

## Preliminary Investigation on Multi-Modal Approach for Teaching Social Interaction Skills to Autistic Children

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**Abstract:** Autism which is a lifelong neurobiological disorder that blocks a child's communication, emotional and social development is on the rise in Malaysia with 30% increase being reported in Malaysia from 2008-2011. Characteristics often associated with autism include quality impairment in social interactions such as eye-to-eye gaze, facial expression, body postures or lack of social or emotional reciprocity quality impairment in communication such as delay of development of spoken language or repetitive use of language and restricted repetitive and stereotyped patterns of behaviour, interest and activities. Due to this, an early childhood intervention is essential in ensuring autistic children have the opportunity to develop their full potential and to contribute to society in later years. The intervention will also enhance education opportunities of such children, thus supporting the efforts of NASOM as well as the government's "education for all aspirations". One approach that has shown great potential in enhancing social interaction skills among autistic children is the multi-modal mind games approach. The purpose of this study is to present a result on needs analysis that have been conducted at one training institute in Pahang to determine weaknesses and strengths of the current practices in developing social interaction skills among autistic children. Parents, teachers and students were interviewed to get a comprehensive view of the existing situation. The findings indicate that the use and ownerships of smart devices are prevalent and development of multi-modal communication application for enhancing social interaction skills of autistic children is feasible.

**Key words:** Special education, Autism multi-modal, social interaction, needs analysis, Malaysia

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### INTRODUCTION

Autism which is a lifelong developmental disabilities represents a serious challenge because they often accompanied by extremely disruptive antisocial behavior. Autism characteristics often include quality impairment in social interaction such as eye-to-eye gaze, facial expression, body postures or lack of social or emotional reciprocity quality impairment in communication such as delay of development of spoken language or repetitive use of language and restricted repetitive and stereotyped patterns of behaviour, interest and activities. Such behaviour if not addressed can lead to unfulfilled life and potential. According to the National Autism Society of Malaysia (NASOM), there has been an increase of 30% in the number of children registered as autistic from 2008-2011 as well as the number of children diagnosed

with Autism Spectrum Disorder (ASD). Thus, more effective educational approaches must be identified to help autistic individuals fulfill their potentials.

To achieve this goal, more research is necessary to assess the situation and to draft effective education provisions to address the needs of autistic children. Research findings indicate that autistic children requires a structured day and teachers who know how to be firm but gentle at the same time (Grandin, 2015) and the severity of autism can be reduced with early childhood intervention that enhance the development of their social, behavioural and communication skills (UNICEF, 2013). Among the many challenges faced by autistic and ASD individuals, social interaction is one of the most crucial elements lacking in their daily lives. The importance of social interaction cannot be overstated as it is a principle aspect of development that is influential throughout one's life. The inability of individuals with autism to integrate

comfortably in a social setting can be very taxing for family and friends during childhood and even throughout adulthood. Thus, improving social interaction skills is essential in improving the quality of life for autistic individuals and their family members. An early intervention can help individuals acquire the social interaction skills that they need to engage in typical interaction with others.

It is also recognized that there is no single method that can be universally applied and will be successful in enhancing social interaction skills for all children with ASD. However, increasing the involvement of a child with culture-based social games has been shown to have the potential to improve his/her social interactions skills. This paper reports on an important part of a larger study, a developmental research study-that attempt to design and develop an instructional system for promoting social interactions skills among autistic children. The specific focus of this study is on the needs analysis stage of the development process that sought to identify the weaknesses and strengths of current practices in developing social interaction skills among autistic children in Malaysia.

#### **Teaching methods for developing social interactions**

**skills:** It is important to understand that ASD is a complex and heterogeneous neurological deficit which affects not only cognitive functioning but also emotional and social behavior as well as language development (Crane *et al.*, 2013). Every child on the autism spectrum is unique with different strengths and needs at different ages. The right tools and environment are needed to create an engaging learning experience for students with ASD. The use of multimedia as educational aid for autistic children is not new and multimedia applications which involved the combination of text, graphics, videos and animation have been shown to be useful in providing autistic children with a suitable environment to play and learn at the same time. Autistic people tend to be visual thinkers, pictures and simple short textual presentations are best and using long strings of verbal instructions is not suitable as they have problems with remembering the sequence (Grandin, 2015). Thus, multi-modal communications is the key to helping autistic learners where image, gesture, music, spoken language and written language can be combined in the learning tool. In the following paragraphs some of the interventions that have been carried out and tools that have been developed to address social interactions skills needs of autistic children will be discussed.

