The Assistive Technology for Teaching and Learning of Social Skills for Autism Spectrum Disorder Children: Multimedia Interactive Social Skills Module Application

Zuraida Ibrahim* [ID]
Universiti Tun Hussein Onn Malaysia, MALAYSIA

Juliana Mohamed [ID]
Universiti Tun Hussein Onn Malaysia, MALAYSIA

Noordiana Kassim [ID]
Universiti Tun Hussein Onn Malaysia, MALAYSIA

Ida Aryanie Bahrudin [ID]
Universiti Tun Hussein Onn Malaysia, MALAYSIA

Abstract: An earlier study found that assistive technology based on mobile applications significantly improved how social skills were taught to and learned by autism spectrum disorder (ASD) children. Nevertheless, the content of the existing mobile applications is inadequate for capturing the diversity of Malaysian culture, making it unacceptable for local use. Considering cultural norms is a factor in developing social skills in ASD children. It is therefore necessary to develop new assistive technology based on mobile applications that consider Malaysian cultural norms. As a result, the Multimedia Interactive Social Skills Module (MISSM) application was created based on the Addie Model, which offers a systematic process for assisting in developing successful instructional material by fusing instructional theory with learning theory. The MISSM application is based on Malaysia's current social skills curriculum, which helps ASD children become socially competent. Hopefully, it will help them develop better social skills and achieve academically. Finally, local culture-sensitive material for assistive technology based on mobile applications would support Malaysia's adoption of a technology-based teaching and learning strategy and contribute to a better understanding of social skills.

Keywords: *ASD children, autism, MISSM application, mobile application, social skills.*

Introduction

Children with Autism Spectrum Disorder (ASD) fall behind regular children's social skills, behaviour, and communication during childhood because of their impairment (Silveira-Zaldivar et al., 2021). People occasionally find them to be self-centered and uncomfortable to be around. The cause is that they struggle to build strong interpersonal relationships and communicate with those around them (Nair, 2015). Also, those who have ASD struggle with performing simple daily tasks like socialising with others. As a result, ASD children become socially isolated from society (Evans et al., 2019).

Subsequent investigation revealed that children with ASD suffered from social skills deficiencies (Frye, 2018; Silveira-Zaldivar et al., 2021; Yeo & Teng, 2015). Due to weaknesses in their emotions, behaviour, reality and fiction, believing, feeling, and desires, they experienced developmentally below-average growth in developing social skills (Khantreejitranon, 2018). This is also one of the critical causes of social isolation problems in Malaysian schools (Affandy & Azman, 2022; Yaacob et al., 2021). Therefore, to address social isolation in ASD children, a focus on social skills development is needed.

Additionally, a good foundation in social skills helps support ASD children's relationships with their peers, academic success, and mental fortitude (Silveira-Zaldivar et al., 2021). A study by Carter et al. (2014) found that kids with ASD who learned social skills early on would go on to develop social competence and achieve higher academic standards in the classroom. Their favourable qualities, such as superior computer abilities, photographic memory, and prominent level of mathematical ability, can be used for their educational purpose to overcome social skill deficiencies (Gentry et al., 2015).

As is well known, educators find it challenging to teach, and ASD children often find it challenging to learn. Since teaching and learning for ASD children are becoming a challenge for educators, there is a need in advance strategies to rectify the arising problems (Djatmika et al., 2020; Ghani et al., 2014; Nair, 2015). Currently, teaching and learning for ASD children

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* **Corresponding author:**
Zuraida Ibrahim, Universiti Tun Hussein Onn Malaysia, Johor, Malaysia. ✉ zuraidai@uthm.edu.my

worldwide involve various methods, such as embedded teaching, hand-made visual materials, printed materials, social stories, video modelling and assistive technology (Rosly & Abd Rahim, 2015). The assistive technology strategy is currently only applied in a small number of Malaysian educational institutions' classrooms. (Hussain et al., 2021; Satiakumar et al., 2022; Senan et al., 2017). As a result, it is strongly advised to adopt assistive technology to promote technology-based approach in teaching and learning practices in Malaysia, as stated by Zainal and Zainuddin (2020).

