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DEVELOPMENT FRAMEWORK FOR SOCIAL CIRCLE RELATIONSHIP LEARNING SOFTWARE FOR CHILDREN WITH AUTISM

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ABSTRACT

Autism, also called Autism Spectrum Disorder (ASD), is a complex condition that includes problems with communication and behaviour. Due to the increasing awareness among parents, these children are increasing every year. The safety of children is a crucial subject in family life both inside and outside the home. All parents want the best for their children, especially when they are away from the family. Recognising this situation, an application proposal was developed to expose their level of security when meeting the people around them. The social circle relationship was first introduced as an aid for students with special needs to categorise the people they meet. This study implemented the social circle relationship as an application for an early-stage prototype to be tested on selected respondents. Five autistic children, with their parents as instructors, modified the prototype to suit their child. The built-in framework was used as a guide and reference for developing the application that fits this concept of social circle relationship. The study employed a mixed method, mainly implying a quantitative methodology to analyse the collected data. The effectiveness of the proposed framework was validated using two experts' judgments and learners' feedback through interviews and experimental evaluation, respectively. The results indicated that the proposed framework effectively taught social boundaries and provided autistic children with satisfaction.

Keywords: Autism, social circle relationship, prototype method, safety, communication skill.

INTRODUCTION

According to statistics from the Department of Social Welfare (JKM) Malaysia (2024), until 31st January 2024, there were 691,630 people with disabilities registered with the JKM database. This number has been increasing to 213,261 people since 2018. The number of children with disabilities who were less than six years old and up to 12 years old and had learning problems was 77,229, and it made up the most significant fraction of 81% among all types of disabled people. Due to the rising number, it can be concluded that the awareness among parents and adults increases year by year, and many more children have been identified with autism spectrum disorder (ASD) in their early stages. Making a safe and comfortable environment for a child is a current issue faced by adults and caretakers, especially those with a disabled child. In 2018, 3,600 children were identified as needing preservation and protection (2024 data is not yet available). In other words, our world is not only a place for children to explore, but dangers await if these children meet strangers. In other ways, ASD children are typically described as not being able to respond in expected ways to strangers like normal children do (Wachholtz et al., 2023). This makes it easier for strangers if they have bad intentions towards ASD children. Thus, these ASD children need to recognise people in their surroundings and know how to react when meeting people.

Individuals, including children with ASD, are at risk due to a lack of safety (Abadir et al., 2021) and communication skills (Jayanath & Ozonoff, 2020). They are exposed to various dangers such as abduction and sexual exploitation not only from strangers but also from themselves as they do not know how to react to their changing bodies and how to respond appropriately when meeting with an opposite gender. Also, due to a lack of sexual education, they do not know how to strictly interpret and react to these issues (Pecora et al., 2021). Therefore, a tool is needed to help the children recognise who they are meeting and how to reciprocate appropriately. Various software applications have been developed to improve different skills, such as communication, social, and imitation skills (May et al., 2024; Rezayi et al., 2023) in children with autism. However, none of these software applications help children engage with people in their surroundings. Implementing colours to categorise the level of boundaries is another additional point, as colours also play a significant role in attracting attention, especially from children with disabilities. Applying visual aids using a traditional Picture Exchange Communications System (PECS) (May et al., 2024) is still effective in teaching and learning children. Nevertheless, a mechanism to cope with the fast-changing technological evolution is needed.

Parents' involvement in editing and constructing the tools and computer software for the children is still limited (Liu et al., 2023). In some situations, the tools might change according to the children's mood, such as when the children are excited and triggered by Star Wars characters. The editing and constructing tools will give the parents a better understanding and tighten the bond between the children and the parents. These tools can play the role of teaching aid or guideline for better intervention with their children and reflect the method of Treatment and Education of Autistic and Communication Handicapped Children (TEACCH) (Shminan et al., 2020), Applied Behaviour Analysis (ABA) (Alves et al., 2020), Son-Rise (Kahjoogh et al., 2020), and Picture Exchange Communications System (PECS) (Li et al., 2024). Other than that, Augmented Reality (AR) (Doulah et al., 2023) and Virtual Reality (VR) (Lorenzo et al., 2023) can also be used for child therapy. The tools may be advanced. Thus, the parents and their autistic children will face a problem as they are unfamiliar with the tools and environment from the visual setting of VR.

The role of information and communication technology (ICT) has been proven to be a fundamental prerequisite for personal development in teaching ASD children. Interactive learning can assist these children in interpreting knowledge better and faster than the old-fashioned chalk-and-talk learning process. The burden of the caretakers and the child guardians can be reduced by applying the tools in the teaching

and learning process. The objectives of this study are to propose a development framework for social circle relationship learning software for children with autism and to validate the effectiveness of the proposed framework.