To address lack of social interaction skills, mind games have been identified as an essential part of

the learning tools for these children. Barakova *et al.* (2007) proposed an interactive toy and it was shown to be beneficial in improving social interaction skills indicators among autistic children. The toy which consists of an undefined number of cubes that express emergent behavior by communicating with each other and changing their colors as a result of how they have been positioned by the players was shown to stimulate motivation, explorative and social skills of autistic children as indicated by longer engagement duration with the toy in comparison with their usual play routines. Instead of using a toy, Finkelstein *et al.* (2009) uses virtual humans in their digital game called cMotion to teach emotion recognition and programming concepts to children. Motion is designed to teach the intended users how to recognize facial expressions via an interactive virtual character using a visual drag-and-drop programming interface. The game has three stages a playable introduction which focuses on social skills and emotion recognition an interactive interface which focuses on computer programming and a full game which combines the first two stages into one activity. More complex systems have been developed for more complicated goals. For example, Choi and Chang developed an interactive therapy system which has five types of social skills training scenarios and one type of visuomotor coordination ability assessment scenario. On the other hand, Battocchi *et al.* (2009) developed a technology supported interactive game for fostering collaboration skills in children with ASD called the Collaborative Puzzle Game (CPG). The study indicates that shaping interaction with a set of system-provided rules called “enforced collaboration” that makes interaction more complex has a positive impact on children’s collaboration skills.

Past studies indicate that culture has a big influence on the development of children in general. A recent study by Kanaiaupuni *et al.* (2010) found a set of nested relationships linking the use of culture-based educational strategies by teachers and by schools to student educational outcomes. They found that culture-based educational positively impacts students socio-emotional well-being such as identity, self-efficacy and also social relationship. According toKatlyrn it is imperative to take culture into account when establishing a treatment plan for a devastating disability such as autism. She believed that cultural values play important roles in shaping thoughts and feelings, including how to deal with autism. Chaby *et al.* (2012) and Jones *et al.* (2011) explored multimodal social-emotional behaviors in ASD. They conducted fundamental and applied research regarding the reception and production of social signals involved in human interactions. To fulfill their aim, they modeled

cognitive and multimodal emotional integration during infancy and analyzed dysfunctions in pathologies that affect the dynamics of social interactions in ASD. They proposed a method that could be a valuable tool for examining language, emotional and social interactions in clinical populations like ASD. According to Grynszpan, it is important to understand the signs of communication challenges that may appear in autistic child's multimodal behavior which encompasses speech, gesture, gaze, facial expression, etc. They described their methodology and developed the architecture of a system to analyze autistic multimodal behavior observed in videos of speech therapy sessions. They highlighted the benefits and limitations in the approach and prospects for the design of accessible education software. Farrow and Lemon has proposed one of the well established technology supported intervention named as ECHOES technology enhanced learning environment which uses a Virtual Character (VC) to engage young children in social games. The VC is capable of performing a limited set of gestures and they suggested ways to enhance the system's communication options with the addition of phrases in both British Sign Language and Sign Supported English integrated with existing pointing gestures and gaze behavior. According to Guldberg *et al.* (2010) the system targets both Typically Developing (TD) children and those with ASD. They briefly described the ECHOES TEL environment whereby both developing children and those with autistic spectrum disorders can interact with a virtual character to perform cooperative tasks in a series of learning activities and social games as a means to practice and develop social and communicative skills. They believed that the ECHOES system with the additions they proposed will bring new opportunities for studying the educational development of deaf children, both TD and ASD. Decisions must also be made whether to use web-based or stand alone platform. For example Ibrahim developed a web-based educational aid for autistic children which was found to be helpful but troubled by accessibility constraints and related maintenance cost.

