



Examining Perception of Malaysian autistic children social interaction for Virtual Reality

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Abstract

This paper has reviewed the effect of Virtual Environments (VEs) in facilitating children affected by autism, in this context, extensive researches have been carried out by the researcher to review the significant works on the strategies employed to enhance the skills of autism children and help them to manage their day to day activities, including communication with their parents, brothers and sisters, teachers, as well as their friends. This study has identified that, the consequences of virtual environments applications are clearly witnessed on autism children. Basically, VE facilitates autism children to enhance their social skills, and to exhibit their inner thoughts. This paper also attempted to evaluate the autistic level of Malaysian children at NASOM Center and check whether they impaired in social interaction, based two instruments, observation and Q-chat questionnaire. Those children were analyzed for understanding on their favorite aspects such as, games, colors, shapes etc. Based on this understanding we have created an initial design of virtual system , including the favorite shapes, colors, 3-D Game, and used haptic (joystick), as interface, Apart from being practical, the system facilitated us in providing the much realistic experience in 3-D virtual environment, which will be incredibly valuable for autistic children.

Keyword: naturalistic inquiry observation, Q-CHAT, autistic children, social interaction, ASD, 3D Environment, Virtual Peers, visualization.

1. Introduction

The word autism originates from the Latin root “auto”, which means “self”. Later, Swiss psychiatrist Eugene Bleuler has modified the term, in order to demonstrate the self-centered thinking of adult patients who believe that everything in the world is centered about them. In line with Bleuler’s terminology, (Kanner, 1943) has adopted the term to characterize the children who shared similar characteristics including repetitive behaviour, emotional isolation, detachment from others (including their parents), self-centricity, and attachment to objects such as toys (Ritvo, 2006; Subramaniam, Ramachandran, Putit, & Raju 2020).

Autism Spectrum Disorder (ASD) is a neurodevelopmental disease that is specially characterized by impairments in social communication and social skills. ASD has a high prevalence in children, affecting 1 in 160 subjects. Virtual reality (VR) has emerged as an effective tool for intervention in the health field. Different recent papers have reviewed the VR-based treatments in ASD, but they have an important limitation because they only use clinical databases and do not include important technical indexes such as the Web of Science index or the Scimago Journal & Country Rank. To our knowledge, this is the first contribution that has carried out an evidence-based systematic review including both clinical and technical databases about the effectiveness of VR-based intervention in ASD. The initial search identified a total of 450 records. After the exclusion of the papers that are not studies, duplicated articles, and the screening of the abstract and full text, 31 articles met the PICO (Population, Intervention, Comparison and Outcomes) criteria and were selected for analysis. The studies examined suggest moderate evidence about the effectiveness of VR-based treatments in ASD. VR can add many advantages to the treatment of ASD symptomatology, but it is necessary to develop consistent validations in future studies to state that VR can effectively complement the traditional treatments (Mesa-Gresa et al., 2018; Gal et al., 2019; Mubin, Thiruchelvam, & Andrew 2020).



2. Literature review

Adults with high-functioning autism spectrum disorder (HFASD) are understudied within the literature, especially within the context of employment. Extant data, though limited, suggests competitive integrated employment rates which are significantly lower than neurotypical individuals. Researchers have suggested that one factor related to these low employment rates are limited interview skills demonstrated by individuals with HFASD. Additionally, individuals with HFASD tend to report lower levels of self-confidence and self-efficacy (SE), within the context of their ability to successfully pass a job interview. Benefits of employment for those with HFASD include a sense of purpose, independence, and social interaction, all of which improve wellness. To address these needs, a Virtual Reality Job Interview Training Program (VR-JIT) was implemented in an adult transition program to improve job interview skills. As such, this exploratory study examined pre-post changes in participants' SE and self-confidence specific to their perceived interview skills; VR-JIT was a viable method to improve confidence and skill with interviewing and may help improve vocational opportunities that are linked with wellness for those with HFASD (e.g., Najwani & Abdul (2010), Schmidt & Schmidt (2008), Merryman et.al,(2008), Robins & Dautenhahn (2004), Moore et.al,(2005), Gillette et.al,(2007), and Chamberlain (2009)).

