Navigating the Digital Realm: The Learning Experiences of Adolescents with Autism Spectrum Disorder in Online Communication

Jasmine Jain[1*], Koh Kian Seng[2]

[1]School of Education, Faculty of Social Sciences and Leisure Management,
Taylor's University Lakeside Campus, Jalan Taylor's, 47500 Subang Jaya, Selangor, Malaysia
jasmine.jain@taylors.edu.my
[2]Greyspace Psychology,
A-5-3, 10 Boulevard, PJU 6A, 47400 Petaling Jaya, Selangor, Malaysia
aevent.koh@greyspace.my
[*]Corresponding Author

https://doi.org/ *to be updated*

Received: 6 May 2024
Accepted: 2 June 2024
Date Published Online: 17 November 2024
Published: 17 November 2024

Abstract: Social communication is essential in the development of human relations, the core of one's psychosocial well-being. Unfortunately, it is also one of the most significantly impaired aspects of people with Autistic Spectrum Disorder (ASD). For people with ASD to be independent and blend into society, they must learn some important life skills. However, it is extremely difficult for them to learn these life skills as they have an impairment of social communication, which plays a significant role in learning these skills based on some of the dominant learning theories. This research aims to explore and understand the online learning experiences of high-functioning adolescents with ASD through online synchronous and asynchronous communication. This study was conducted using a basic qualitative study based on the philosophy of basic and interpretive qualitative research. The research questions focused on the experiences of online learning through online communication among high-functioning adolescents with ASD and how they perceive the differences in the use of online synchronous and asynchronous communication during online learning. Eight participants were recruited through purposive and snowball sampling techniques. Data were collected through three sessions of semi-structured interviews prioritised by data saturation instead of the number of recruited participants. The practice of reflexivity, along with member checking, and investigator triangulation were included to enhance a clear understanding of the data collection and analysis process which could persuade readers on the trustworthiness and validity of the study. The findings revealed six themes – ability to self-express, ability to understand others, sense of physical presence, feelings of warmth, useful software features, and effects of negative past experiences. The researcher provided several recommendations for future studies to enhance the quality of support provided to high-functioning adolescents with ASD during their transition to adulthood. This study sets a solid foundation for future studies to build upon and highlights the limited number of studies focused on high-functioning adolescents with ASD, especially regarding their online learning experiences via online synchronous and asynchronous communication.

Keywords: Autism Spectrum Disorder (ASD), Online Communication, Synchronous Communication, Asynchronous Communication, Learning, Adolescent

1. Introduction

It is expected that individuals with Autism Spectrum Disorder (ASD), present unique challenges in the realm of neurodevelopmental disorders. One of its most profound hurdles lies in the impairment of social skills, making social communication a paramount focus in supporting individuals with ASD. Central to the ASD experience are persistent deficits in social communication and social interaction, coupled with the presence of restricted or repetitive behavioural patterns, interests, or activities (APA, 2013; EAP, 2019; Küpper et al., 2020). People with ASD find it challenging to naturally acquire social skills, setting them apart from their neurotypical counterparts (CDC, 2019; Howlin, 1997; Küpper et al., 2020). Their social skill impairments often include a lack of mutual sharing of interests, a deficiency in understanding other people's thoughts or feelings, and atypical behaviours for attention (Roth & Gillis, 2015). Without adequate support, individuals with ASD often encounter difficulties in building and maintaining relationships, as well as securing meaningful employment (Howlin, 1997). In light of these challenges, it becomes increasingly crucial to raise awareness and enhance knowledge within the community, particularly among parents and educators, on how best to support individuals with ASD.

The prevalence of ASD has been steadily increasing worldwide (World Health Organization, 2019). In countries like the United States and Malaysia, the reported cases have surged over the years, with alarming statistics reflecting a one-in-59 children diagnosis rate in the United States in 2014 (CDC, 2018) and a substantial increase in the number of individuals seeking ASD-related services in Malaysia (NASOM, 2018). Furthermore, the absence of local epidemiological studies in Malaysia complicates the understanding of the true prevalence of ASD. Though a study by the Ministry of Health Malaysia in 2016 revealed a prevalence of approximately 1.6 in 1000 among toddlers aged 18 to 36 months, the need for greater awareness and research in this field becomes evident (Ministry of Health Malaysia, 2016). The rising prevalence of ASD underscores the urgency for comprehensive support systems, emphasising not only awareness but also the development of new insights to better serve individuals with ASD. This paper underscores the need to delve into these pressing issues, seeking to understand the dynamics of ASD and the evolving landscape of this disorder, with a specific focus on the challenges faced by high-functioning adolescents with ASD as they navigate a world that is becoming increasingly reliant on online communication and asynchronous learning.