Since a recent study discovered that using assistive technology based on mobile applications significantly improved the teaching and learning of social skills in ASD children (Azahari et al., 2016; Hanna et al., 2022; Hashim et al., 2021; Ur Rehman et al., 2021), therefore, using assistive technology based on a mobile application to educate and acquire social skills in Malaysia might be considered a novel technique and supplemental aid. To their greatest potential, kids with ASD can benefit from the mobile application by strengthening their learning and information acceptance skills and learning to focus (Che Daud et al., 2018).

Unfortunately, to rectify the issues, one critical element must be considered. Developing social skills requires ASD children to learn and apply many skills appropriate within a specific culture. Moreover, the cultural norm is crucial for the development of not only social skills but also elements such as behaviour, emotional, social communication, and others (Davenport et al., 2018). In general, diverse cultures have different attributes that must be learned and practised. The current print-based materials mostly do not cater to the cultural needs of Malaysians due to the curriculum not being locally developed by the expert (Low et al., 2021). Hence, the existing social skills module based on mobile applications tends to be generic and often designed for Western culture as default (Khalid et al., 2012).

Consequently, it lost its strength and was no longer appropriate for teaching and learning social skills for ASD children in Eastern cultures like Malaysia. Further research revealed that this was mainly because the content did not accurately represent the depth of Malaysian culture (Ahmad & Azahari, 2015; Kim et al., 2017; Ntalindwa et al., 2021). They cannot relate to the social skills module's content in those mobile applications. Hence, it cannot give ASD children a sense of belonging because the content features do not reflect themselves (Silveira-Zaldivar et al., 2021). Therefore, there is a need to design and develop a new social skills module for teaching and learning that integrates Malaysian cultural norms for ASD children in Malaysia.

Hopefully, the new social skills module based on assistive technology will improve the social competence of ASD children in Malaysia through broader social skills elements. Additionally, it sets itself apart from already available assistive technologies in the market. Hence, to promote the engagement of a technology-based approach in teaching and learning in Malaysia. It can be considered as an alternative approach and supplemental aid for social skill teaching and learning.

Methodology

Now, Addie, Assure, Kemp Gagne, Dick & Carey, Smith, and Ragan are among the most widely used instructional design (ID) models, among many others (Azimi et al., 2015; Bajracharya, 2019). The wide range of ID model designs focuses on the same concept that underpins educational materials development and leads to the same outcome. After careful consideration and reading, the Addie Model was selected to develop assistive technology based on a mobile application in this study. By combining instructional theory, learning theory, and an astonishing design, the Addie Model offers a rigorous process that promotes the development of effective educational materials for a supportive environment. It may be used with any strategy or theory adaptation and is appropriate in every situation.

Analysis, design, development, implementation, and evaluation are the first five stages of the Addie Model. The Addie model for creating mobile applications, put forth by Aldoobie (2015) and Samsudin et al. (2021), was employed in this study. Figure 1 shows the specific steps of the procedure that will be described.

Analysis	Design	Development	Implementation	Evaluation
(i) Learners' evaluation	(i) An assessment designs	(i) Developing a prototype, materials	(i) Educator training	(i) Formative evaluation
(ii) Instructional material guideline	(ii) A medium of delivery	(ii) Finalising the instructional	(ii) Learner's preparation	(ii) Summative evaluation
(iii) Identification of aims and goals for the outcome	(iii) An instructional strategy	(iii) Conducting a pilot study	(iii) Environment setup	
(iv) A specific learning outcome.				

Figure 1. Details Steps in Addie Model by Aldoobie (2015) and Samsudin et al. (2021)

Findings

Analysis

The primary purpose of the analysis phase is to gather enough data for each issue during the development of the new social skills module based on assistive technology. ASD children in Malaysia registered under the National Autism Society (NASOM) served as this study's participants. NASOM has a considerable number of students with ASD compared to other NGOs in facilitating ASD children in Malaysia. Around 20 centres have been opened by NASOM in Malaysia (https://www.nasom.org.my). Due to a lack of life and social skills, they were enrolled in the *Early Intervention Program*. ASD children also struggled significantly with social skills and had trouble following directions. Additionally, they struggled with emotion, social contact, and self-awareness on a basic level (Yeo & Teng, 2015). Therefore, addressing their social skills deficiencies by giving them assistive technology based on mobile applications for educational reasons was undoubtedly a viable answer.