Autism remains an enigma and it is one of the most complex disabilities. It is possible to nail down its causes in some cases. For example, quite a few rare genetic disorders and toxic exposures are known to cause autism, or "autism-like symptoms" that may be misdiagnosed as autism. Most cases of autism are considered "idiopathic," which means that, they have no known cause(s) (Stelios et.al, 2013; Hwa, & Peck 2020). However, in some cases, autism has a genetic basis and hence it is quite possible that, genetics are involved in all cases of autism. A number of earlier studies have showed many cases of "spontaneous" genetic mutation which are not inherited (Brašić et.al, 2007). Some other studies have shown that, parents, who hail from families with autistic members, are more likely to have autistic children than parents from families with no autism history; families with one autistic child are at increased risk of having more than one autistic child (Burgess et.al, 2007; Wan et.al, 2012; Mubin, Poh, Rohizan, Abidin, & Wei 2020).

An Australian psychiatrist Kanner(1943) is the pioneer to conduct research on autism, and has explained the diseases of autism in his research paper (Wing, 1996). Kanner has presented a comprehensive explanation about 11 children, whom shared several common features, and he classed those children having 'early infantile autism'. Similarly, Hans Asperger (1944) an Austrian paediatrician, discussed a condition, known as Asperger's syndrome (Wing, 1996). Furthermore, in his compilation Frith (2003) has included the English version of Asperger's original paper, named as 'Autistic psychopath' in childhood. Where, Asperger (1944, 1991) has investigated four children, who shared prevalent features, similar to those explained by Kanner(1943). Apart from the above, quite a number of scholars have conducted researches related to subgroups of autism relates (Wing et.al, 1971s; Cumine et al.,1998; Frith, 2003). These studies have identified Kanner's autism and Asperger's syndrome, as subgroups of autism, and recognized that autism is actually a spectrum of disorders (Wing, 1996). It is also proposed that, as a matter of fact, certain 'spectrum disorders' such as, Asperger's syndrome, share a lot of attributes found in the fundamental autism, however, they might not essentially connect with all the features (Peters et.al, 2012; Lamb 2020).

(Battocchi et.al,(2010);and Messer, (1994)) stated that The prevalent complications, which persons with autism encounter, are associated to the 'triad of impairments'. These complications are related with, disabilities in social interaction social interaction relationship, communication and imagination (Wing, 1996). Furthermore, many individuals with autism endure a strange sensitivity to neurological inciters, issues with attention span and motivation levels; and some individuals go through high levels of stress, along with specific fears (Wing, 1996).

Arshad et al., (2013) reviewed the effect of Virtual Environments (VEs) in facilitating children affected by autism, in this context, extensive researches have been carried out by the researcher to review the significant works on the strategies employed to enhance the skills of autism children and help them to manage their day to day activities, including communication with their parents, brothers and sisters, teachers, as



well as their friends. This study has identified that, the consequences of virtual environments applications are clearly witnessed on autism children. Basically, VE facilitates autism children to enhance their social skills, and to exhibit their inner thoughts. This paper also attempted to evaluate the autistic level of Malaysian children at NASOM Center and check whether they impaired in social interaction, based two instruments, observation and Q-chat questionnaire. Those children were analyzed for understanding on their favorite aspects such as, games, colors, shapes etc. Based on this understanding we have created an initial design of virtual system , including the favorite shapes,colors,3-D Game, and used haptic (joystick), as interface, Apart from being practical, the system facilitated us in providing the much realistic experience in 3-D virtual environment, which will be incredibly valuable for autistic children (Hoh 2018;Hasan, & Islam 2019) .

