_____

Designing Factors to Improve Verbal Ability among Children with Autism in Subang Jaya, Malaysia

Asiehsadat Hosseinioun[1] and Shahrizal Mohd Dolah[2]
Faculty of Design and Architecture, University Putra Malaysia
Jalan University 1 Serdang, 43400 Seri Kembangan, Selangor, Malaysia
asieh.6919@gmail.com

Abstract

This study analyzed the knowledge and implementation of a suitable approach for children with autism to improve their language delay and speech problem, which is related to communication and behavior patterns. It aimed to improve kids with autism who has speech difficulty by proposing the idea of a new device to increase their communication, social skills, and behavior pattern. Thus, it identified a current method to practice speaking with kids to improve the ability to talk, and besides that, to increase the patterns of behavior. Based on the theory of mind which shows how a mind can control a specific subject and part a conceptual framework had been suggested. The research used observation, and survey methods to evaluate the findings. The result is the impaired a kid with mild autism's ability to communicate and social skills. Thus, it shows the advantage of talking to others and increases the ability to communicate by user experience.

Keywords: Autism, Communication, Device.

Introduction

Education is one of the essential tools for all aspects of life. Every day, everybody uses their experience mixed with knowledge which comes from education and learning to leave better and have a wonderful life. How to speak, how to take someone's attention, how to show our work, etc. are the first, small, and easy communication methods that everybody uses for daily life but imagine someone without any of this knowledge. It means that if someone does not know or doesn't learn how to start a small conversation and take attention, probably will face some difficulty in life. Kids with autism can be one of these groups of people. Autism is a life-long developmental disability. Recent trends in autism show that children with autism spectrum show setbacks in the development of this capability, with a knock at the implications for cognitive empathy throughout the lifespan (Klin et al., 2003; Robertson & Baron-Cohen, 2017; Rosenfield et al., 2019; Thompson et al., 2017). Autistic people show up differences in their social communication, social interactions, sensory sensitivities, with limited and repetitive concerns and behaviors (Cage et al., 2018).

Comprehensive or understandable communication assessment and intervention as a useful educational program can be helpful not only for children with autism but to other developmental disorders and those who have lack speaking and social interaction. This issue can be the lack of speaking with they don't know how to talk, so they don't know how to ask. It seems like they understand what the structures are, but they usually forget the steps, and as a result, they cannot finish the task. Typically involves assessment by a speech and language pathologist as well as informal observation and classroom-based evaluation (Bottema-Beutel et al., 2021).

Autism Spectrum Disorder (ASD) is explaining important and essential standards and criteria. The first one is the deficit in social communication and interaction in a way that led the person to isolate from the different areas, and the second one has repeated some patterns of behavior and activities such as repeating the same sentences over and over or moving hands in the same patterns and figures. To identify someone as ASD, these two criteria must be present in him (Olusanya et al., 2018; Tseng et al., 2016; Wing, 1993). Deficits or insufficient non-verbal social

behaviors, as well as lack of eye contact or eye gaze at the other objects during the conversations which shows lack of attention, are the first noticeable disorders particularly in ASD (Simon Baron-Cohen, 1992; Simon Baron-Cohen et al., 1997). It is because in the different social functions eye contact may serve and evolving this necessary behavior may have significant implications for children with autism (Livingston et al., 2019).

The best option or equipment that can use for kids with autism, or any language and speech delay is Speech Generating Devices (SGD) (DM Kagohara, 2010; Harris, 2015). Speech Generating Devices or SGD are portable electronic devices used to teach learners communication skills and provide assistance of communication (Meer & Rispoli, 2010). SGDs can make a digital speech or talk as the user. SGDs are using graphic symbols as well as alphabet keys to make a conversation or sentences for the user (Kander, 2013). Any different group age of people can use SGDs from early childhood through high school with children and adolescents with autism spectrum disorders who have limited or no verbal speech (N Trottier, 2011). SGDs are portable devices that allow a parent, teachers, or caregiver to program the specific vocabularies for the child with an autism spectrum disorder (Olusanya et al., 2018). The goal areas are demonstrating positive outcomes in communication and social (Livingston et al., 2019).

However, only a few researchers have recently attempted to condition the response of the communication partner as a reinforcer for social behavior and thereby arrange the conditions under which typical children develop social responses (Carbone et al., 2012; Thompson et al., 2017).

