The practical implications are expected to point out the reasons for teachers' lack of technology adoption. They are eventually engendering recommendations to the stakeholders to remove those reasons for efficient technology usage and derive the best possible practices. Additionally, answering How to redefine special education teachers' roles and responsibilities and how the stakeholders/administration can support them.

1.1 ASD and its Prevalence

Autism spectrum disorder (ASD) is characterized by a neurological inability to control brain functions like social interaction and behavior. A person diagnosed with ASD shows dissimilar emotional, mental, and learning patterns compared to neurotypical individuals. These ancillary

variations affect their working memory, which creates a unique/unusual social presence. ASD can be classified as a neurodevelopmental disorder that affects social communication, interaction, and behavior. This impairment includes nonverbal behavior of multiple kinds, such as eye-to-eye gazing, postures of the body, expressions of the face, and other regular social interaction gestures, along with communication impairment, that consists of complete absence or delay in spoken language development or the impairment to sustain or initiate a conversation with other individuals. ASD can range from mild to severe. Individuals with ASD may also have intellectual disability, difficulty with motor coordination, repetitive, restricted, and physical health issues, stereotyped behavior, and other activities and interests, including observing a non-functional ritual or routine. The prevalence of ASD is estimated to be around 1% of the global population. It is more common in males than females and tends to be diagnosed more frequently in higher-income countries. The exact cause of ASD is not known, but it is thought to be caused by a combination of genetic and environmental factors, has been reported by the study done by the US Centers for disease control and prevention (CDC)'s Autism and Developmental Disabilities Monitoring (ADDM) network [13]. The global prevalence of ASD, ADHD (Attention Deficit Hyperactivity Disorder), intellectual disability, epilepsy, vision loss, and hearing loss. Figure 1 shows the data analyzed from 1990 until 2016, and it is reflected that the global prevalence of ASD is more when compared to intellectual disability and ADHD [14].

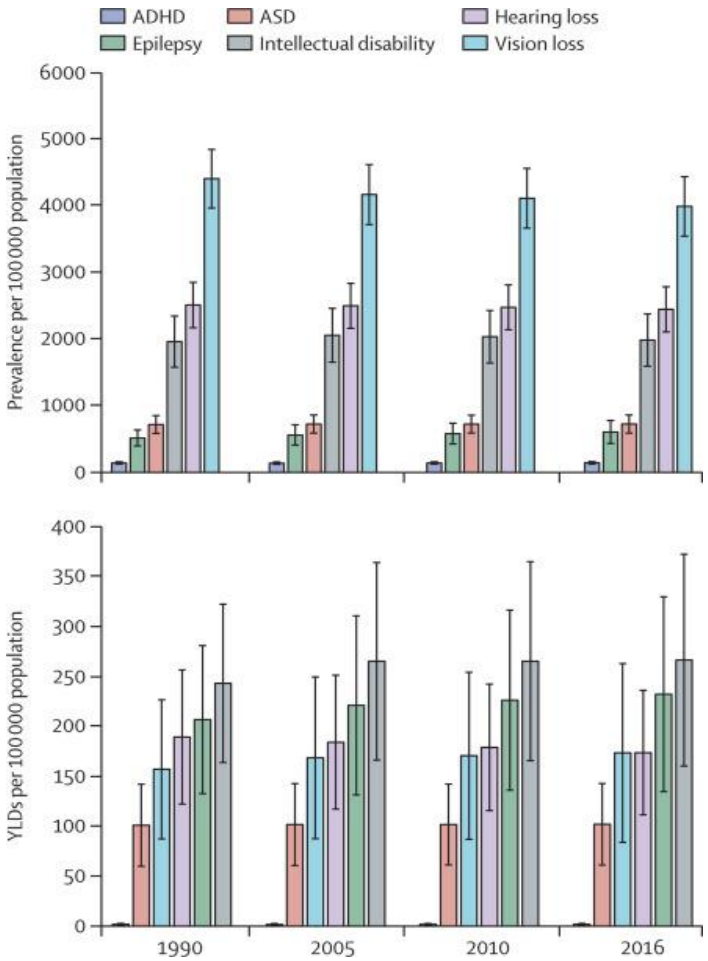

Fig. 1. Developmental disabilities global trends from 1990 to 2016 among children younger than five years [14]