Mustafa et al., (2015) provides the Framework Methodology of the Autism Children -Vibratory Haptic Interface (AC-VHI) conducted on the mild autism children who have impairment in social interaction. This paper has exclusively explored problems faced by Malaysian autistic children in a National Autism Society at Kuala Lumpur, Malaysia. It also has been conducted at two locations: the classroom and the court of the National Autism Society in Malaysia (NASOM), Kuala Lumpur, Malaysia. The paper has sampled 20 children with mild autism, who have impairment in social interaction, based on the records of the National Autism Society of Malaysia. The sample collection method followed the purposive sampling approach, which is a form of non-probability sampling that allowed us to choose a case, because it illustrates some features or processes, in which we are interested. The framework included three main three process which are Process one, process Two and Process Three. This's three processes of the framework was suitable with the area of research and could to accomplish objectives of this research in helping the autism children to interact and communicate effectively with their families, friends and the broad community. The framework included three main three process which are Process one, process Two and Process Three. This's three processes of the framework was suitable with the area of research and could to accomplish objectives of this research in helping the autism children to interact and communicate effectively with their families, friends and the broad community (e.g., Deepa (2008) & Vetere et.al,(2005)). .

3. Problem Statement

There is no deficiency of literature on the haptic interface, which includes vibration, and that can be integrated in a virtual, 3-D environment, to help those children in tackling the social interaction problem but in Malaysia is still lacking in using haptic interface techniques which have vibration with 3D environment. The specialists are showing great interest in children with learning disabilities, which in fact include a wide spectrum of disability categories, because Autism Spectrum Disorder (ASD) is a neurodevelopment condition that has a prevalence of one in 110 children in the USA, and one in 625 children in Malaysia (Centre for Disease Control and Prevention, 2009; Dolah, *et.al*, 2011; Ghanouni *et al.*,2019).Children with autism are considered to be a heterogeneous group. These include mental retardation, specific learning disabilities such as, dyslexia and dyscalculia, emotional and behavioural disorders, which include autism and Attention Deficit Hyperactivity Disorder (ADHD).

Finally, despite the voluminous research on the techniques, which may help autistic children to manage their life smoothly (e.g.Motor Movement, 3D virtual learning environment (3D VLE), Virtual Peers (VPs), 3D generic virtual environment platform (Razali *et.al*,2010),Schmidt, *et.al*,2008), Merryman *et.al*, 2008), Robin *et.al*, (2004), Moore *et.al*, 2005), Gillette *et.al*, 2007), Chamberlain (2009), Ip *et la.*, 2018), the effectiveness of the existing techniques still needs to be improved, and the researchers have indicated that, the relationship between haptic interfaces has to be identified, which includes vibration on the disabled children such as, autism children, in order to enhance their skills, get the sense of innovation, or just feel relaxed (Bashiri, Ghazisaeedi, & Shahmoradi, 2017).

As mentioned above, the previous techniques still lack haptic interface, which includes vibration, and that can be integrated in a virtual, 3-D environment, to help those children in tackling the social interaction problem. Accordingly, a study, like the current one, which aims at developing a technique that employs a haptic device having vibration and that can be included in a virtual, 3-D environment to help autistic children, will be remarkably valuable. This idea has been stressed by many researchers (Deepa ,2008) and Vetere et.al, 2005)). Therefore, the current study contributes to



design and implement a new technique that integrates a haptic interface, having vibration into virtual, 3-D environment via a computer program. This technique will help autistic children to effectively interact and communicate with their families, friends, and the broad community. Consequently, the focus of the current study is autistic children and how to improve their social interaction capabilities, by using 3-D game and glasses; a screen supporting 3-D display with vibratory haptic interface, such as, joystick technique in particular.