LITERATURE REVIEW & FRAMEWORK DEVELOPMENT

The proposed framework (see Figure 1) combines a few theories and intervention approaches to identify the related content for the framework. The proposed social circle relationship framework has four main components and five subcomponents. The study mainly focused on four components adapted from (Morrison et al., 2019): Identifying Learners, Learning Objectives, Teaching Method – Interactive Circle Relationship, and Evaluation. The components of the Kemp Instructional Model (Kurt, 2016) designated for a non-linear step make it flexible for the designer to choose the steps that can finish fast and are suitable for the social circle relationship framework development. Each component of the proposed framework will be elaborated on in the next section.

Identifying Learners- Component 1

Identifying Learners is the first step in the research. Respondents, the caregivers/parents, and the children were interviewed to get their profiles. It was critical to understand the respondents' background, particularly the ASD children's characters, to determine whether the system can be evaluated.

Learning Objectives – Component 2

The second major component is the main reason the framework was developed. It involves the knowledge to be taught to learners. The learning objectives determine the focus of the learning system to achieve the expected goal. The goal is to develop social communication skills with other people. Using the prototype system is expected to improve the learners' skills.

Teaching Methods – Component 3 (Prototype Development)

This step is essential to ensure that the respondents (caregivers/parents) have mastered the techniques of editing the system to teach their children how to implement the system in teaching the social circle relationship. The teaching process includes uploading and deleting pictures for each circle, changing the background, and choosing the user's favourite song. This will lead the prototype to be close to the user's environment. There are three stages proposed to develop the prototype to satisfy and fulfil the needs of the children so that they can easily socialise within their social circle relationship. The prototyping process is known as iterative prototyping, where the design goes through a few steps until the end of the final prototype. Iterative prototyping assists designers in honing their concepts and identifying problems and opportunities that have yet to be apparent (Hansen, 2021).

The proposed stages to develop the prototype system are as follows:

- i. Prototype 1: Content Creation
The social circle relationship refers to the work of Walker-Hirsch and Champagne (1991), which has six coloured circles and the people in each circle (see Figure 2).
- ii. Prototype 2: Evaluation – The Child's Reaction to the Parent's Feedback
- iii. Prototype 3: Enhancement – Combination of Content Creation and Evaluation

The final stage of the outcome is to determine that all features have satisfied the system's end user. Prototype 3 is based on the parents' feedback, with a few factors influencing the outcome of the end product. The adult respondents' teaching factors include image uploading, animation, the reward, and additional details regarding the theme, background, and audio. The changes from prototype two will gain the children's attention to use the system correctly (see Figure 3).

Figure 1

Proposed Framework for Social Circle Relationship Learning Software for Children with Autism