1.2 ASD and its Support in Malaysia

Under the Malaysian government, the Department of social welfare reported, that in 2017 about a total of 15,484 officially listed autism cases. The overall listed population consisted of individuals of different age groups. In an evaluation made by the World Health Organization (WHO) in 2018, the general world population is estimated to be one child on the autism spectrum among 160 children, and this occurrence rate is projected to increase in the global scenario. In the Malaysian context, no such data is available in the recent studies; instead, a report in the year 2005 from the Institute of Public Health under the Ministry of Health reported that one child in 625 children in Malaysia is on the autism spectrum [15].

In the United States of America (USA), a study on Autism and its associated behaviors conducted by the Center for Disease Control (CDC), the prevalence rate is estimated to be one child in sixty-eight newly born children. On the National Autism Society of Malaysia (NASOM) authority, in the national yearly gross birth rate analysis, it is projected that about 8,000 to 9,000 newly born children could have Autism. Several studies have discussed the early detection of autism and related disabilities symptoms by parents, teachers, and caregivers from 0 to 3 years of age. These symptoms include fixation on routine and activities, sequencing habits, struggling to relate events, people, and things, repetitive behaviors and body movements, and, most importantly, social and communicative issues [2,16]. Hence, Child psychologists and Physicians recommended exercising early intervention therapies for speech, behavioral, and occupational. To the "Malaysian People with the Disability Act 2008", people with different disabilities have the right to formal education, and formal education should be available. Within the Malaysian scope, three ministries are responsible for facilitating children with various disabilities, which are the Ministry of Women Family and Community Development (MOWFCD), Ministry of Education (MOE), and Ministry of Health (MoH), where the first two are administering the provisions of education among the disabled children [2]. An educational program under "Special education" emphasizes spiritual, emotional, physical, and intellectual development is designed. The students are encouraged to pursue their academic dreams to their desired level and later have an independent livelihood.

1.3 Teaching ASD Children

The World Health Organization (WHO) issues guidelines under article 24 of developmental disabilities, which emphasizes that all countries must ensure the right to education for all persons with disabilities, and there should be no discrimination based on disability. Moreover, children with disabilities are not excluded from inclusive, quality, accessible and compulsory primary and secondary education [17]. The United Nations Sustainability Development Goals (UNSDG) for 2030 form its fourth pillar of 'Quality education', with a standing notion of 'leaving no one behind'. Moreover, the Malaysian education policy blueprint for 2013 – 2025, 'Zero tolerance' directly correlates to UNSDGs. The traditional education system designed for neurotypical learners often does not suit the needs of neurodiverse learners as they have different disabilities.

Furthermore, special needs educational programs must be adaptive to address the individual's learning needs with a disability [18]. The core issues, such as the inability to perform communication, non-socialization cues, matters related to behavior, and neurological disability, make children with ASD different from neuro-typical learners. Technology-based early intervention has been identified as the most active research domain regarding learning for individuals with ASD. As technological means and mechanisms fulfill some of the learner's sensory needs, an expert control the technology-based learning environment. Various studies recommend that if an early-age intervention is provided

as a treatment, it brings significant positive developmental growth. The technology-based environments have stimuli in numerous forms to support neurological development outcomes [19].

The role of a teacher who is teaching an individual with special needs is deemed very crucial. A special needs educator understands the learners' needs because of his professional learning and experience, and at the same time, they can communicate those needs back to the parents and caregivers [20]. The social-emotional intelligence and the tact of teaching are part of the extensive training a teacher undergoes, which is the need of the hour to facilitate learning for children with ASD [21]. Special education teachers' qualities make their presence an integral and non-separable component in developmental growth and learning. Hence, this research area needs more attention so that teachers' perceptions and behaviors are studied in depth. This argument is supported by the study conducted by Ford *et al.,* [22], where they advocated the effectiveness of teaching in an early intervention program for children on the autism spectrum, which could save the financial cost of millions of dollars spent on academics and support provided for a learner from infanthood to the age of fifty-five years. Henceforth, the positive markers for financial cost-cutting, the global prevalence, and eventually, enhancing the lives of autistic learners demand extensive outcomes-based research in the field of autism and its teaching pedagogy [23].