Instead of relying on technology, Holladay on the other hand chose the more authentic method of developing social interaction skills by exposing autistic children of all spectrums to those of typically developing children. In her research, she set up a play group that consisted of both typically developing children and other autistic children hoping that autistic children will learn from normal children. Her finding indicates that higher functioning autistic children only mimic the lower functioning autistic children. Although, the finding was counter intuitive, the seemingly non-productive learning was later on found to lead to better learning for the higher

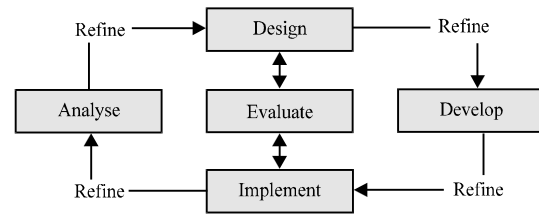


Fig. 1: Typical ISD Model

functioning children as they receive feedback on their inappropriate behaviour from teachers and normal children. Thus, this suggests that autistic children do under certain circumstances mimic other peoples behaviour.

In brief, the complexity of learning social interaction skills by autistic children demand a multi-modal approach that integrates concrete and virtual experiences such as in technology assisted learning. Thus, this research will adopt the best practices from technology assisted interventions as well as face to face interventions in formulating a framework that would serve as a guideline for designing intervention materials for the development of social interaction skills.

**Instructional design model basis for designing instructional materials:** To be effective, design of any instructional materials must be based on a sound Instructional System Design Model (ISD) such as the well known (Analysis, Design, Develop, Implement and Evaluate) ADDIE Model. A typical ISD model based on the ADDIE Model is shown in Fig. 1. From the model, it can be seen that the development process starts with the analysis stage (needs analysis phase) which forms a critical aspect of the process.

At the analysis stage, the answers to the following questions must be obtained: Who are the learners and what are their characteristics? What is the desired new behavior? What types of learning constraints exist? What are the delivery options? What are the pedagogical considerations? What learning theories must be applied? and What is the timeline for project completion? The answers to this phase will shape the design and content of the instructional materials such the multi-modal mind games courseware to be developed for this research. Thus, the needs analysis phase is one of the “research phases” of the design and development process of an instructional materials and this paper is focusing on this aspect of the current research project.

## MATERIALS AND METHODS

This research uses the development research methodology which is a variation of the ADDIE Model

Table 1: Seven phases involved in the research

Phase	Explanation
Preliminary investigation	Understand the concept of multi-modal approach
Planning	Decisions are made regarding the design for the study, the sample and the instruments for data collections during the needs analysis as well as the actual study
Needs analysis	Surveys are conducted on parents and teachers who are in direct contact with the autistic children. Additionally, autistic children will be observed to study and identify the requirements to be included in the proposed games
Designing and developing	Three main submodules need to be considered: Pre-production (content, users, development, specification and story board), Production (ensure the contents tally with the prepared scripting) and Post Production (testing the games)
Implementing	Selected children will be exposed to the culture-based multi-modal mind games for four months
Testing	Data will be collected and analyzed
Evaluating	The adequacy of the multi-modal mind game as a support for early childhood education intervention focusing on social interaction for autistic children will be verified

discussed previously. The specific phases involved in the study is summarized into seven phases as shown in Table 1 and since this paper is focusing on the analysis phase only the methodology used at this phase will now be presented. This courseware is going to be used by autistic children with the support of their teachers and parents.

**Research design:** The survey design was used for collecting quantitative and qualitative data at the analysis phase of the research. However in this study, only the quantitative data collection methods and analysis will be presented which is the preliminary stage of the analysis phase.

**Research participants:** Participants were selected using the purposive sampling method as they have the necessary information that is required for the study. The participants were parents and teachers who were in direct contact and closely involved with the target of the courseware (multi-modal mind games) who are autistic children. Their close proximity to the target group can provide accurate and comprehensive information about the target that can be used effectively in the design of the learning materials. The participants consist of all teachers who deal directly with the autistic students and all parents of students at one institute, the Imperial College, a special college for training learners with ASD in Bukit Gambang, Kuantan, Malaysia. The college was chosen as it is one of the institutions that have a large number of ASD students which will provide the rich information needed for the design of the courseware.

**Data collection instrument:** Online questionnaires supported by Google Doc were used to gather data from respondents. Questionnaires were designed specifically to ensure good return rate; the questionnaire is designed to be user-friendly using absolutely essential items (n = 17) short items with alternative and written in both Bahasa Malaysia and English. The questionnaire consists of 3 parts, A-C. Part A is designed to elicit the ICT

knowledge and usage of respondents who are going to use the courseware (parents, teachers and ASD students). Part B is on the teaching and learning approach used by teachers and parents and part C is on the behavior of the targeted users the autistic children. The data from the questionnaire will provide important data related to the questions posed at the analysis phase of the courseware development stated in the ADDIE Model discussion section.