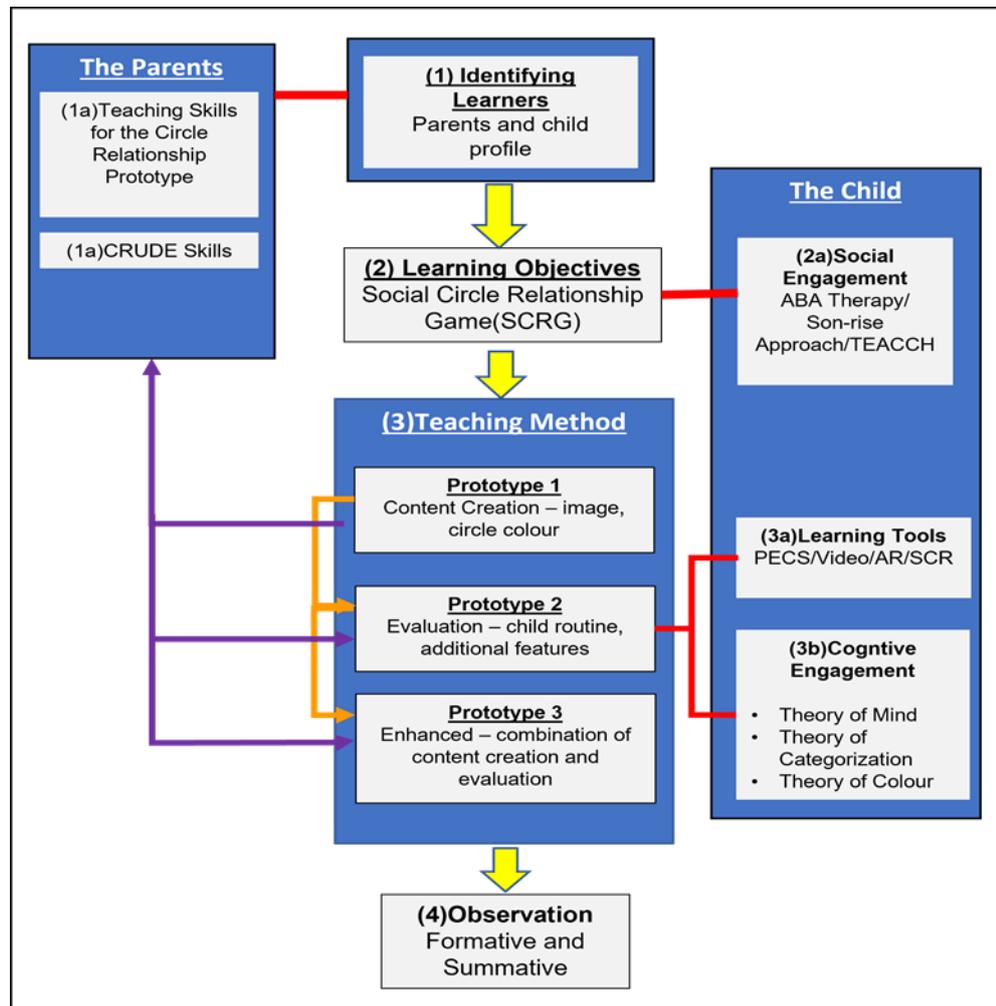
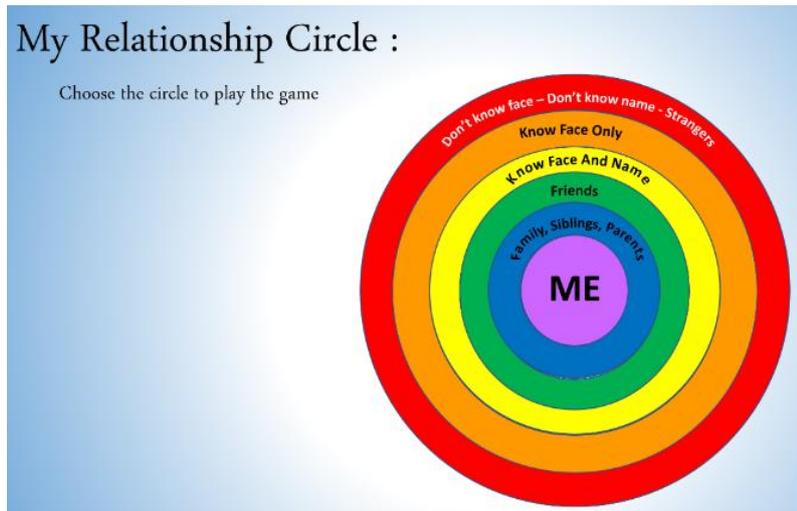


Figure 2

Social Circle Relationship Interface



The final component is to validate the developed system by observing and evaluating the system. The step involves respondents, the children, and the selected experts familiar with the children's environment. As for the formative and summative assessment, the system evaluation results are collected in formal or informal assessments. Interview and fieldwork notes from observation are conducted to collect the details of the designed system, such as whether the system development has met the objectives or whether any addition or elimination of some features is required.

Figure 3

Interface of the Proposed Prototype

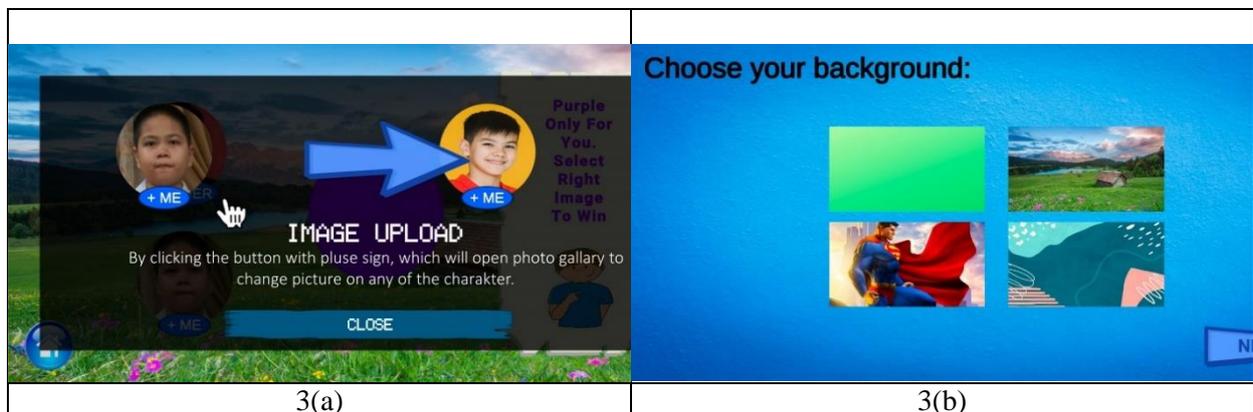
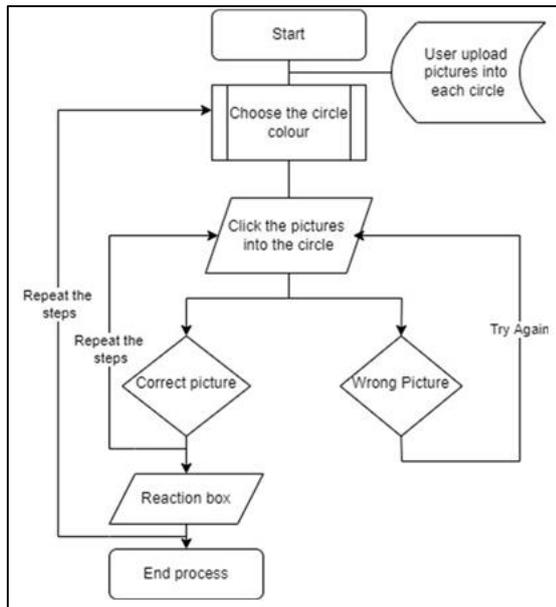