Research in Autism Spectrum Disorder (ASD) interventions, focusing on inclusive education and special needs programs, often overlooks the significance of communication channels, indicating a critical gap in understanding (Bravou & Drigas, 2019; Cinquin, Guitton & Sauzéon, 2019; Ndongko & Agu, 1985; Pham, 2020; Zhou & Brown, 2015). As virtual and hybrid learning options grow (Abdul Halim et al., 2024) but remain underutilised in special needs programs, there is a pressing need to explore how online communication can support individuals with ASD in the context of online learning, given the limited research on this topic (Hartley, Bird & Monaghan, 2020; Newton, Kramer & Mclntosh, 2009; Küpper et al., 2020; Pham, 2020; Swain et al., 2015). However, recent studies have raised concerns about the psychological and physical effects of online communication for individuals especially adolescents with ASD, underscoring the need for a comprehensive examination of its benefits and drawbacks (Anderson & Phillips, 2019; Phillips & Anderson, 2020; Van Der Aa et al., 2016). Moreover, the global rise in ASD prevalence, particularly in regions like Malaysia, necessitates research efforts to be extended to diverse, multicultural populations (Ramachandram, 2019; Freeth, Milne, Seppard & Ramachandran, 2014; Neik et al., 2014), offering culturally informed insights into ASD to better address this growing issue (Llias et al., 2017). Hence the objective of this study is to explore the online learning experiences of adolescents with ASD through online synchronous and asynchronous communication. As such, the question guiding this research is: What are the experiences of online learning through online communication among high-functioning adolescents with ASD?

2. Literature Review

2.1 Barriers to Learning for people with ASD

Research on the factors impacting the learning of individuals with Autism Spectrum Disorder (ASD) has revealed significant gaps in understanding. McDougal, Riby, and Hanley (2020) point out

that despite some individuals with ASD performing well academically, we need to address not only how to facilitate their learning but also the barriers they face. Previous studies have identified potential predictors of academic achievement, such as IQ level, sensory processing, social skills, autism severity, and environmental factors, but most have focused on student characteristics rather than external factors (Assouline, Foley Nicpon & Dockery, 2012; Estes et al., 2011; Keen et al., 2016; Mayes-Dickerson & Calhoun, 2008). To gather detailed information about the learning experiences of those who struggle, qualitative research has been recommended, but the challenges in social communication make it a significant barrier to data collection (McDougal, Riby & Hanley, 2020).

Additionally, studies have explored strategies for overcoming learning barriers in students with ASD, but they tend to offer general guidelines rather than tailored approaches based on different levels of autism severity (Brady et al., 2015; Pawlett, 2017; Sugai et al., 2000). McDougal, Riby, and Hanley's (2020) recent study highlighted barriers in autistic students, including anxiety, attention, sensory issues, and social and communication difficulties, but it encompassed students of varying ages and autism severity levels. Given the diversity within the autism spectrum, investigating specific severity levels is essential as students with different needs may require distinct forms of support. The term "barrier to learning" encompasses both external factors, such as an unsupportive environment, and internal factors, like fear and anxiety (Pawlett, 2017). Negative past experiences, including social isolation and discrimination, have been found to have a profound impact on the mental health and learning of individuals with ASD (Hudson, Hall & Harkness, 2018; Van Heijst & Guerts 2014). These experiences, rooted in memory, lead to hesitancy in engaging with others, which poses a challenge in both face-to-face and online learning (Cappadocia, Weiss & Pepler, 2012; Kerns, Newschaffer & Berkowitz, 2015; Zeedyk et al., 2014). It is crucial to understand how these experiences affect participation in online learning among individuals with ASD.

2.2 Theoretical Framework

Constructivism is a widely embraced theory in the realms of psychology and education, emphasising that learners actively construct knowledge and meaning from their prior experiences rather than passively receiving, processing, and storing information, as suggested by the cognitivism theory (Ertmer & Newby, 1993). Phillips (1995) notes that new knowledge is shaped, and existing knowledge is modified based on prior knowledge. Von Glasersfeld (1984) outlines four principles of constructivism, including the active role of the individual in constructing knowledge, the adaptiveness of cognition in the face of new experiences, the organisation and analysis of one's experiences, and the influence of both cognition and the environment, particularly social and cultural interactions.

Furthermore, constructivism can be categorised into cognitive constructivism, social constructivism, and radical constructivism, as elucidated by Jean Piaget, Lev Vygotsky, and Ernst von Glasersfeld, respectively (Kraus, 2015; GSI Teaching & Resource Center, 2016). Cognitive constructivism posits that knowledge is acquired through individual mental processes. Social constructivism, on the other hand, emphasises the role of social interaction, language use, and shared knowledge within society in shaping learning. Radical constructivism underscores the effort individuals put into constructing knowledge from new information. Each category has distinct characteristics and implications for the learning process (Doolittle, 2020).