Plays, toys, and games have an essential value and place in every child's life, and play is an important job for all children. Children with autism can understand the real world better by playing. They can try different social and communication roles during playing the games. They can learn how to have eye contact while they have a conversation with others, how to take a turn, and how to contribute in different communications (Önder, 2018). Suitable and significant games can help parents or caregivers to give them ideas to engage with children, evaluate social interaction, and challenge the critical development of the brain at an early age. Lack of appropriate games can cause difficulty in this evaluation especially for children with autism who need more these types of activities (Healey et al., 2019; Liu et al., 2017).

This research aimed to investigate the factors of a suitable device to develop communication skills in children with Autism. In this way, in proposed a conceptual framework and evaluate the finding in mixed methodology by using observation and survey instruments which will discuss in follow (Pagani et al., 2010).

Methodology

This study used the mixed method which is both quantitative and qualitative methods. The observation method had been used for the qualitative approach and a survey had been conducted for the quantitative methodology.

Observation is a method that the researcher used by observing 33 children with autism during the learner and gathering her information in this field. She collected her data based on the observation of 33 children in a small institution in Malaysia. The observation reports had been

checked daily by the psychologist to ensure the accuracy of the contents and followed all the related ethical concerns about the children.

The survey had been conducted by parents, teachers, and caregivers of children with autism outside of the organizations. This research has collected data first for the pilot study to evaluate the reliability and validity of the questionnaire and then for final analysis and research evaluation. In the pilot test data collection, this study collected data from 10 participates to evaluate the survey questions (Canault et al., 2015).

According to The National Autism Society of Malaysia (NASOM) which is a government organization, the population of children under age 12 years old in 2018 was 4851 in Malaysia. Based on this population the research used the (Krejcie & Morgan, 2016) formula to calculate the research sample size. The final result revealed that 72 respondents are needed for the sample size and data collection.

A questionnaire had been developed to analyze and evaluate the conceptual framework. In this way, a survey had been designed in six sections based on respondents' background and conceptual frameworks factors. In the first session, Demographic Profile, the background of the respondents includes family and child conditions had been collected. These questions, the identity of the children and their families is preserved and the answers to the questions are completely and confidentially protected. In the next five-section, questions cover the conceptual framework factors, and answers should be chosen from, Never (value 1), Rarely (value 2), Sometimes (value 3), Often (value 4), and Very Often (value 5). To evaluate the reliability of the questionnaire, the pilot study had been conducted with 10 participates.

The pilot test had been conducted to evaluate the relativity of the designed questionnaire to the conceptual framework and assess the survey's question's reliability and validity to evaluate the consistency of the questionnaire items and ensure it is error-free (Sekaran & Bougie, 2010). This research has collected and analyzed the 10 participants' answers to the survey and based on the reliability test modify the questionnaire to actual data collection. The Cronbach alpha coefficient for the internal consistency reliability test had been used to evaluate the questionnaire.

Based on Cronbach's alpha high level of reliability should have Cronbach's alpha value results greater than 0.7, and value results in less than 0.3 means the reliability level is low and should remove. Table I represents the result reliability test for the research survey and as the result represented is satisfied the level of reliability.

Based on the result of a pilot study the final data collection had been conducted and the answer of 75 respondents had been sent for analysis which its result represented in the next session.

Table I. Cronbach's alpha results of the pilot test (n=10)

Constructs	Items	Mean	Std. Deviation	Cronbach's Alpha for Construct
Consonant Vowel Consonant	CVC-1	2.3	1.15950	0.788
	CVC-2	2.5	1.08012	
	CVC-3	2.7	0.67495	
	CVC-4	2.2	0.63246	