## RESULTS AND DISCUSSION

Fifteen respondents completed the questionnaires fully and the following analysis is based on their data only.

**Demography:** The demographic profiles of the respondents who are mostly females and parents are shown in Table 2.

**ICT knowledge and usage:** Table 3 shows the breakdown of the questions with the answers by respondents for Part A. Basically, respondents have basic knowledge and can use smart devices. In terms of gadgets, it can be seen that all parents and teachers owned a smart device (tabs, phones) and with the proposed intervention, it is not impossible for the autistic children flash cards, study etc., in teaching and learning. In fact, many researches showed that the use of multimedia has a great outcome in improving student's understanding on certain topics. However, some parents and teachers have difficulty in using online facilities (20%) which means that careful considerations must be made as to the platform to be used for the tool stand alone or online.

**Teaching and learning approach:** Questions in part B is more on the multimedia usage in teaching autistic children. The breakdowns of the questions are shown in Table 4. In general, respondents feel that they are not familiar with using smart devices for teaching and learning (46.7-66.7%).

Table 2: Demographic of respondents

Demographics	Frequency (N = 15)	Percentage
Male	4	26.7
Female	11	73.3
Teacher	3	20.0
Parents	12	80.0

Table 3: ICT knowledge and usage

Questions	Frequency (N = 15)		
	Yes	No	Not sure
Do you understand the basic function of computer?	10	3	2
Do you own any tablet/smartphone?	15	0	0
Does your tablet/smartphone has data plan that enable you to access internet?	11	4	0
Do you know how to open a web browser and go to specific website on the world wide web (www)?	12	1	2
Can you download and save any file from the world wide web?	9	3	3

Table 4: Teaching and learning approach

Questions	Frequency (N = 15)		
	Yes	No	Not sure
Have you been exposed to the use of multimedia in teaching and learning?	3	7	5
Have you used applications such as computer, tablet or smartphone in teaching and learning before?	3	10	2
Have you ever used any multimedia products?	2	10	3
Do you think the materials prepared sufficient?	6	0	9
From your experience and observation, do you think multimedia tools are suitable to be used as an education material for autistic children?	11	2	2

Table 5: Autistic children behavior

Questions	Frequency (N = 15)			
	Poor	MILD	AVG	High
How well the children take instruction and follow it?	3	7	3	2
How do the children interact with others in class?	4	8	3	0
How well do the children pay attention to details during lesson?	4	6	4	1
How skillful are the children in doing their homework while holding pen/pencil or playing with small objects?	5	7	3	0
Do the children show happy expression when they are pleased with something?	7	3	4	1
Do the children look at your eyes while talking or making a conversation with you?	6	3	4	2
Do the children repeat any conversation they heard while responds to you?	5	4	5	1

**Autistic children behavior:** Table 5 shows the results given by respondents based on the autistic children behavior. The respondents are given a four-scale (poor, mild, average and high) to rate the behavior or the characteristics of the autistic children. Most children according to the respondents are in the range of poor to MILD in their capabilities to demonstrate social interactions skills behaviors. Most notable is the inability of the autistic children to show happiness (66.7%) where appropriate and their reluctance to have eye to eye contact (60%).

At the analysis phase of the instructional materials development for teaching social interaction skills, vital information on the needs of parents and teachers as well as autistic children in regards to the proposed course were assessed. Inadequate materials for learning as voiced by the respondents are a strong motivation for designing new learning materials.

Autistic children surveyed were found to be having difficulty in expressing happiness and making eye contact which is typical of autistic children who tend to have problems in emotional and social behavior (Crane *et al.*, 2013) which are important indicators for social interaction skills. Thus, to focus on developing social interactions skills among them seem to be supported.

Pedagogical considerations which are associated with parents and teacher's skills and cognition are important for any teaching efforts to succeed. Teachers and parents from the survey are found to be confident in the idea that using multimedia would be beneficial to learning for the autistic children under their care (Item 10). The finding is in line with previous studies where multimedia is found to benefit ASD learners (Battocchi *et al.*, 2009; Finkelstein *et al.*, 2009). These studies support the idea that multiple mode of learning is better than a single mode of learning. Multimodal learning which is an 'embodied learning situation can engage multiple sensory systems

and action systems of the learner. Thus, the literature also lends support for the multi-modal mind games instructions being proposed.