Information about the existing social skills module for people participating in the *Early Intervention Programme* was gathered to guide them. To select an appropriate direction for the instructional material to follow in the teaching and learning process of social skills, the already-existing module was evaluated after that. As a result, three sub-modules were chosen as a substantial part required for social competence. The choices were made in accordance with the NASOM subject expert.

A new social skills module aims to boost knowledge competency and skills needed to develop academic, social skills and a sense of belonging in ASD children. Cognitive, social communication, social behaviour, social interaction, and emotional intelligence were the targeted domains chosen for social competence in this study based on the prior literature review by Ibrahim et al. (2021). Therefore, teaching and acquiring social skills primarily focus on these areas for growth.

The learning outcome for the social skills module was mapped to the social skills domains previously chosen through systematic review for a better result (Ibrahim, 2019). The lesson plan was also made available to the teacher so they could use it as a guide during the teaching and learning process. Lesson rationale, content, and procedural teaching and learning were all covered in the lesson plans. To ensure consistency in using the mobile application as an assistive technology tool throughout the teaching and learning for all NASOM centres in Malaysia, NASOM will also provide teachers with yearly training.

Design

The information received in the analysis phase was utilised to design an appropriate assessment for the social skills module. The student's social skills knowledge was evaluated to determine their level of social competence in this study. The social skills module's curriculum, objective and learning outcome should be the basis for each instrument's items. It is against the law to alter the learning goal, objective, or outcome to comply with the curriculum (Hathcoat et al., 2016).

The Social Skills Knowledge Test (SSKT) instrument was utilised in this study to evaluate the social skills knowledge of ASD children. There were four types of validation established for SSAT; (i) content validity, (ii) face validity, (iii) construct validity, and (iv) criterion validity. By creating a table of specifications that acted as a guide for the items reflecting the domain accessibility, content validity was achieved. Two subject experts validated the SSKT instruments' items to establish face validity. The construct validity was extremely dependable, with a Cronbach's alpha value of 0.951. Finally, the correlation coefficient value (p=0.83) obtained by SSKT was evidence of criterion validity (Ibrahim, 2019).

The literature review suggested that assistive technology was the most suitable solution for social skills development. Hence, the mobile application is currently trending and benefits ASD children worldwide. With this knowledge, the design and development of a new social skills module based on a mobile application for teaching and learning of social skills in this study could begin. The benefits of the mobile application include its portability, affordability, and vast storage (Ahmad & Azahari, 2015; Martín, 2018).

Due to ASD children learning differently than typical children, there were numerous considerations to be made when developing a mobile application. As a result, Pavlov's (2014) design and development criteria that emphasis on presentation, navigation, and interaction will be adhered to. In addition, the researcher will follow the guidelines from the study by Hussain et al. (2016) on interaction design concepts for edutainment systems for ASD children.

In this study, fifteen principles were proposed. Also, a teacher can only instruct ten students at a time at one facility. On every action or behaviour the students exhibit, they also practice rewarding them and providing feedback. Because most ASD children have trouble focusing during instruction and learning, the study time was limited to 15 minutes per session.

Development

The next step is to create a mobile application prototype using the storyboard created during the discussion between the researcher and NASOM. The material, activities, prizes, audio, animation, and navigation were incorporated and put together based on the storyboard. In order to construct a quality prototype, high-end hardware and software were needed to allow for many types of media integrations. The authoring tool *Adobe Animate* was used to create and combine all media components. After it was finished, a meeting with NASOM was held to review the prototype. The meeting's comments were gathered. The prototype was then modified to adhere to the required curriculum and material laid out by NASOM. This step was crucial to fix any flaws or errors after the prototype's construction.