4. Analysis for the Autism Children

This section shows the instruments used in this study in order to analysis the autism children who have the mild autism children and who have impairment in social interaction particular .These tools are very helpful to understand .Through the observation and questionnaire, we have understood the problems faced by those children such as impairment in social interaction relation, verbal and non-verbal communications and limited interest in activities and play in their daily life. However, we have focused on only one of those problems, which is impairment in social interaction among children with mild autism.

4.1 Observation Conducted on NASOM Center

Based on previous studies related to autistic children (e.g., Nilanjana & Anasuya,(2011); Tamela, (2011);CDCP,(2009a); Dolah *et.al*,2011),we have conducted a pragmatic observation at national autism society (NASOM) Center in Kuala Lumpur, Malaysia. The observation has revealed that, the children have mild autism and impaired in social interaction relationship; furthermore, we have also gained good knowledge about their favorites things and behaviors (i.e. games, colors, shapes). We have conducted the observations in the classrooms and the court of a national autism society (NASOM) in Kuala Lumpur, Malaysia. Social interaction indicates the involvement of an individual with other human beings in a reciprocal social way. It is a process, which “involves participants altering their behavior to adapt to the activities of a partner, and in doing this a coherent sequence of activities is created” (Messer, 1994). Wing & Gould (1979) have identified that, 21.2 cases of every 10,000 children under the age of 15 in London are impaired with social relationships. Furthermore, Waterhouse & Fein (1997) have stated that, individuals with neurological impairment, as in the case of individuals with autism, will face challenges in developing social relationships and interacting with other people.

As a matter of fact, autism which affects, imagination, understanding and attention, is not just a single disorder, with a well-defined set of symptoms; rather it is a broad spectrum of disorders, which ranges from mild to severe complications. Furthermore, the abnormal behavior occurs in many different situations, and is persistently inappropriate for their age. Based on the observation conducted in the NASOM center and the diagnosis criteria of qualitative impairment in social interaction, the table below illustrates that many studies have considered impairment of social interaction as the core deficit of autism by (Mundy *et.al*, 1994; Kanner, 1943; Travis & Sigman, 1998) (Constantino & Todd, 2003), (American Psychiatric Association, 2000); the table also shown the seven cases of mild autism children, who have impairment in social interaction. Based on the table we have concluded that, the investigated children have low to mild level of impairment in social interaction; hence they can e considered as suitable samples for this study.

Table 1Summary of the results of observation which conducted on NASOM Center, which indicated to those children mild autism and have impairment in social interaction between medium and low.



			1. Autism Children			2. Autism Children			3. Autism Children			4. Autism Children			5. Autism Children			6. Autism Children			7. Autism Children					
			(A)			(B)			(C)			(D)			(E)			(F)			(G)					
			H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L	H	M	L
Main problem (impairment in social interaction)	Deficits in Nonverbal Behaviors	eye-to-eye gaze	√				√				√			√			√			√			√			√
		facial expression	√			√			√			√			√			√			√			√		
		gestures to regulate social interaction		√		√			√			√			√			√			√			√		
	Failure To Develop Peer Relationships Appropriate To Developmental Level		√			√			√			√			√			√			√			√		
	lack of spontaneous seeking to share enjoyment and interests (e.g., by a lack of showing, bringing, or pointing out objects of interest),		√				√		√			√			√			√			√			√		
Lack of social or emotional reciprocity		√				√			√		√			√			√			√			√			

Table 1: Summary of the Results of Observation

And in this table: 2 shows Summary of environmental data collected from A naturalistic inquiry of observation.