	CVC-5	2.5	0.84984	
Game	G-1	2.6	1.26491	0.751
	G-2	3.0	1.15470	
	G-3	2.5	0.97183	
	G-4	2.6	1.34990	
	G-5	2.5	1.17851	
	G-6	2.5	0.52705	
Musical Interaction	MI-1	3.3	1.25167	0.769
	MI-2	3.2	0.91894	
	MI-3	3.9	0.73786	
	MI-4	3.5	1.35401	
	MI-5	3.9	0.87560	
Interaction Conversation	IC-1	2.5	0.84984	0.909
	IC-2	2.6	1.07497	
	IC-3	3.0	0.81650	
	IC-4	2.7	0.82327	
	IC-5	1.7	0.82327	
	IC-6	1.6	0.84327	
Electronic Devices	ED-1	3.3	1.56702	0.830
	ED-2	3.3	1.05935	
	ED-3	3.2	0.78881	
	ED-4	3.6	0.51640	
	ED-5	4.2	0.78881	

Results and Discussion

Based on the research the population of children with autism is increasing every day, and the number of boys who have been diagnosed with ASD is more than girls. The cost of this disorder treatment is also too high, and insurance was not covered fully (Parisi et al., n.d.; T Buie, 2010). Besides that, symptoms of autism have included avoiding eye contact, repetitive behaviors, and pattern, lack of interest in speaking, lack of social interaction, and weakness in having attention (A Ana-Maria, 2018; Kamaralzaman et al., 2018).

On the other hand lack of suitable devices makes the situation harder for these kids. There are different devices as Speech Generation Devices which are used for children and people who don't have the ability to specking and have physical disorders (Bottema-Beutel et al., 2021). But there is no appropriate and affordable device or gadget to help these children to improve and increase their weaknesses (Ellawadi & Weismer, 2015).

Also, the Theory of mind has supported this study that children with autism spectrum experience different degrees of mental theory disorder, and therefore need to be correct and reinforced (Fischer et al., 2017; Fox et al., 2021). This ability is manifested in the first years of children's lives and develops around the age of 2.5 to 4.5 years (Henry et al., 2013; Livingston et al., 2019). This mental ability not only predicts behavioral goals, but also includes deep mental states

such as thinking, believing, knowing, dreaming, and so on. With this ability, we can describe and predict the social behaviors of others (S Baron-Cohen, 2002; Hadwin et al., 1997).

Based on the research conceptual framework had been developed as illustrated in Figure I which defines the relevant factors that affect communication and social skills of children with autism who have difficulty talking and their relationships. These factors are consonant vowel consonant (CVC) vocabularies, Games, Music (song), and short conversations (Canault et al., 2015).
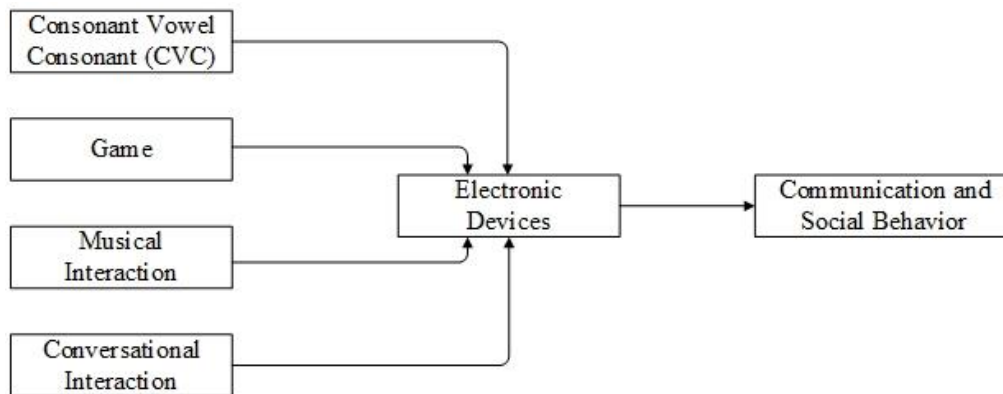