The second meeting was held at the NASOM headquarters to complete the enhancement once the mobile application prototype's modification was completed. During this stage, feedback was collected to complete the development of the mobile application prototype following the company's and learners' needs. The meeting allowed for correcting any mistakes, errors, and suggestions. Following that, the NASOM acceptance certification was obtained. The creation of the mobile application prototype was improved and enhanced using all the meeting-related information. Finally, the "*Multimedia Interactive Social Skills Module (MISSM)*" application was given as the name of the mobile application prototype. Once finished, the MISSM application was made available for educational use on the Google Play Store. The MISSM application's user interface is described below;

(i) MISSM Application: Homepage

Figure 2. MISSM Application Homepage

The default webpage for the MISSM application is depicted in Figure 2. There are three submodules in it (i) *Know Yourself*, (ii) *Body Part,* and (iii) *Feeling*. Four pictures of kids dressed in several ways to represent the major races in Malaysia were used to adopt the social constructivism theory (Malay, Chinese, Indian and Indigenous people). By incorporating Malaysian cultural norms, the MISSM application helps learners create a sense of belonging in them (Albert & Trommsdorff, 2014; Kim et al., 2017).

The MISSM application employed a soft colour scheme and varied contrast for the background and title. Additionally, it had basic visuals and no backdrop transparency. The pictures, text, and buttons on the page were all huge. The small file size of each sub-module eases the rapid loading of pages (Pavlov, 2014). The organisation's name was at the bottom of the page, and the copyright icon was on the left-bottom corner. There were four straightforward navigation buttons that were simple to understand. Background audio was incorporated to catch the children's attention. English was chosen as the primary language since it was more familiar to the ASD children at the NASOM centre than *Bahasa Melayu* (Hussain et al., 2016).

(ii) Sub-Module "Know Yourself": Home Page

Figure 3. Sub-module "Know Yourself" Main Page

The first sub-module was *Know Yourself*. Figure 3 depicts the user interface design for the sub-module's home page. The students learned everything they needed to know about themselves in this sub-module. Basic information about the students was provided, including their names, gender, favourite foods, and more. Ten subjects were covered so that they could learn about themselves. At the bottom of the page, there were ten buttons, numbered 1 through 10, for each topic. The close button was in the upper right corner, and the return to the homepage button was on the left.

Every page has a home and close button to adopt a user-friendly interface. The sub-navigation module's buttons all clearly displayed the page title. Each submodule's small file size facilitates quick page loading. San serif text type and a contrast backdrop colour were used to enhance the aesthetics of the user interface. There was a brief audio-based tutorial included. The text, graphics and buttons were systematically arranged to avoid clutter (Pavlov, 2014).

(iii) Sub-Module "Know Yourself": Lesson Page

Figure 4. Sub-module "Know Yourself" Lesson page

Figure 4 depicts the layout of the *Know Yourself* sub-module lesson page's user interface. There is a lot of information on the lesson page for teaching and learning social skills. The sub-module covered 10 subjects. The ASD children may freely navigate using the labels and numbered buttons on the page's bottom. A brief instruction was also given to help ASD children develop a deep knowledge of themselves. The page's buttons, icons, text, and visuals were huge (Pavlov, 2014). Few topics were presented in each interface since the website utilised cognitive load theory, making teaching and learning easier (Chandler & Sweller, 1991).

A Malaysian cultural norm was also present, such as using noodles and rice as a common meal. It coincided with the advent of the social constructivism theory in education, which emphasised how culture and environment influence children's learning (Jones & Brader-Araje, 2002). To optimise students' learning, the design was kept straightforward. The topic was presented using a Picture Exchange Communication System (PECS), a form of visual communication. The number of graphics in each user interface was compelled to look like real-world items to prevent clutter. There was corresponding audio included (Hussain et al., 2016).

(iv) Sub-Module "Body Part": Main Page

Figure 5. Sub-module "Body Part" Main Page

The second sub-module was the *Body Part* sub-module. Figure 5 depicts the user interface design for the *Body Part* sub-module main page. It offers details on various body components of a person. This lesson is crucial since most ASD children have trouble understanding how a boy's physique differs from a girl's. As a result, this encourages improper behaviour in public, such as people taking off their clothing wherever they like (https://www.nasom.org.my). This sub-module aims to promote proper public behaviour in ASD children.

The *Body Part* sub-module covered 10 subjects. Each topic's navigation buttons were listed at the bottom and denoted by numbers. To help users become accustomed to the MISSM application's navigation buttons, the location was like that of the preceding sub-module. Even though the background and photos used different ideas, they incorporated contrasting colours ideas. It served to distinguish each sub-module from the others. The background and text box were separate (Pavlov, 2014). To depict this module concept, the navigation buttons were transformed into balloon graphics (Hussain et al., 2016).