No of Participant	Time of Day	No of autistic children	Most common activity
1.	Morning-noon	11	Failure To Develop Peer Relationships Appropriate To Developmental Level
2.	Morning-noon	9	Lack in eye contact.
3.	Morning-noon	10	lack of social or emotional reciprocity
4.	Morning-noon	14	Failure To Develop Peer Relationships Appropriate To Developmental Level
5.	Morning-noon	10	lack of social or emotional reciprocity
6.	Morning-noon	13	facial expression- gestures to regulate social interaction
7.	Morning-noon	11	facial expression- gestures to regulate social interaction

Table 2: Summary of environmental data collected from a naturalistic inquiry of observation

4.2 Analysis Questionnaire for the Autism Children

This study has employed Q-CHAT, which was adapted from Allison *et.al*, (2008), to collect the data from the teachers of autistic children. Specifically; we have adopted first eight questions out of the twenty-five questions, as these questions are considered more appropriate to this present research. However, we have added three additional questions, to the eight selected questions, to investigate whether the autistic children feel comfortable when using haptic interface, and to identify the favorite colors for the autistic child, and if they prefer to play alone or with others. The Q-CHAT instrument was employed to achieve the purposes mentioned in study. It is noteworthy that, adopting the Q-CHAT instrument was based on the pragmatic data that were gathered in this study. A pragmatic inquiry of observation suggests that, control changes the process of inquiry and the social context of human communication



influences, what and how things and relationships occur. This theme of research is interested in studying people in the situations, where they usually interact, behaving as they customarily do when engaged in their everyday activities, without interfering in (or controlling) what they say or do (Volkmar *et.al*, 2005).

Results of the questionnaire analysis designed for the teachers of autistic children, are presented according to frequency. For example, for the questions one to four, majority of teachers have responded as “sometimes”, 42%, 50%, 50%, and 58%, respectively. Specifically, for question 4, which asked if autistic children are capable of pointing to what they need (e.g., toy that is out of reach), seven out of twelve teachers have answered “sometimes”. A histogram depicting the frequencies of answers to questions 1-4 is shown in Figure 3.3. The four questions were: (i) Does the autistic child look at you, when you call his/her name? (ii) To what extent does the autistic child practice eye contact with you? (iii) Can you easily understand the speech of autistic children? and (iv) does the autistic child point to indicate that he/she wants something(e.g., a toy that is out of reach)?

The results presented in this histogram show that, the sample children are more likely to be mild autism than severe autism. Accordingly, the opportunity for improving their social interaction is highly expected.

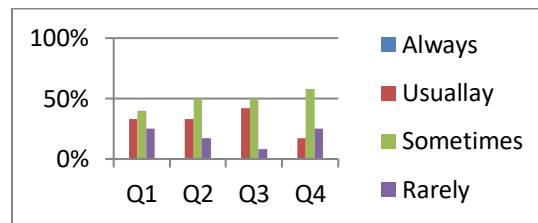


Figure 3.3 A histogram depicting the frequencies of answers to questions 1-4 of the Q-CHAT instrument

After that, results of the analysis of the questionnaire designed for the teachers of autistic children are presented, according to frequency. For example, in the case of questions five and six, the most frequent answer was “a few times a week”, with frequencies of approximately 50% and 59%, respectively. These two questions were: (i) does the autistic child point to share interest with you?(e.g., pointing at something interesting), and (ii) how long the interest of autistic child can be maintained by a spinning object (e.g., washing machine, electric fan, toy car wheels, etc.)?

Seven out of twelve teachers have provided the answer “a few times a week” for question number six. Figure 3.4 is a histogram of the teachers’ feedback on these two questions. This histogram also indicates that, the sample children are more likely to have mild than severe autism with substantial impairment in their social interaction, and consequently these children fail in developing peer relationships, appropriate to their developmental levels.

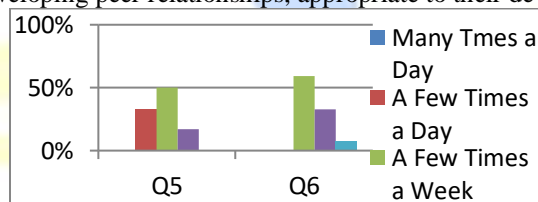


Figure 3.4 A histogram of the teachers' feedback questions 5 and 6 of the Q-CHAT instrument

In the case of questions seven and eight, the response of “half an hour”, was the most frequent answer; almost 67% and 59%, respectively. The two questions were: (i) how quickly the autistic child responses when asked to do something? (ii) to what extent does the autistic child keep motivated (e.g., with games)?