Figure I. Conceptual Framework

The first factor is consonant vowel consonant (CVC) words in communication. According to Katie Marie Heines, CVCs have effective methods of teaching children with ASD to tact phonemes (Haines, 2016). Also, Helen Tager-Flusberg mentioned that CVCs can offer the set of essential and recommended measures that be used for evaluating and practicing interventions that target spoken language to help the children to pronounce the words correctly, learn the names of the different objects, and memorize or understand the related objects (Tager-Flusberg et al., 2009). Games are having an essential part in this framework as the second factor. Different types of games related to CV vocabularies to explain if children with ASD can learn and understand the names of different shapes, objects, and pictures after they were a different way of practicing. Luis Antonio claimed that if parents presented the objects and names of them without any specific behavior in the area of games, it will ease the learning process of children with autism (Carnerero & Pérez-González, 2014; Milteer et al., 2012). One of the factors of this study was to increase social interaction by the effect of music and song texts to teach emotional understand and improve the speech to children with autism (Katagiri, 2009). According to Kate Simpson, this study can determine the evidence base for the use and benefits of music as an intervention for ASD children. Successful conversation requires that the speaker's behavior is sensitive to non-vocals listener responses. These are conversational ability, in particular the ability to expand on conversation, and the use of mental state terms in speech (D Achmadi, 2012; N Trottier, 2011). Results showed that no discernible improvement was seen on either measure of communication following mental state teaching. Discussion centers on real versus superficial changes in understanding mental states because of teaching (Peters & Thompson, 2015). Children with Autism Spectrum Disorder (ASD) are known to have difficulty in social communication, with research indicating that children with ASD fail to develop functional speech (N Trottier, 2011; Wiles Higdon & Hill, 2015). Over the years several Augmented and Alternative Communication (AAC) devices have been used with children with ASD to overcome this

barrier and to facilitate communication. According to Sulata Ajit Sankardas that small-scale electronic devices such as iPad, tablets, and mobile phones which design for ASD more effectively than pen and paper(Sankardas & Rajanahally, 2017).

Based on the analysis result, in the preschool years, play is the leading source of development. Through play, children learn and practice many necessary social skills. They develop a sense of self, learn to interact with other children, how to make friends, how to lie, and how to role-play. As a child grows, the way he plays will change if he'll get more creative and experiment more with toys, games, and ideas. It might mean he needs more space and time to play. Research shows that children learn through play. Children use the first-hand experiences they have had in life during the game and they keep control as they play (Hassani et al., 2020; Hastings et al., 2009). The game does not bow to pressure to conform to external rules, outcomes, targets, or adult-led projects. It is intrinsically motivating and spontaneous and children rehearse their possible futures in their play The game has the potential to take children into a world of pretend, beyond the here and now, in the past, present, and future, and it transforms them into different characters. In the play, children try out their recent learning, mastery, competence, and skills, and consolidate them (Chaffey et al., 2018; Howarth et al., 2015). Play makes children into whole people, able to keep balancing their lives in a fast-changing world (Ellawadi & Weismer, 2015; M Aragon, 2012).

Conclusion

Comprehensive or understandable communication assessment and intervention as a useful educational program can be helpful not only for children with autism but to other developmental disorders and those who have lack speaking and social interaction. This issue can be the lack of speaking with they don't know how to talk, so they don't know how to ask. It seems like they understand what the structures are, but they usually forget the steps, and as a result, they cannot finish the task. This research analyzed the factor suitable device to improve verbal ability in children with autism. It evaluates its result by using mixed methods and observation and survey instruments. However this study was focused only on children with autism and in the mild case, so factor impact communication device has the potential to analyze for the children with other types of disorder with verbal disfunction.

Acknowledgments

References

A Ana-Maria, E. I.-S. (2018). Studies concerning the importance of physical exercise in prevention and treatment the obesity in children with ASD. *Journal of Physical Education and Sport*, *18*(Supplement 5), 2143–2146. https://doi.org/10.7752/jpes.2018.s5324

Baron-Cohen, S. (2002). The extreme male brain theory of autism. *Trends Cogn Sci.*, *6*(6), 248–254. https://doi.org/10.1016/s1364-6613(02)01904-6

Baron-Cohen, Simon. (1992). Out of Sight or Out of Mind? Another Look at Deception in Autism.

_____

Journal of Child Psychology and Psychiatry, *33*(7), 1141–1155. https://doi.org/10.1111/J.1469-7610.1992.TB00934.X

Baron-Cohen, Simon, Jolliffe, T., Mortimore, C., & Robertson, M. (1997). Another advanced test of theory of mind: Evidence from very high functioning adults with autism or Asperger syndrome. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *38*(7), 813–822. https://doi.org/10.1111/J.1469-7610.1997.TB01599.X

Bottema-Beutel, K., Kapp, S. K., Lester, J. N., Sasson, N. J., & Hand, B. N. (2021). Avoiding Ableist Language: Suggestions for Autism Researchers. *Https://Home.Liebertpub.Com/Aut*, *3*(1), 18–29. https://doi.org/10.1089/AUT.2020.0014

Cage, E., Di Monaco, J., & Newell, V. (2018). Experiences of autism acceptance and mental health in autistic adults. *Journal of Autism and Developmental Disorders*, *48*(2), 473–484.