(v) Sub-Module "Body Part": Lesson Page

Figure 6. Sub-module "Body Part" Lesson Page

Referring to Figure 6, the user interface design for the lesson page in the *Body Part* sub-module utilised the same idea as its main page. The information was put in the page's centre to grab the students' attention. The positioning of the navigation buttons was the same as it was for the preceding sub-modules. The image on this page is just half the size of the screen and depicts the actual thing. ASD children could focus better thanks to the user interface's straightforward design. Most lessons were delivered using PECS (Hussain et al., 2021)

(vi) Sub-Module "Feeling": Main Page

Figure 7. Sub-module "Feeling" Main Page

The third sub-module, Feeling, was used to help them better comprehend their own and other people's feelings. Figure 7 shows the user interface design of the Feeling sub-module main page. Most ASD children have issues comprehending feelings owing to their main disability and characteristics of ASD (American Psychiatric Association, n.d.). The *Feeling* sub-module covered four primary subjects (*Happy*, *Sad*, *Angry* and *Tired*). The top right corner of the page has images of apples labelled with numbers that can be used to access the topic. To set this module apart from other sub-modules, the concept was altered.

Given how important this module is to them, additional activities topics were offered. There were 4 activities pertaining to the primary topics: (Activity Happy, Activity Sad, Activity Angry and Activity Tired). You may access the buttons for each activity on the bottom left of the website. The button's appearance changed, but its location did not. An animation of a bird soaring about was present to grab the students' attention.

(vii) Sub-Module "Feeling": Lesson Page

Figure 8. Sub-module "Feeling" Lesson Page

Figure 8 depicts the *Feeling* sub-module lesson page's user interface design. Additional navigation buttons were available for the learner on the lesson page for the *Feeling* sub-module, which employed the forest theme. The previous and next arrows were at the top of the rabbit image on the bottom right page. It functioned as a link between the pages of each lesson. To make teaching and learning easier, topics for this sub-module were divided into manageable sub-topics. There are 25 lesson pages, 5 each for *Happy*, *Sad*, *Angry*, and *Tired topics*. The remaining navigation buttons are unchanged.

(viii) Sub-Module "Feeling": Activity Main Page

Figure 9. Sub-module "Feeling" Activity Main Page

Another activity topic is offered under the *Feeling* sub-module lesson page. Figure 9 shows the layout of the user interface. When the activity buttons at the bottom of the page were selected, a pop-up window containing links to the 5 several types of activities were displayed on top of the blackboard graphics. Each exercise has five lesson pages, making 25 lesson pages for the *Feeling* sub-module activity.

(ix)   Sub-Module "Feeling": Activity Lesson Page

Figure 10. Sub-module "Feeling" Activity Lesson Page

Figure 10 illustrates the user interface design for the sub-module *Feeling a*ctivity lesson page. The student must choose an appropriate scenario that resembles the photographs from a set of offered images. Additionally, there are navigation buttons at the bottom right of the page, above the rabbit image. The navigational buttons and design philosophy stayed the same.

Finally, the MISSM application goes through a pilot study after completion. It is a procedure that must be followed before the product's implementation, to find any other errors or problems that may arise when the product is used in its intended context. To run a MISSM application in the real world, every aspect must be measured in a pilot study (Neuman, 2014). The pilot study took place over two weeks in one of the NASOM centres in Selangor, Malaysia.

Implementation

In this study, a mobile application was chosen as the assistive technology for teaching and learning social skills for ASD children in Malaysia. Additionally, Malaysian cultural norm was integrated into the content of the current social skills module, which is based on the curriculum provided by the NASOM. Conducting educator training was the most crucial task to complete before the implementation. During the educator training, specific details about the goal, the content, the resources, the assessment, the process, the lesson plan, and the teaching strategy were explained. To ensure that each centre uses the same teaching strategy, process, and assessment, respectively. The MISSM application's user manual was also provided for reference. A Q&A session was also provided so that the educator may express any concerns or issues they might have had with the MISSM application during implementation.

The learners' preparation comes next before the specified implementation date. Since the MISSM application is a technology-based educational tool, only chosen students who satisfy the requirements may use it. The requirements are (a) participation in an *Early Intervention Programme*; (b) age between 4 and 12; and (c) comfort level with using a smartphone or tablet for teaching and learning. The recommended intervention time is 2 weeks. Teaching and learning sessions took place every Tuesday and Thursday for 15 minutes in the morning and 15 minutes in the afternoon.