In question seven specifically, eight out of twelve teachers answered “half an hour” when questioned “how quickly the autistic child responses, when asked to do something?” Figure 3.5 is a histogram of the teachers’ feedback on these two questions. This histogram also indicates that, the sample children are more likely to have mild autism. These

children struggled to interact with their peers, and thus experienced difficulties in constructing successful relationships.

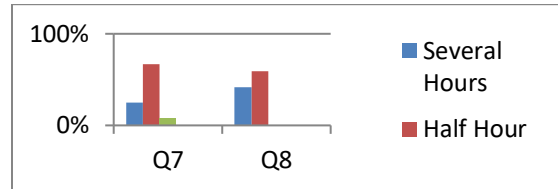


Figure 3.5 A histogram of teachers’ feedback on these questions 7 and 8 of the Q-CHAT instrument

For the question nine; “Does the autistic child feel comfortable when he/she catch vibration haptic interface (joystick)?”, 75% of the teachers have responded as “yes”; and, approximately nine out of twelve teachers, answered “yes” , for the question “Do you think that, an autistic child feels comfortable when wearing haptic interface (joystick)?”.

The figure 3.6 illustrates the histogram of the teachers’ responses to question nine, which indicates that, those children were willing to use haptic interface (joystick) without hesitation, as this haptic device, besides being practical, helped in bringing much realistic the sensation . Moreover, the wearable devices are beneficial as they help the autistic children to be mentally and physically comfortable, while allowing them to enhance their innovative skills, and ultimately relieving body pain and stress (Deepa, 2008). The haptic interface has been part of the equipment used in the development of a wide range of virtual reality devices. It functions with a mechanism resembling the human hand, which makes it easy for the users, as they will be able to easily move their fingers. In the meantime, it is also equipped with electronic wiring and devices that help in stimulating sensation, while allowing electronic image interface (Malcolm, 2008).

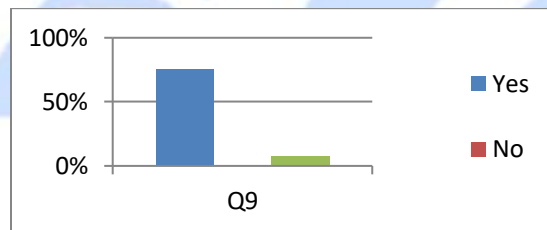


Figure 3.6 A histogram of the teachers’ responses to question nine of questionnaire

In case of question 10; “What are the favourite colours for the autistic child?” 75% of the teachers have responded as “yes”; and nine out of twelve teachers, have answered “yes”, when asked “Do you think that colors are important in the daily lives of autistic children?”

Figure 3.7 is a histogram of the frequency of responses to question ten. It indicates that, the importance of colours in decorating the autistic child’s room, or when creating games. It is crucial to choose the appropriate colours, which will excite the children, despite the difficulty in doing so. Therefore, it is essential for the caretakers to be equipped with the knowledge of the varying colours, and their impacts on the children’s psychology. The language of colors can be used as a tool for communication with the children, who are fond of colours, and who positively respond to varying colour palettes. Children at the early age of six months are able to learn and distinguish the colors much more quickly, as toddlers will reach out for attractive and eye-catching colours upon seeing them. It has been shown that, red is the most attractive colour for children, followed by the yellow, blue, green, and orange colours. However, when girls grow-up, they tend to develop preference for the violet, pink, and lavender colours; while boys prefer darker colours such as, blue, brown, and black (Manasi, 2011).