2. Literature Review

The technology is used as a learning intervention toolkit for people with ASD, and it is very well known that autistic individuals are visual learners and using multiple communication mediums for interaction is advocated. Among the most popular support for specially abled learners is in the form of Assistive technology, which refers to augmentative and alternative communication (ACC) devices and computer software that helps in reading, writing, and other academic skills. The Educational and software applications, both online and on stand-alone devices, are specifically designed for students with special needs. Whereas Virtual reality (VR) and Augmented reality (AR) is used to create an immersive and interactive learning experience in the virtual environment for neurodiverse learners, using new concept and ideas through interactive and visual simulation [2,23]. Such Technological devices used in educational intervention or assistance are broadly categorized into two categories, such as devices of advanced nature: computers, smartphones, tablets/iPad, robotic mechanical devices, wearables for virtual reality (headsets) frequency modulations systems devices to create an innovative holographic system, smart glasses, eyewear glasses with intelligent systems, smartpens LiveScribe and others which respond to the utilization of high power. On the other hand, the more traditional technological assistance devices are calculators, graphical organizers, electronic ramps, pogo boards, etc., without the power source, which assist in different ways for learning and developmental skills for individuals with intellectual disabilities [2].

Technology-based intervention research for Autism is still an open avenue of research in the Malaysian context. In the past two decades (2000 – 2020), the search string "technology and Autism" on Scopus search retrieved 24588 articles worldwide, out of which only 448 research articles were published from Malaysia, where the US is the top contributor with 11837 articles, as shown in Figure 2. "Computer-based intervention" or "Assistive technology", "special needs" or "ASD" or "autism spectrum disorder" or "Autism"; and the keywords were searched over Google Scholar, IEEE Xplore, Scopus, and ScienceDirect resource databases.

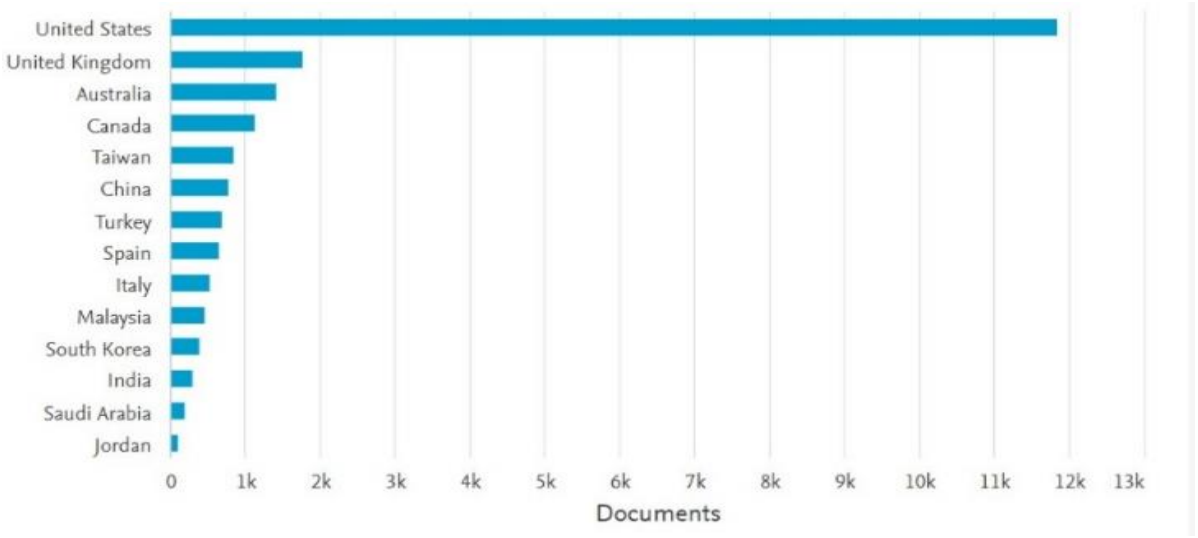

Fig. 2. Scopus search results showing articles for "Technology and Autism" from 2000 to 2020

Very few studies have been conducted in light of teachers' acceptance of technology among special needs children. In contrast, there is no evidence of any study measuring the behavioral intention and use of behavior for technology-based intervention among children with ASD in Malaysia.