Before the intervention, the selected NASOM centres undergo a crosscheck for equipment needed to deploy the MISSM application. The equipment and facilities in the centre served as the basis for the crosscheck. A computer room, Wi-Fi, tablet, and smartphone should be available at the centre. Additionally, it is recommended that each student have a smartphone. The educator in charge of that centre will prepare all the materials needed for the teaching and learning process based on the user manual provided.

Evaluation

The formative and summative evaluation was implemented in the evaluation phase. The formative evaluation consists of one-to-one, small group, and pilot study. Meanwhile, the summative evaluation will be done on a different case study once the MISSM application comes into practice towards the target sample. The NASOM board member conducted a one-on-one formative evaluation using the materials. The critical information concerning the material's effectiveness, strength, and weaknesses was validated. The improvement was being made based on the information offered. A few representatives from the management office and teachers were given the MISSM application to test out during the small group formative evaluation. They were urged to use the product on their children. Then, via email, their feedback and recommendations were gathered to enhance the development of the MISSM application.

Pilot Study

The pilot study had the following goals: (a) to assess the potential for technical error during the deployment of the MISSM application at NASOM centres; (b) to estimate the time and cost for the deployment of the MISSM application; (c) to identify potential threats during the actual experiment; (d) to assess the validity and reliability of the SSKT instrument; and (e) to enhance the development of the SSKT instrument.

According to Table 1, there were 30 participants in the pilot study, of whom 50% were Chinese, 33% were Malay, 13% were Indian, and 3.3% were of other races, demonstrating the diversity of Malaysians' varied cultural backgrounds. Three instructors have been hired to gather data during the implementation in the chosen centre. Twenty centres were accessible in Malaysia, but only one was selected, and the participants were randomly chosen.

Table 1. Participant's Pre-Test and Post-Test Data

Child	Pre-Test	Post-Test	Child	Pre-Test	Post-Test
1	49	49	16	29	48.5
2	47	45	17	23	27.5
3	46.5	50	18	31	41.5
4	50	50	19	43	42
5	48	48	20	45.5	47
6	40	47	21	41.5	50
7	37.5	36	22	47	45
8	43	46	23	49	49.5
9	19.5	25.5	24	12	23
10	36	36.5	25	25	32
11	46	46.5	26	33.5	45
12	9	35	27	28	40
13	33.5	50	28	12	19
14	40	46	29	11	18
15	48	48	30	47	44

A visual inspection of Table 1 data analysis based on the histogram, normal Q-Q plots and box plots showed that the pre-test data were normally distributed, with skewness of -0.830 (SE=0.427) and kurtosis of -0.528 (SE=0.833). However, the post-test data were not normally distributed, with skewness of -1.198 (SE=0.427) and kurtosis of 0.301 (SE=0.833). Further investigation using a Shapiro-Wilk's test (p> 0.05) showed a significant departure from normality in pre-test data, $W(30) = 0.87$, $p=0.002$. Similarly, the post-test data differed from normality, $W(30) = 0.83$, $p=0.000$. Consequently, the data analysis for the pilot study used the nonparametric test (Field, 2017)

Next, a Wilcoxon Signed Rank Test was used to evaluate if there were any differences between the exam scores obtained in the pre-test and post-test by ASD children after using the MISSM application during the teaching and learning process of social skills. The test revealed that using the MISSM application in teaching and learning social skills enhanced the

knowledge of those ASD children (Md = 45.00, n = 30) more than before being exposed (Md = 40.00, n = 30), z = -3.596, p = 0.00, with a larger effect size, r = 0.46. Additionally, the homogeneity (internal consistency) of the SSKT items' reliability was assessed by computing the value of Cronbach's alpha using post-test data. The SSKT value of = 0.951 after the screening process proved highly reliable.

This study discovered that the academic achievement of ASD children had greatly improved based on the exam score results obtained using the SSAT instrument. After utilising the MISSM application, the exam scores show that their knowledge of social skills improved through the teaching and learning process. Despite utilising the MISSM application for only two weeks, they saw a significant increase in their exam scores. This illustrated how crucial cultural norms are to the acquisition of social skills. Mobile apps also facilitate the simplification of the teaching and learning process. Lastly, this study was feasible based on the pilot study data collected.