Figure 4 shows the flow of the proposed application to be developed and tested for the children. The Graphic User Interface (GUI) is based on Figure 4.

Figure 4

Data Flow of the Proposed Prototype



METHODOLOGY

The parents were included as the respondents to be interviewed by the researcher. There were three phases: Phase 1: Identifying the Needs, Phase 2 - Teaching the Respondents, and Phase 3: Evaluation from the Experts.

Phase 1 – Identifying the Needs

An interview was conducted with the parents to get their details, as we had to select appropriate respondents to ensure that the results would be consistent. The interview was also essential to learning the children's behaviour and understanding their social relationships: friends, family, teachers, and strangers. The responses collected from the interview were considered in the development of the proposed framework. The interview concluded with how far the children knew about their social circle and their reactions when meeting others.

Phase 2 – Teaching the Respondents

Teaching and learning are essential to understanding knowledge better. During this phase, the researcher taught the parents about editing the pictures, such as how to upload, delete, add, and make an animation based on what the children needed upon testing the prototype. In this phase, applying their (Copy, Redo, Undo, Delete and Edit) CRUDE skills was essential to maintain or edit the slide according to the children's interest. The children's favourite superhero characters or their favourite movies were prioritised. Adding the details would be an additional interest for the children to learn a new thing in their lives. Learning a new thing sometimes can be difficult for some parents to handle, as children with autism could have rigid behaviours. They needed to be prepared well if the parents wanted to introduce a new lesson. The learner's feedback involved the respondents' answers from the ASD children and parents/caregivers to validate the framework developed.

Phase 3 – Evaluation from the Experts

This step was conducted to validate whether the proposed prototype was able to teach the children with autism about social circle relationships and to improve their social communication skills with other people, especially with the person who taught them about using the prototype. The experts were occupational and speech therapists from a therapy centre in Shah Alam. They were asked to study the prototype and answer a few feedback questions regarding the prototype and social circle relationship. This was conducted through a video call, and the feedback was written in a form. The feedback validated how well the developed prototype can be applied in helping children with autism recognise people in their surroundings. The experts also observed the reaction of the children with autism to have their feedback on the effectiveness of the prototype.

RESULTS

Phase 1: Identifying the Needs

The respondents were chosen based on the background of the ASD child. To ensure they were suitable for the research, both the caregivers/parents had to be involved during the research fieldwork. The caregivers/parents must have basic CRUDE skills to edit the prototype. Table 1 shows the demographic details of the caregivers/parents, including age, gender, level of education, and marital status. The adult respondents' demographic profiles are shown in Table 1, and the children respondents' demographic profiles are shown in Table 2.

Table 1

Adult Respondents' Demographic Profiles

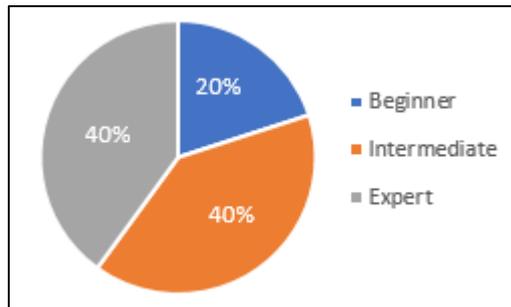
Respondents	Age (y/o)	Gender	Level of Education	Marital Status	CRUDE Skill
Parent A	40–50	Female	Bachelor	Married	Intermediate
Parent B	40–50	Male	Master	Married	Expert
Parent C	30–39	Female	Diploma	Married	Intermediate
Parent D	40–50	Male	Bachelor	Married	Expert
Parent E	40–50	Female	Diploma	Married	Beginner

Most of the parents were between 40–50 years old. Only Parent C was 30 years old. All the respondents were married; three represented the mother of the ASD child, while another two were fathers. The adult respondents' CRUDE skills were also assessed and asked about editing the prototype developed. It was found that two (40%) of the parents were experts with the skills, another two (40%) were intermediate, and one (20%) was a beginner. Figure 5 shows the percentage of CRUDE skills of the adult respondents. We can conclude that most of them had the skills to copy, redo, undo, delete, and edit using the PowerPoint application.