Niknejad *et al.,* [12] thoroughly reviewed wearable smart technologies among students as technological adoption. In the findings, the researcher has reported positive adoption. This study was limited to neurotypical students and did not work on students with special needs [12]. Anuar *et al.,* [24] studied teacher's behavior towards digitalized education using the theory of planned behavior (TPB) model approach, but again the set of teachers did not form the special needs category; it instead measured the behavior of teachers in a government secondary school. A pilot study was conducted in Pahang, Malaysia, to study the function of teachers' willingness as a facilitator between the ICT organization and ICT experience using the TPB model, reporting the findings that infrastructure plays an essential role in adoption. However, this study did not focus on the behavioral intention toward using technology as an intervention among children with ASD [25]. Majid and Shamsudin [26] interpreted quantitative research using the technology acceptance model (TAM) to measure the acceptance, attitude, and intention of augmented reality (AR) and virtual reality (VR) among in-service teachers pursuing postgraduate studies, where the findings reordered that teachers showed conviction of it to be included as a part of the classroom, but this study lagged to focus on special education teachers. Nasir and Efendi [27] identified the progress and obstacles for special needs children using a qualitative systematic literature review accompanied by focused group interviews. They highlighted the need for early intervention using computer-assisted learning but did not measure the teachers' behavior use behavior [27]. Yusof *et al.,* [7] measured the teachers' perception of special needs learners using mobile-based edutainment applications and identified the importance of AR and game-based learning as an intervention. However, they did not measure teachers' behavioral intention and use behavior for using technology-based intervention [7]. Hence a comprehensive framework is developed to measure the behavioral intention and use behavior of technology-based intervention among teachers for ASD children.

3. Proposed Framework

The proposed framework based on the existing research is an extension of the UTAUT2 model on use of technology to measure the influence of external factors on behavioral intention and the use behavior of special education teachers responsible for teaching children with ASD. A concurrent analysis of the several relationships under the UTAUT2 model is examined with the assistance from the existing constructs such as 'Effort Expectancy',' Performance Expectancy', 'Facilitating Condition', 'Social Influence', 'Habit', 'Hedonic Motivation', 'Personal Innovativeness', 'Behavioural intention' and 'Use Behaviour' [1,28]. However, the variable' Price Value' is omitted from the current framework as it is not directly related to the special education teachers. Instead, it is for the stakeholders and financial administrators of the educational system to evaluate and inculcate the cost of technological means used in the educational system.

In the modified UTAUT2 framework, as shown in Figure 3, the primary UTAUT2 base model is measured, and additional external variables are recommended from different research studies. Variables such as 'Access to Technology', 'Self-Efficacy', 'Trust', 'Time', 'Volunteer' and 'Job Relevance' are used as external variables to measure the influence on 'Behavioural Intention' and 'Use Behaviour' towards use and adoption of technology while teaching children with ASD. This investigation will identify teachers' degree of perception towards the use of technology in teaching children with ASD and act as a guiding mechanism to find and explore underlying problems, to develop better measures to enhance the academic output of the teachers [5,29].