Discussion

Mobile applications are growing popular as assistive technology in the teaching and learning process for ASD children. There are advantages and disadvantages to adopting mobile applications in teaching and learning, albeit every tale has two sides (El-Shoubashy et al., 2020; Stathopoulou et al., 2019). If appropriately utilised, it will be enjoyable for the children. It is also helpful for teachers to help some ASD children who have trouble paying attention and learning using conventional techniques, like books (Low et al., 2021).

Based on the observation by the educators, the MISSM application provides ASD children with a fun and productive learning environment. Additionally, it can be mentioned that, when effectively used, mobile applications can make studying enjoyable and fruitful for them. The results of this study supported the claims made by Hanna et al. (2022), Hashim et al. (2021), and Ur Rehman et al. (2021) that assistive technology based on mobile applications had improved the social skills knowledge of ASD children. This study also discovers an intriguing fact: after utilising the MISSM application, ASD children exhibit a changed approach toward learning. Some express excitement and plan to use the MISSM application again. This comment resulted from interactive and engaging user interfaces than traditional paper-based instruction, as demonstrated by the study by Ntalindwa et al. (2021).

Due to Malaysia's cultural norms, developing the MISSM application as an alternate approach and supplementary aid in teaching and learning social skills also fosters a sense of belonging in ASD children. Some children say the MISSM application's character reminds them of themselves. Additionally, their choice of favourite foods and items mirrors their life experiences and surroundings. This substantiated the prior claim made in the opening chapter about the value of culture in the teaching and learning of social skills (Davenport et al., 2018). The fact that the MISSM application can be downloaded from anywhere at any time gives the ideal environment for ASD children who struggle to remain seated during the teaching and learning process. Such an example is some ASD children could experience anxiety in particular educational settings. Due to their ASD impairment, they might not like some places (Ntalindwa et al., 2021).

The lesson can be taught to the children as often as possible. However, if used for a more extended amount of time, it might occasionally lead to distraction. When not being watched over by their instructor, some kids with moderate ASD impairment misuse it. They launch unrelated apps that appeal to them, such as games, YouTube, and other applications, like stated by Novack et al. (2019). Therefore, the MISSM application had to be used in a controlled environment under the supervision of their instructor or parents to address these problems.

Conclusion

The MISSM application was developed to help teach and learn social skills and evaluate how assistive technology based on mobile applications influences the social skills development of ASD children. It was meticulously finished in accordance with the Addie model protocol and guidelines to ensure that all ASD children in Malaysia could utilise it in the future. The intervention that uniquely benefits ASD children is reflected in the result of this study. The crucial phase for designing and developing the MISSM application has been effectively utilised and carefully defined earlier. The cultural norm is one of the crucial components that had to be used to give ASD children in Malaysia a sense of belonging and a unique identity. However, it is recommended that assistive technology based on mobile applications be used in teaching and learning social skills under close supervision in a controlled environment. Hopefully, all Malaysian children with ASD will be able to fully utilise it.

Recommendations

A different case study is also required to implement the MISSM application in a larger target sample with a broader population drawn from various Malaysian regions. Additionally, assessments of the ASD children's knowledge of more specialised social skill domains like cognitive, social interaction, social communication, emotional intelligence, and social behaviour were also required to ascertain their level of social competence. Secondly, to better understand the future, the observation of the teaching and learning process should be captured through video recording and analysed meticulously. The teaching and learning processes should last longer in the present study. Finally, this research provides the

framework for future investigations into the underlying interest in social skill teaching and learning via mobile applications.

Limitations

For the current investigation, a few limitations must be taken into consideration. Firstly, the study was implemented in a single region in Malaysia with a small number of participants. Therefore, the results could not be generalised to other populations of different regions in Malaysia. The observation was conducted through the eyes of their educator and based on a checklist. Consequently, a slight flaw and missing part could be detected.

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Authorship Contribution Statement

Mohamed: The concept and design of the paper and critical revision of the manuscript. Kassim: Securing funding, admin and providing material support. Bahrudin: Data acquisition, data analysis and statistical interpretation analysis.

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