Based on Table 2, it can be concluded all the children had already taken an intervention/therapy class to control their behaviour and to teach them how to socialise and mingle around with others. The ages of the respondents were around 9–11 years old. The parents indicated that the children were detected with signs of autism when the children were 1–2 years old.

Figure 5

Percentage of CRUDE Skills of Adult Respondents



During this period, we clarified the questions, determined the need to tape-record parents’ answers, and established interrater agreement on parents’ responses to each questionnaire item. Once this process was completed, we conducted telephone interviews with the individual families in this study. All interviews were conducted with one parent, video-recorded, and finally summarised.

Table 2

Children Respondents’ Demographic Profiles

Respondents	Age	School	Signs of Autism Detected	Has been in Intervention/Therapy Before
Child A	11	SK – Mainstream	Two years old	Yes
Child B	10	SK – PPKI	One year old	Yes
Child C	9	SK – PPKI	One year old	Yes
Child D	10	SK – PPKI	1½ year old	Yes
Child E	10	SK – PPKI	One year old	Yes

Social and communication skills play a leading role when ASD children meet a new friend or a new person they have never met before (see Figure 6). It was hard for them to make a welcoming gesture, even to greet appropriately. All questions in Table 3 were asked during the interview through a video call via Google Meet. The interview took around 20–30 minutes. Table 3 shows the answers to questions asked by the researcher. Each of the parents had their challenge in teaching social education to the children. Various methods have been used, similar to the interventions and approaches applied to teach the children effectively. Some of the children could be taught verbally, and two-way conversations could be made to get a reply from the children. A more challenging method with more effort from the parents had to be used with a non-verbal child. For example, the parents needed to come out with pictures or show a video to learn what the child needed.

Phase 2: Teaching the Respondents

An interview was conducted with the parents to learn how they related to the people in each circle. Each provided reasonable answers based on their experience teaching the children about coloured circles and the social circle relationship. The responses are described in Table 4.