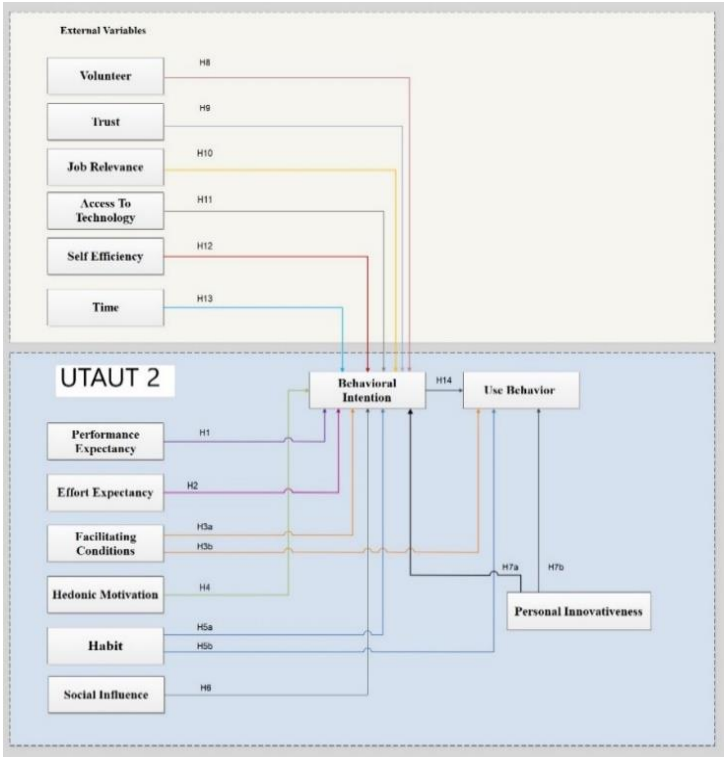

Fig. 3. Proposed framework based on the UTAUT 2 model

3.1 Research Hypothesis

i. Performance expectancy has a positive impact on behavior intention.
ii. Effort expectancy has a positive impact on the behavioral intention to use ICT's.
iii. Facilitating conditions have a positive impact on the behavioral intention to use technology.

iv. Facilitating conditions have a positive impact on the use behavior.
v. Hedonic motivation has a positive impact on the behavioral intention to use technology.
vi. Habit has a positive impact on the behavioral intention to use the technology.
vii. Habit has a positive impact on use behavior.
viii. Social influence has a positive impact on the behavioral intention to use the technology.
ix. Personal Innovation has a positive impact on the behavioral intention to use the technology.
x. Personal Innovation has a positive impact on use behavior.
xi. Volunteering has a positive impact on the behavioral intention to use the technology.
xii. Trust has a positive impact on the behavioral intention to use the technology.
xiii. Job relevance has a positive impact on the behavioral intention to use of the technology.
xiv. Access to technology has a positive impact on the behavioral intention to use of the technology.
xv. Self-efficacy has a positive impact the behavioral intention to use of the technology.
xvi. Time has a positive impact on the behavioral intention to use of the technology.
xvii. Special education teachers have positive behavioral intentions toward the use of educational technology.

4. Methodology

In this study, the researcher uses deductive logic, which starts with hypotheses, which are mentioned above in 3.1, and then data is collected using a survey to find out whether the idea is supported or not with the determination of empirical evidence. The respondents' population is from the schools under the Ministry of Education, with a total of 8369 teachers in special education pre-schools and primary schools [30]. A cluster-based sampling is selected for the six most populated schools and many special needs schools in the peninsular Malaysian region. This cluster is later identified in groups like Penang, Kula Lumpur Federal Territory, Selangor, Melaka, Johor, and Terengganu over Malaysia's 13 states. Educators will be targeted based on each cluster for the survey, and the analysis will be done on the sampled cluster. The sampling size will be determined based on the equation suggested by Sekaran and Bougie [31] to a confidence level of 95 %. The quantitative approach is beneficial for addressing specific questions about relatively well-defined phenomena, and it answers the hypothesis, which tends to be very specific, describing transparent relationships between the independent and dependent variables.

5. Pre-Test and Pilot Study Results

The pre-testing and pilot study concerning Sekaran and Bougie [32] should be steered upfront before the primary survey's data collection stage. To guarantee the instrument's validity and eliminate anomalies from the questionnaire.

It was explained by Sekaran and Bougie [32], that the initial assessment of the questionnaire (pre-test) helps in recognizing insufficiencies in the language of the questionnaire, it has been designed. To fix the underlying issues and make it the best fit for the people who will respond. A pre-test was conducted with ten experts; they distributed the questionnaires and received seven positive responses. The experts raised some language ambiguity and question order issues, which the researcher fixed before the redistribution. Table 1 shows the demographic details of the pilot study.