Canault, M., Le Normand, M.-T., Foudil, S., Loundon, N., & Thai-Van, H. (2015). Reliability of the Language ENvironment Analysis system (LENA™) in European French. *Behavior Research Methods 2015 48:3*, *48*(3), 1109–1124. https://doi.org/10.3758/S13428-015-0634-8

Carbone, P. S., Murphy, N. A., Norlin, C., Azor, V., Sheng, X., & Young, P. C. (2012). Parent and Pediatrician Perspectives Regarding the Primary Care of Children with Autism Spectrum Disorders. *Journal of Autism and Developmental Disorders 2012 43:4*, *43*(4), 964–972. https://doi.org/10.1007/S10803-012-1640-7

Carnerero, J. J., & Pérez-González, L. A. (2014). Induction of naming after observing visual stimuli and their names in children with autism. *Research in Developmental Disabilities*, *35*(10), 2514–2526. https://doi.org/10.1016/J.RIDD.2014.06.004

Chaffey, T., Kim, H., Nobrega, E., Lubold, N., & Pon-Barry, H. (2018). Dyadic Stance in Natural Language Communication with a Teachable Robot. *ACM/IEEE International Conference on Human-Robot Interaction*, 85–86. https://doi.org/10.1145/3173386.3176979

D Achmadi, D. K. L. M. M. O. G. L. D. S. (2012). Teaching advanced operation of an iPod-based speech-generating device to two students with autism spectrum disorders. *Research in Autism Spectrum Disorders*, *6*(4), 1258–1264. https://doi.org/10.1016/j.rasd.2012.05.005

DM Kagohara, L. M. D. A. V. G. M. O. A. M. (2010). Behavioral intervention promotes successful use of an iPod-based communication device by an adolescent with autism. *Clinical Case Studies*, *9*(5), 328–338. https://doi.org/10.1177/1534650110379633

Ellawadi, A. B., & Weismer, S. E. (2015). Using spoken language benchmarks to characterize the expressive language skills of young children with autism spectrum disorders. *American Journal of Speech-Language Pathology*, *24*(4), 696–707. https://doi.org/10.1044/2015_AJSLP-14-0190

Fischer, A. L., Rourke, N. O., & Thornton, W. L. (2017). Age differences in cognitive and affective theory of mind : Concurrent contributions of neurocognitive performance, sex, and pulse pressure. *Journals of Gerontology: Psychological Sciences*, *72*(1), 71–81. https://doi.org/10.1093/geronb/gbw088

Fox, E., Economos, A., & Potvin, N. (2021). Assessment and Clinical Decision-Making During

Imminent Death in Hospice Music Therapy. *Journal of Music Therapy*. https://doi.org/10.1093/JMT/THAB016

Hadwin, J., Baron-Cohen, S., Howlin, P., & Hill, K. (1997). Does Teaching Theory of Mind Have an Effect on the Ability to Develop Conversation in Children with Autism? *Journal of Autism and Developmental Disorders 1997 27:5*, *27*(5), 519–537. https://doi.org/10.1023/A:1025826009731

Haines, K. (2016). Using discrete trial training with progressive time delay prompting to teach children with autism spectrum disorder to tact phonemes. *Theses: Doctorates and Masters*. https://ro.ecu.edu.au/theses/2077

Harris, O. (2015). A Cultural Bases to Develop Strong Advocates for Client and Family Involvement In the Speech-Generated Device Evaluation and Funding Process. *Perspectives on Augmentative and Alternative Communication*, *24*(4), 142–146. https://doi.org/10.1044/aac24.4.142

Hassani, F., Shahrbanian, S., Shahidi, S. H., & Sheikh, M. (2020). Playing games can improve physical performance in children with autism. *International Journal of Developmental Disabilities*. https://doi.org/10.1080/20473869.2020.1752995

Hastings, E. C., Karas, T. L., Winsler, A., Way, E., Madigan, A., & Tyler, S. (2009). Young children's video/computer game use: Relations with school performance and behavior. *Issues in Mental Health Nursing*, *30*(10), 638–649.