Figure 6

Chart of the Children's Character

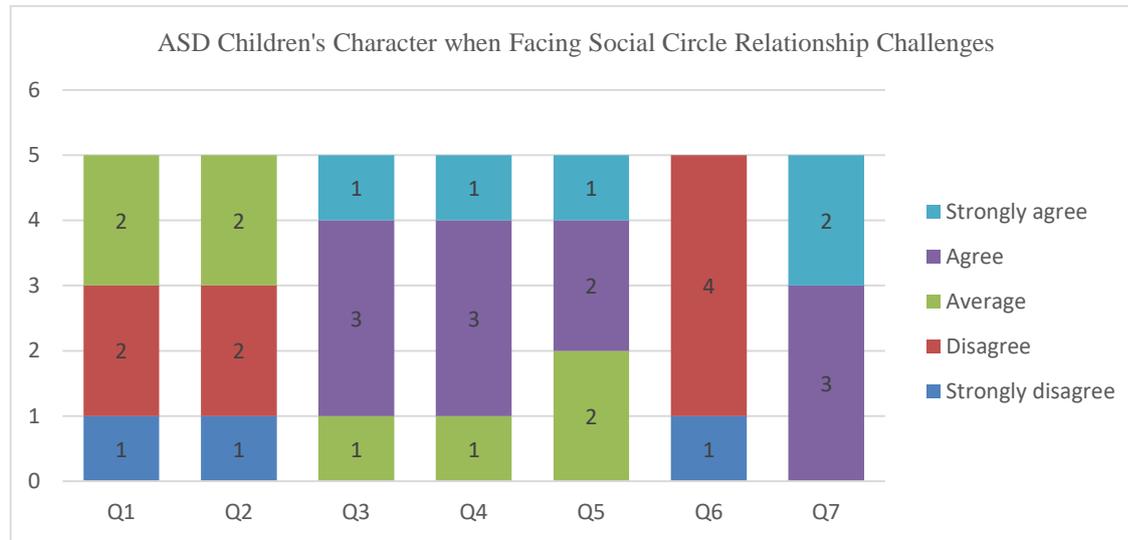


Table 3

Methods Used in Teaching Social and Communication

Question	What methods do you use to educate the child about social relationships with other people?
Parent A	<i>We will introduce a new person to him verbally and tell him to call with the nickname of the person they met. It is easy for us to introduce a new person since he can recognise the person well and differentiate the relationship between them.</i>
Parent B	<i>My son can interact with his friends well but with a minimum response. Usually, to introduce him to other people like relatives, we will take him to the relative house and ask him to greet us and react appropriately. The same goes for meeting a new person; we will introduce ourselves to him at once.</i>
Parent C	<i>We use PECS (Picture Exchange Communication System) to teach about social relationships and communication skills with other people. Since my son is non-verbal, he uses actions such as hitting the person he intended to rather than a 'hi' gesture to greet others. We also show him a video of Upin & Ipin to explain 'salam' to others.</i>
Parent D	<i>My son is verbal. Sometimes, we introduce an instance without using any approach, such as PECS or video. When he was younger, about 5-6 years old, we used more visual aids to communicate and teach him. For example, I could teach him about puasa (fasting). Parents used cartoon characters and clock images to demonstrate the activity according to the time, such as images of people eating during sahur and iftar. Along with the visual aids, they also explain verbally. For example, "This is your friend. You need to share your stuff with them; do not hit them." However, it could be more effective as the child must only understand some of it.</i>
Parent E	<i>Usually, we will use video calls to teach social relationships and communication with others, such as our relatives. He will ask to speak with the person he wants. In the same way, we will introduce ourselves to other people through video calls. He will react well and say hi since he is verbal.</i>

The Time Measurement Completion Result with Confidence Interval (CI)

The time the children took to finish the task is summarised in Table 5. The time to finish the task was recorded with the parents' guide while monitoring the children using the computer hardware, such as clicking the mouse.

Table 4

How Parents Related the Colours with Their Autistic Children in Each Circle

Questions	Parent A	Parent B	Parent C	Parent D	Parent E
1. How do you teach colour to your child?	<i>I taught my child about colour by using slides. I introduced the colours one by one and let him see them thoroughly.</i>	<i>I use objects as references. For example, red as an apple, blue as the sky.</i>	<i>First, colour pictures using three primary colours (red, blue, and yellow) gradually introducing other colours while colouring pictures. Then, we move on to other objects, including the circle of relationships.</i>	<i>Showing a picture card, repeat until he can identify and remember the colour.</i>	<i>I showed him YouTube videos and did Q&A sessions as well as exercises.</i>
2. How did you relate a specific colour to a specific person? Introduce the step or method to the child in the first place.	<i>I introduced the steps that have been taught to the child.</i>	<i>Method – matching the picture with the colour.</i>	<i>Pretend play (facial expressions, body language prompting) matches the colours with the person's picture. They are repeating verbal, simple descriptions.</i>	<i>Each colour line with the person shown.</i>	<i>I relate colours to people using statement words. For example, mummy drives a silver car. Dad drives a black car.</i>
3. Did you use a circle relationship to teach your child about boundaries?	<i>Yes, I do. The Circle Relationship is very useful for teaching my child about boundaries. Colour-coded has helped him</i>	<i>Yes, I did.</i>	<i>Yes, indeed, each circle can represent the person within which boundaries.</i>	<i>Yes, teaching colour to differentiate the person using the circle is easier.</i>	<i>Yes, and he understands it very well.</i>

	<i>to recognise more about it.</i>				
4. Do you agree that the colour codes are closely related to specific human beings? Please explain.	<i>Yes, I do. All the colours reflect a specific individual. Children may recognise a person by the colour taught to them. Each of the colours has its characteristics that suit each of the individuals.</i>	<i>Yes. I agreed. The colour codes help my autistic child understand the circle of relationships and the boundaries.</i>	<i>Yes. I justify it with the traffic light concept. Red means stop or NO. Yellow in the middle, friendly but not too close. Green for the go or family. And other colours in between to match types of people.</i>	<i>Yes, colour plays its own role in our life. For a child, it makes them excited to play with. My son understands red colour means it is a dangerous situation and blue means comfortable for him.</i>	<i>Yes, I agree. Colour makes it easier to differentiate different things.</i>

Table 5

Time Measurement for Completion

Children Respondents	Time for Completion (s)
Child A	6.5
Child B	5.5
Child C	6.7
Child D	7.1
Child E	6.2

The maximum value from the result was 7.1 s, while the minimum value was 6.2 seconds. Due to a small sample proportion, the t-distribution was calculated to find the 95% confidence interval from the result. The mean value was 6.4, with a standard deviation of 0.6. The confidence interval (CI) is a range of values likely to include a population value with a certain degree of confidence. It is often expressed as a % whereby a population mean lies between an upper and lower interval. From the results, it can be defined that the respondents can be 95% confident that the population mean (μ) fell between 5.655 and 7.145. The CI formula is as shown in equation (1):

$$\bar{x} \pm t \left(\frac{s}{\sqrt{n}} \right) \quad (1)$$

Where:

\bar{x} = mean sample

t = t-distribution

s = standard error

\sqrt{n} = equation of sample

Table 6 and Figure 7 show the percentages of correct answers the children gave. Child C scored 95%, while Child E scored the lowest with 75%.