Table 1
Demographic of Pilot Study Respondents

	Group	Frequency	Percentage %
Gender	Male	7	22.58
	Female	24	77.41
Age	Under 25	2	6.45
	25–34	13	41.93
	35–44	8	25.80
	45–54	7	22.58
	Above 55	1	3.22
Education	Certification	2	6.45
	Diploma	0	0
	Undergraduate	8	25.80
	Postgraduate	20	64.51
	Other	1	3.22
Current Job	Special Education Teacher	20	64.51
	Special Education Coordinator	1	3.22
	Speech/ Occupational/Behavioral/Therapy Teacher	8	25.80
	Subject Teacher for Inclusive Education	2	6.45
	Other	0	0
How long have you been teaching?	Less than One Year	1	3.22
	One to Three Year	5	16.13
	Four to Six Year	9	29.03
	Seven Years or more	16	51.61
Teaching hours per week?	Less than 1 hour	1	3.22
	2 to 5 hours	4	12.90
	6 to 9 hours	5	16.13
	10 to 13 hours	7	22.58
	More than 14	14	45.16

Pilot Study: The pilot study used representation data to identify the questionnaire design's deficits. The researcher selected the city of Kuala Lumpur because of its urban population and because it has a higher number of special needs schools. The pilot testing was a month-long process, and the researcher collected 35 questionnaire responses, out of which 31 were analysed. SPSS 21.0 is used for the preliminary statistical analysis for this pilot study.

Demographic Profile of Respondents of Pilot Study: The demographic information of the pilot study respondents is illustrated in this section. Table 1 presents the participants' gender, age, education, etc., in Malaysia. The pilot study results show that most respondents were female (n=24, 77.41%) while others were male (n=7, 22.58%). Most respondents fall in the age group between 25 and 34 (n=13, 41.93%). The findings show that the respondents were highly qualified, i.e., postgraduate (n=20, 64.51%).

Reliability of the Instrument: The sample size of the pilot study was considered to be a minimum of 30, according to the recommendations made by Memon *et al.,* [33]. The researcher selected forty responses, and five questionnaires were withdrawn because of the repetitive pattern in the answers. So, 35 questionnaire responses were selected by the researcher for final analysis.

This pilot study estimated the measured items' dependability through the internal consistency test (Cronbach's alpha) employed in the questionnaire. Cronbach's alpha calculated the consistency of the respondents' answers to all the items in the measure. It considers the values acceptable.

The values above 0.70 [33]. Sekaran and Bougie [32] asserts that Cronbach's alpha's reliability value of less than 0.6 should be considered poor, while a value of 0.7 is acceptable, and a reliability value greater than 0.8 is good. Hence, the reliability values keep getting better as it gets closer to 1.0.

However, for Larson-Hall [34], the survey needs to add only an item-to-total-test correlation, which falls between 0.3 and 0.7. Hence, in this study, as shown in Table 2, Cronbach's alpha values (between 0.825 and 0.956) portrayed appropriate dependability concerning all the measures used.

Table 2
Cronbach's Alpha Coefficients for all Constructs in the Pilot Study

Construct	Cronbach's Alpha
PE	0.933
EE	0.825
SI	0.918
FC	0.925
HM	0.876
HA	0.908
SE	0.845
PI	0.928
T	0.935
ATT	0.956
VO	0.948
JR	0.911
TR	0.834
BI	0.829
UB	0.953

6. Conclusion and Future Work

According to the adopted methodology, the pre-test and pilot study's initial success will be conducted as an in-depth survey among special education teachers for ASD children. This research will be extended to complete all the research questions and achieve the desired objectives. Machine learning-based statistical analysis will be used to support the statistical results attained through Statistical Package for the Social Science (SPSS). And further extending the results of Partial Least Square Structural Equation Modelling (SmartPLS 3.2.6) to develop a comprehensive framework, which would eventually help point out the teachers' perception while using technology as an intervention for teaching children with ASD. What are the possible barriers to adopting technology and recommendations to address the stakeholders to remove those barriers for efficient technology usage and derive the best possible results and solutions? This study is a part of a large project, and the current findings show that positive implications provide multiple cues for the improvement of technological-based intervention among teachers for children with ASD.

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