Healey, A., Mendelsohn, A., & CHILDHOOD, C. O. E. (2019). Selecting Appropriate Toys for Young Children in the Digital Era. *Pediatrics*, *143*(1), 20183348. https://doi.org/10.1542/PEDS.2018-3348

Henry, J. D., Philips, L. H., Ruffman, T., & Bailey, P. E. (2013). A meta-analytic review of age differences in theory of mind. *Psychology of Aging*, *28*(3), 826–839. https://doi.org/10.1037/a0030677

Howarth, M., Dudek, J., & Greer, R. D. (2015). Establishing derived relations for stimulus equivalence in children with severe cognitive and language delays. *European Journal of Behavior Analysis*, *16*(1), 49–81. https://doi.org/10.1080/15021149.2015.1065635

Kamaralzaman, S., Toran, H., Mohamed, S., & Abdullah, N. B. (2018). The Economic Burden of Families with Autism Spectrum Disorders (ASD) Children in Malaysia. *Journal of ICSAR*, *2*(1), 71–77. https://doi.org/10.17977/um005v2i12018p071

Kander, M. (2013). Will Payers Cover Speech-Generating Apps? *The ASHA Leader*, *18*(1), 24–25. https://doi.org/10.1044/LEADER.BML.18012013.24

Katagiri, J. (2009). The Effect of Background Music and Song Texts on the Emotional Understanding of Children with Autism. *Journal of Music Therapy*, *46*(1), 15–31. https://doi.org/10.1093/JMT/46.1.15

Klin, A., Jones, W., Schultz, R., & Volkmar, F. (2003). The enactive mind, or from actions to cognition: Lessons from autism. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *358*(1430), 345–360.

Krejcie, R. V., & Morgan, D. W. (2016). Determining Sample Size for Research Activities:

Http://Dx.Doi.Org/10.1177/001316447003000308, *30*(3), 607–610. https://doi.org/10.1177/001316447003000308

Liu, X., Wu, Q., Zhao, W., & Luo, X. (2017). Technology-Facilitated Diagnosis and Treatment of Individuals with Autism Spectrum Disorder: An Engineering Perspective. *Applied Sciences 2017, Vol. 7, Page 1051*, *7*(10), 1051. https://doi.org/10.3390/APP7101051

Livingston, L. A., Colvert, E., Bolton, P., & Happé, F. (2019). Good social skills despite poor theory of mind: exploring compensation in autism spectrum disorder. *Journal of Child Psychology and Psychiatry and Allied Disciplines*, *60*(1), 102–110. https://doi.org/10.1111/JCPP.12886

M Aragon, C. Y.-I. (2012). Using Language ENvironment Analysis to improve outcomes for children who are deaf or hard of hearing. *Seminars in Speech and Language*, *33*(4), 340–353. https://doi.org/10.1055/s-0032-1326918

Meer, L. A. J. van der, & Rispoli, M. (2010). Communication interventions involving speech-generating devices for children with autism: A review of the literature. *Http://Dx.Doi.Org/10.3109/17518421003671494*, *13*(4), 294–306. https://doi.org/10.3109/17518421003671494

Milteer, R. M., Ginsburg, K. R., Mulligan, D. A., Ameenuddin, N., Brown, A., Christakis, D. A., Cross, C., Falik, H. L., Hill, D. L., Hogan, M. J., Levine, A. E., O'Keeffe, G. S., Swanson, W. S., Siegel, B. S., Dobbins, M. I., Earls, M. F., Garner, A. S., McGuinn, L., Pascoe, J., & Wood, D. L. (2012). The importance of play in promoting healthy child development and maintaining strong parent-child bond: Focus on children in poverty. *Pediatrics*, *129*(1).