Table 6

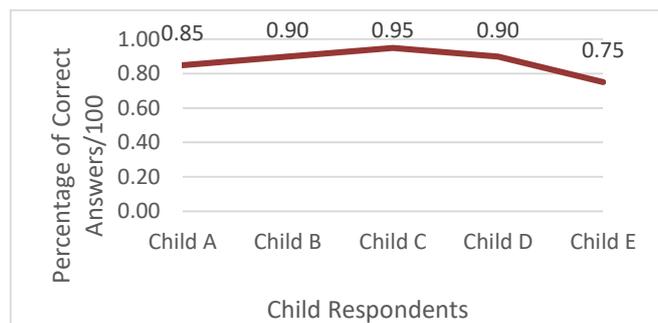
Percentage of Correct Answers

Child Respondents	Correct Answers/20	Percentage
Child A	17	85
Child B	18	90
Child C	19	95
Child D	18	90
Child E	15	75

In many ways, colour is like music. A single note has a distinct quality. However, if combined with other notes, it only elicits a strong emotional response. How the sounds are mixed determines whether that response is pleasurable or not. From the interview, all answers agreed that colours are closely related to person categorisation.

Figure 7

Percentage of Correct Answers



The parents responded that ‘each colour has its characteristics’ (Parent A) and it is ‘easy to differentiate the person using colour’(Parent E). This finding shows that colours have an essential role in humans and relationships.

According to Fehrman and Fehrman (2004), colour is a human illusion in which the world appears to be colourless. They explained that colour appearance is influenced by light. Human eyes can see colours when a substance is illuminated. When asked how the parents taught the children about colours, each had their own verbal or nonverbal method. For example, ‘using objects as reference’ (Parent B), ‘introducing a picture card and repetitive action’ (Parent D) and ‘showing him YouTube videos’ (Parent E) were the methods to teach the children about colours.

Colours make it easier to group people according to characters. The parents were asked about how they related specific colours to specific people. The answers came out in different ways and actions, such as

‘pretend play-prompting to match the colour to the person’ (Parent C) and ‘applying everyday habit, e.g., mother use the silver car and father-always use black car’ (Parent D).

In conclusion, the results from the interview showed that colours had their characters and made it easier to categorise things or people. In terms of the children’s memories, colours played essential roles in remembering people or when they were at different scenes, such as at the traffic light junction. One parent used this method to test whether the child understood colours. It was found that the child could understand colours easily. Therefore, we can utilise the method in many ways to make children understand life and protection better.

Phase 3: Evaluation from the Experts

The proposed prototype was presented to the two experts, an occupational therapist and a speech therapist from a therapy centre in Shah Alam. The therapists were experienced in teaching and assisting students with disabilities for almost five years. Both had work experience with over 30 children by providing them with sensory stimulation and intervention at the centre. The following is the feedback from the experts on how the prototype framework can teach children with autism to learn social relationships and the boundaries within their circle of relationships.

Assessment of Identifying Learners

Question 1: What is your view about identifying autistic children to create a learning system used in the social circle relationship framework?

E1: Sometimes, they have their obsession, and we can tackle them (using the obsession) to understand the prototype concept.

E2: The method/tool seems complicated and complex since each child has abilities and difficulties. These children are not mentally disabled; they only have problems in processing information. However, the method becomes more accessible with the help and guidance of adults.

Assessment of Learning Styles

Question 2: Is it a suitable application to categorise people with colours to introduce different boundaries of different people within the children’s circle?

E1: Colours can be easy, and be difficult for the child to recognise the colour. The idea of categorising using colours is brilliant, but with an adult guide. Colours can attract their attention, and applying colour codes will help them know the boundaries better.

E2: Colours are the best way to differentiate things better. For me, using colours to introduce boundaries in the children’s surroundings is good and needs further action.

Assessment of Effectiveness of the Social Circle Relationship

Question 3: How effectively can the children understand and implement the system daily?

E1: We meet a new person every day, a new name, a new identification, and a new face. This will be a problem for the children in recognising the person initially. Cognitive development for autistic children is different from typical children. Implementing this app, the prototype, in their daily life might come with several challenges, and of course, intervention must be done before we can use the app. However, this is only possible if the prototype has more benefits for them.

E2: I agree but only for specific children. Children with low function may have problems difficulty understanding the prototype's function. Functional children will need a faster understanding of catching things they are learning. Preparing the child each time before going outside their safe and close circle will

be very helpful. Give them an idea of what it looks like when meeting other strangers outside and how can they respond when meeting them (the strangers).