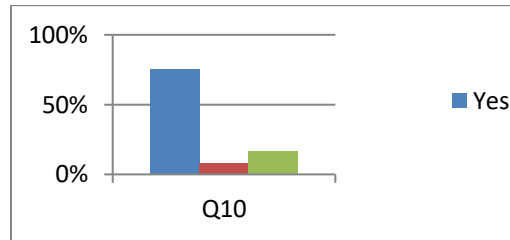


Figure 3.7 A histogram of the frequency of responses to question 10 of questionnaire

• **Elaboration on Colors with normal children and autism children:**

- i. White: Symbolizes, joy, peace, and purity
- ii. Yellow: Soothes the nerves, by providing a calming effect. It is also capable of stimulating muscle activities.
- iii. Blue: Signifies, confidence, peace, and wisdom. It helps in calming the nerves of children, as well as providing them with good night sleep.
- iv. Green: Signifies, refreshment, which helps to reinforce self-esteem and hope. It is suitable for overcoming depression and low self-esteem in children.
- v. Red: An attractive colour that signifies passion and desire, and ignites excitement in children.
- vi. Purple: The dark shade of purple signifies power, luxury, and royalty; while, the light shades, such as violet and lavender, provide a peaceful atmosphere, as well as help in soothing the nerves. The dark shades of purple are believed to evoke frustration and sadness in children; hence, they are cautiously avoided among children.

Regarding question 11 (What is the favourite place that seems to be comfortable for playing and enjoyment?), for which, 75% of the respondents have replied that the children tend to play “Alone”; furthermore, nine out of twelve teachers, have answered “Alone”, when asked “Does the autistic child play alone or with others?”

Figure 3.8 illustrates histogram of the teachers’ feedback for question 11, which indicates that, young children diagnosed with autism are frequently described as independent, as they seek little assistance in difficult situations. For instance, a young child may refuse to point at the desired toy, but will weep or make effort to obtain the object himself. The child may also be observed to isolate himself, rather than to play with others.

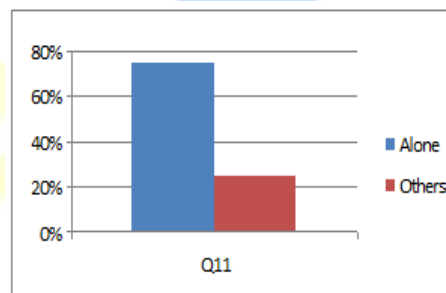


Figure 3.8 A histogram of teachers’ feedback on question 11 of questionnaire

Children may display affectionate signs such as hugging and kissing, but lack reciprocal quality. The autistic children tend to create anxiety, tantrums and aggression, if they are exposed to an unfamiliar situation or encountering strangers (Lord & Spence, 2006). Moreover, autistic children might find large group activities, such as play groups to



be overwhelming, hence they get discomfort feeling. Elderly autistic children may face difficulties in building relationships with their peers, due to lack of social skills, as they tend to be shy and hide/stay away. Autistic children may also prefer to participate in cooperative games, especially sports or other demanding activities, due to their limited motor skills. Hence, they are commonly labeled as ‘bench warmer’ in schools, due to their clumsy and restricted motor skills (Lord & Spence, 2006; Cotugno, 2009).

Precisely, his questionnaire conducted at national autism society (NASOM), Kuala Lumpur, Malaysia, shows that the children have mild autism, and have impairment in social interaction, and in addition it also indicates the importance of colors in decorating the autistic child’s room, or when creating games. Autistic children may also prefer to participate in cooperative games, but it will be a bit difficult. Furthermore, the outcome of the questionnaire has also indicated that, those children were willing to use haptic interface (joystick) without hesitation, as this haptic interface, besides being practical, has helped in bringing much realistic sensation.

5. Major Contribution

A number of relevant issues that require the use of suitable Examining Perception of Malaysian autistic children social interaction for Virtual Reality on their daily life have been highlighted and discussed in this study, the input of which is threefold:

- to the ongoing debate on the factors that Examining Perception of Malaysian autistic children social interaction for Virtual Reality on their daily life in developing countries;
- to the knowledge concerning the benefits and conditions for the Virtual reality intention of autism; and
- A study on how these factors will prepare autism children for using VR intention of Malaysian autism.