N Trottier, L. K. P. M. (2011). Effects of peer-mediated instruction to teach use of speech-generating devices to students with autism in social game routines. *Augmentative and Alternative Communication*, *27*(1), 26–39. https://doi.org/10.3109/07434618.2010.546810

Olusanya, B. O., Davis, A. C., Wertlieb, D., Boo, N. Y., Nair, M. K. C., Halpern, R., Kuper, H., Breinbauer, C., de Vries, P. J., Gladstone, M., Halfon, N., Kancherla, V., Mulaudzi, M. C., Kakooza-Mwesige, A., Ogbo, F. A., Olusanya, J. O., Williams, A. N., Wright, S. M., Manguerra, H., … Kassebaum, N. J. (2018). Developmental disabilities among children younger than 5 years in 195 countries and territories, 1990–2016: a systematic analysis for the Global Burden of Disease Study 2016. *The Lancet Global Health*, *6*(10), e1100–e1121. https://doi.org/10.1016/S2214-109X(18)30309-7

Önder, M. (2018). Contribution of Plays and Toys to Children's Value Education. *Asian Journal of Education and Training*, *4*(2), 146–149.

Pagani, L. S., Fitzpatrick, C., Barnett, T. A., & Dubow, E. (2010). Prospective associations between early childhood television exposure and academic, psychosocial, and physical well-being by middle childhood. *Archives of Pediatrics and Adolescent Medicine*, *164*(5), 425–431.

Parisi, L., Di Filippo, T., & Roccella, M. (n.d.). *THE CHILD WITH AUTISM SPECTRUM DISORDERS (ASDS) : BEHAVIORAL AND NEUROBIOLOGI-CAL ASPECTS*.

Peters, L. C., & Thompson, R. H. (2015). Teaching children with autism to respond to conversation partners' interest. *Journal of Applied Behavior Analysis*, *48*(3), 544–562. https://doi.org/10.1002/JABA.235

Robertson, C. E., & Baron-Cohen, S. (2017). Sensory perception in autism. *Nature Reviews Neuroscience*, *18*(11), 671.

Rosenfield, N. S., Lamkin, K., Re, J., Day, K., Boyd, L., & Linstead, E. (2019). A Virtual Reality System for Practicing Conversation Skills for Children with Autism. *Multimodal Technologies and Interaction 2019, Vol. 3, Page 28*, *3*(2), 28. https://doi.org/10.3390/MTI3020028

Sankardas, S. A., & Rajanahally, J. (2017). iPad: efficacy of electronic devices to help children with autism spectrum disorder to communicate in the classroom. *Support for Learning*, *32*(2), 144–157. https://doi.org/10.1111/1467-9604.12160

T Buie, D. C. G. F. G. F. J. L. J. V. (2010). Evaluation, diagnosis, and treatment of gastrointestinal disorders in individuals with ASDs: A consensus report. *Pediatrics*, *125*(Suppl 1), S1–S18. https://doi.org/10.1542/peds.2009-1878c

Tager-Flusberg, H., Rogers, S., Cooper, J., Landa, R., Lord, C., Paul, R., Rice, M., Stoel-Gammon, C., Wetherby, A., & Yoder, P. (2009). *Defining Spoken Language Benchmarks and Selecting Measures of Expressive Language Development for Young Children With Autism Spectrum Disorders*. *52*(3), 643–652. https://doi.org/10.1044/1092-4388(2009/08-0136)

Thompson, A., Murphy, D., Dell'Acqua, F., Ecker, C., McAlonan, G., Howells, H., Baron-Cohen, S., Lai, M. C., & Lombardo, M. V. (2017). Impaired Communication Between the Motor and Somatosensory Homunculus Is Associated With Poor Manual Dexterity in Autism Spectrum Disorder. *Biological Psychiatry*, *81*(3), 211–219. https://doi.org/10.1016/J.BIOPSYCH.2016.06.020

Tseng, K. C., Tseng, S.-H., & Cheng, H.-Y. K. (2016). Design, development, and clinical validation of therapeutic toys for autistic children. *Journal of Physical Therapy Science*, *28*(7), 1972–1980. https://doi.org/10.1589/JPTS.28.1972

Wiles Higdon, C., & Hill, K. (2015). Five SGD Funding Rules of Commitment. *Perspectives on Augmentative and Alternative Communication*, *24*(4), 129–134. https://doi.org/10.1044/AAC24.4.129

Wing, L. (1993). The definition and prevalence of autism: A review. *European Child & Adolescent Psychiatry 1993 2:1*, *2*(1), 61–74. https://doi.org/10.1007/BF02098832