Assessment of Effectiveness of the Social Circle Relationship

Question 4: Do you agree that social circle relationships can improve autistic children's social and communication skills with the people in their surroundings?

E1: Referring to the system ... maybe yes or maybe not. We have a broad perspective when talking about social skills. Many ways can be used to improve social skills, including using a tool like the system. In a way, using the system or prototype can improve the children's social skills a bit, but it needs a lot of adult guidance and help. Just need a lot of improvements to make it attractive for the children.

E2: Social and communication skills are essential to show significant growth in a child. I agree with the point that there are many ways to teach and improve social and communication skills, not only for disabled children but also for normal children. In this situation, the system needs communication either by a guide or a teacher to teach and then use the system. I could not agree more; yes, it can improve the children's social and communication skills with other people using the system.

Having an adult guide is a big help to test the prototype. The different capabilities of each child might affect the final results. Both experts agreed that identifying the child in the first place was important. Interaction with each of them differed from that of a typical development child. The intervention was to ensure the children could follow the instructions during the test. Undeniably, the system can help children with autism understand their circle of families, friends, and strangers. One of the therapists, however, felt that the system was still not capable of helping the children with autism in their daily lives. The children had low functional abilities; thus, they would take longer to understand the system. Both experts agreed colours coded with categorisation were the best way to group things effectively. The colours also had a significant impact on human-computer interaction, whereby it can limit certain things from large to small groups.

Moreover, the children were attracted to colours, and it was easier for the children to group things according to the colours. Social and communication skills are essential for human beings to transfer information from one to another. Both experts agreed that the system can improve the children's social and communication skills.

In conclusion, the system needs to improve before it can be implemented to improve the social and communication skills of children with autism. Understanding that they need assistance identifying who is safe to be around and who poses a danger, the system can help them recognise the people within their circle.

DISCUSSIONS AND RECOMMENDATIONS

Categorisation and grouping have been the best solutions for organising things around us. It becomes much easier for children to learn new things and adapt to their surroundings as they grow. A child with a disability such as ASD will have much more difficulty recognising things and people in their surroundings, as highlighted in this study. Parents were included as respondents to assist and guide the children using the tools. Teaching and communication skills are critical in editing the tools. Knowledge of approach and intervention is also essential to tackling the child and creating a comfortable and conducive environment for the testing to run smoothly without any unexpected incident. Children with autism can have various behaviours. They can even act aggressively whenever they feel uncomfortable and uneasy. The responses

and results demonstrated that the prototype framework can effectively teach autistic children about social relationships and communication skills

The theory of Mind is closely related to a child's cognitive development. Beliefs, desires, and intentions are critical concepts in the Theory of Mind, and they are used to find out why people act the way they do or predict how they will act in the future (Bamicha & Drigas, 2022). The Theory of Mind generally includes interpreting another's knowledge, beliefs, emotions, and intentions and applying that knowledge to social situations. Children constantly add new knowledge, build on current knowledge, and change previously held concepts to accommodate new information as they interact with the world around them. This does not occur with children with autism, as they have cognitive development impairments that affect their developmental stages.

When Walker-Hirsch and Champagne (1991) introduced the social circle relationship, the concepts of categorisation using colours emerged. Each circle has their own colour to represent the boundaries of each social network the user will meet within their surroundings. The goal is to prevent and educate individuals with intellectual disabilities using the circle concept, which helps them identify who they can interact with and who they should avoid. Additionally, the framework aims to teach them how to respond when meeting people in each colour circle using the ten principles of touch and sensory experiences, which can help overcome many learning disabilities. The circle concept is suitable for different learning disabilities among children and adults with verbal or nonverbal disabilities. Rosch and Lloyd (2024) introduced the theory of categorisation, which simplified the process of classifying objects for a specific purpose due to our brain limitations. These theories can be described as the backbone of the circle concepts where categorisation by using colours is implemented to differentiate boundaries between each circle.

The proposed framework of the social circle relationship prototype has achieved the objectives of teaching autistic children about social and communication skills with other people. Despite the findings, there is still room for improvement that should be considered for future enhancements. The following options can be used to improve the framework:

1. The function of the social circle relationship is suitable not only for children with autism but also for other disabilities, especially for non-verbal disabilities. It is strongly suggested that future studies use a larger sample size, including individuals with various types of disabilities. A broader range of responses will yield more significant results to test the findings at the end of the study.
2. The proposed prototype's human-computer interaction (HCI) and interface include features that cater to different backgrounds and use audio to capture the child's attention. Adding these features could enhance focus and lead to better learning outcomes.
3. The experts suggested that children with other disabilities could also use the prototype. The colour coding can be replaced with different categorisation methods such as shapes, names, or numbers. This could help children who are colour-blind to maximise their cognitive skills.

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