One of the main inputs of this study is the examination of the factors that Examining Perception of Malaysian autistic children social interaction for Virtual Reality on their daily life in developing countries. Additionally, In this case, the model for this research is the questionnaire analysis, Q-CHAT was adapted from the study by Allison et al. (2008). They collected data from the teachers of autistic children through the use of questionnaire. The questionnaire involved two main components: social interaction and social communication. Specifically, we adopted eight (8) out of twenty-five (25) questions or items in the



questionnaire. These are questions numbered one (1) to eight (8) in Appendix D. However, three questions were added to the eight selected questions in the current study. These are questions 9, 10 and 11. The main goal of the questionnaire was to determine if autistic children feel comfortable when using haptic and non-verbal interfaces such as joysticks, to ascertain their favourite colours and to determine if they prefer to play alone or with others.

5.1 Contributions to knowledge

The contribution of this study to the field of Virtual reality is significant and innovative. At a fundamental level, providing the theoretical knowledge to promote Virtual reality, such as the proposed model, was the focus of this study. Distinctive and noteworthy concerns that are important in strengthening the Virtual reality intention of students is highlighted. For instance, achieved an overall understanding of the field of Virtual reality in Malaysia as well as identified Findings will indicate how the children interacted humorously and how they developed and improved the problem of social reaction among autistic children. That was achieved by way of understanding aspects such as: (i) direct environment (sound, light, temperature and design). (ii) Private excitement (motivation, persistence, responsibility, and the need for flexibility); (iii) physiological needs (entity, competitor, peers, and adults); (iv) physical needs (sensual power, comprehension, time, and mobility).

5.2 Model contribution and Research outcome

This study focuses on the Examining Perception of Malaysian autistic children social interaction for Virtual Reality as a major contribution to Virtual Reality. The Perception of Malaysian autistic children social interaction grants uniformity for improved efficiency in adopted ideas of virtual reality that inevitably experience many challenges. After implementation, testing of the proof-of-concept and evaluation of the model, it was found that



demand for the study on the Perception of Malaysian autistic children social interaction for Virtual Reality exists.

6. Conclusion

Finally, despite the huge volume of researches have been conducted on the techniques, which may help the autistic children to smoothly manage in life, such as, Motor Movement, 3D virtual learning environment (3D VLE), Virtual Peers (VPs), 3D generic virtual environment platform, the effectiveness of the existing techniques still needs to be improved. The above mentioned techniques had not included a haptic interface with having vibration, which can be integrated in a virtual, 3-D environment, to help those children in tackling the social interaction problem. Consequently, this current study had aimed at developing a Haptic Interface Technique for 3-D environment sessions with 3-D sonic game, which employs a vibrating haptic device, and can be included in a virtual, 3-D environment, to be remarkably valuable for autistic children. This idea has been stressed by many researchers.

Based on the observation, questionnaire conducted at national autism society (NASOM), Kuala Lumpur, Malaysia, and the findings of literature review, the researchers had identified that, impairment in social interaction is considered as one of the main problems faced by autistic children in their daily life, in addition, these children have mild autism, furthermore, we had gained knowledge regarding the favorite things of autistic children (such as, games, colours, shapes), which facilitated in creating initial design, which includes favorites shapes, colors, and 3-D Game.

Results of observational checklist and questionnaire were based on data provided by the teachers, as on their response to the questionnaire supported and matched the researcher's findings of the observations. Based on the data obtained from the instruments used (observational checklist and questionnaire), the researchers were able to understand the autistic children's real impairments in social interaction, which was considered as one of the main problems of autistic children. Obtaining there information was crucial in order to help autistic children improve their social interaction.

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