Since 100% of parents and teachers seem to have either smart phone or tab using both devices as platforms for some elements of the learning materials seems to be a reasonable choice. However, the fact that parents and teachers are not currently using these devices for teaching and learning of autistic children under their care is a concern that must be addressed as it can impact the success of the program. The lack of usage could be due several reasons such as lack of knowledge or poor perception on the usefulness of media supported learning for social interactions. The perception that smart devices may inhibit social interaction skills by parents among ASD is not unusual as reported in Healthday (2013). This issue needs to be dealt with in ensuring the success of the multi-modal mind games being proposed. Face to face delivery thus is essential as that will eliminate parent's fears of the learning materials that are fully technology based. Furthermore, human interaction activities have been successful when properly designed implemented as found by Holladay. Again a multi-modal approach is supported here. The content specifics of the multi-modal mind games would also need to take into account the findings from previous studies such as the need for taking into account cultural context. Since the findings indicate that some parents and teachers have difficulty in using online facilities, careful considerations must be made as to the platform to be used for the tool stand alone or online.

### CONCLUSION

This study discusses the analysis phase of the course development for teaching social interaction skills among autistic children which is part of a larger study on the development of multi-modal mind games for enhancing social interaction skills of ASD. While, the literature supports the use of multi-modal communication tools among autistic learners; the findings from the needs analysis phase provides information on the feasibility of the proposed tool as well as give useful information for the design and content development of the tool. The successful development and application of the multi-modal mind games course materials is expected to be useful in promoting equity in opportunities among ASD and thus, improving quality of life and social economic development for people with autism.

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### REFERENCES

- Barakova, E., W.G. Van, L.R. Van and M. Menting, 2007. Using an emergent system concept in designing interactive games for autistic children. Proceedings of the 6th International Conference on Interaction design and children, June 06-08, 2007, ACM, Aalborg, Denmark, ISBN:978-1-59593-747-6, pp: 73-76.
- Battocchi, A., F. Pianesi, P. Venuti, S.A. Ben and E. Gal *et al.*, 2009. Collaborative puzzle game: Fostering collaboration in children with autistic spectrum disorder (ASD) and with typical development. Proceedings of the 2009 International Conference on Virtual Rehabilitation, June 29-July 2, 2009, IEEE, Trento, Italy, ISBN:978-1-4244-4188-4, pp: 204-204.
- Chaby, L., M. Chetouani, M. Plaza and D. Cohen, 2012. Exploring multimodal social-emotional behaviors in autism spectrum disorders: An interface between social signal processing and psychopathology. Proceedings of the 2012 International Conference on Privacy, Security, Risk and Trust (PASSAT) and Social Computing (SocialCom), September 3-5, 2012, IEEE, Paris, France, ISBN:978-1-4673-5638-1, pp: 950-954.
- Crane, L., S.E. Lind and D.M. Bowler, 2013. Remembering the past and imagining the future in autism spectrum disorder. *Memory*, 21: 157-166.
- Finkelstein, S.L., A. Nickel, L. Harrison, E.A. Suma and T. Barnes, 2009. Motion: A new game design to teach emotion recognition and programming logic to children using virtual humans. Proceedings of the VR 2009 IEEE Virtual Reality, March 14-18, 2009, IEEE, North Carolina, USA., ISBN:978-1-4244-3943-0, pp: 249-250.
- Grandin, T., 2015. Teaching tips for children and adults with autism. AbilityPath.Org, Clovis, California.
- Guldberg, K., P.K. Porayska, J. Good and B.W. Keay, 2010. ECHOES II: the creation of a technology enhanced learning environment for typically developing children and children on the autism spectrum. *J. Assistive Technol.*, 4: 49-53.
- Healthday, 2013. Smart technology may help kids with autism learn, communicate. Health Day, Norwalk, Connecticut.
- Jones, C.R., A. Pickles, M. Falcaro, A.J. Marsden and F. Happe *et al.*, 2011. A multimodal approach to emotion recognition ability in autism spectrum disorders. *J. Child Psychol. Psychiatry*, 52: 275-285.
- Kanaiaupuni, S., B. Ledward and U. Jensen, 2010. Culture-Based Education and its Relationship to Student Outcomes. Kamehameha Schools, Honolulu, Hawaii.
- UNICEF., 2013. Early Action. UNICEF, New York, USA.