In an educational context, social constructivism, championed by Vygotsky, has gained prominence due to its focus on social interactions as the primary means of learning. This approach posits that learning precedes development and occurs within the Zone of Proximal Development (ZPD), which represents the gap between independent and assisted performance, with scaffolding playing a pivotal role in advancing within the ZPD. Additionally, social constructivism emphasises methods like modelling (Mok & Jain, 2023), apprenticeship, and group work (Jain et al., 2024) to facilitate learning. For individuals with Autism Spectrum Disorder (ASD), who often struggle with face-to-face communication, the social constructivist approach, with its emphasis on support from educators and peers, holds promise for improving their learning experiences within their ZPD (Watkins et al., 2015).

In the context of online learning, there has been a growing interest in combining social constructivist theory with the Community of Inquiry Model (COI) to understand the importance of communication channels, such as chat boxes, text messages, and video chat, in knowledge construction. Pham (2020) underlines the significance of social presence, cognitive presence, and teaching presence

as key components for effective online learning. His research suggests that online synchronous and asynchronous communication can enhance these components, leading to improved engagement and knowledge construction. This approach can be particularly valuable for individuals with ASD, as it offers an alternative means of communication, potentially addressing their difficulties in face-to-face interactions and supporting their learning of essential life skills. Further research in the field of special needs and inclusive education could help extend these findings to better cater to the unique needs of students with ASD in online learning environments.

2.3 Supportive Learning Environment

Creating a highly supportive learning environment that incorporates technology has shown remarkable promise in improving the learning experiences of students with Autism Spectrum Disorder (ASD). This innovative approach, which focuses on strengths and creativity, has gained attention in special needs and inclusive education (Vellonen, Karna & Virnes, 2013). Such environments are proving more successful than approaches that solely address the challenges and deficits of individuals with ASD (Santos, Breda & Almeida, 2016; Vellonen, Karna & Virnes, 2013). For instance, Vellonen, Karna, and Virnes (2013) introduced four principles for developing a supportive learning environment using technology, while Santos, Breda, and Almeida (2016) created the Learning Environment on Mathematics for Autistic Children (LEMA), a digital platform designed to accommodate sensory sensitivities and individual learning styles. These innovative approaches aim to promote the development of social skills, a significant challenge for many autistic students.

One crucial aspect of a supportive learning environment, whether for students with ASD or typically developing students, is the provision of warmth and emotional support. Past studies have consistently shown that a sense of warmth is closely linked to better mental health development and positive outcomes for children and adolescents (Kochanska et al., 2013; Rohner, 2004; Waller et al., 2014). People with ASD also greatly benefit from warmth and emotional support, which fosters better relationships, adaptation, and favourable behaviours (Borkowski, Ramey & Bristol-Poweres, 2002; Hickey et al., 2020). Warmth has been found to be a protective factor for autistic traits, creating a sense of safety that encourages healthy and positive communication styles (Qian et al., 2020). Additionally, the quality of the parent-child relationship is bidirectionally related to the symptoms of ASD and the emotional and behavioural problems of children with ASD (Hickey et al., 2020). However, despite the crucial role of warmth in supporting people with ASD, there have been limited studies focusing on how to provide a sense of warmth in designing a supportive learning environment, especially in online learning settings, where the focus is often on discouraging inappropriate behaviour and building social skills (Bravou & Drigas, 2019; Cinquin, Guitton & Sauzéon, 2019; Gul and Vuran, 2015; Hickey et al., 2020). Moreover, past research has mainly centred on parent-child relationships, rather than teacher-student or student-student relationships (Borkowski, Ramey & Bristol-Poweres, 2002; Gul and Vuran, 2015; Hickey et al., 2020). As a result, there is a need for further exploration in these areas.

To effectively teach students with ASD, it is crucial to engage them in creative and motivating ways, as they often have decreased attention levels and different learning needs. Many studies have explored innovative teaching methods, such as forward-backward chaining, shaping techniques, precise and positive praise, using meaningful reinforcements, and preparing students for upcoming lessons (Alberta Learning, 2003). The integration of technology has also been pivotal in providing more opportunities for engagement, practice, and communication for students with ASD (Barger, 2020; Diener et al., 2015). For instance, the LeFCA framework, based on Applied Behavior Analysis (ABA), utilises technology in various ways to promote communication, socialisation, and adaptive skills (Hulusic & Pistoljevic, 2012). This approach combines human creativity with technological advancements to create a more supportive learning environment tailored to the specific needs, functioning levels, and abilities of students with ASD. These innovations in teaching and technology hold great promise for enhancing the learning experiences of individuals with ASD, enabling them to become more active and creative learners.

2.4 Online Synchronous and Asynchronous Communication for people with ASD

The modern digital age has introduced various communication channels, including both online and offline communication. Asynchronous communication, where responses don't require immediate feedback, is commonly used in online communication (Goh, Di Gangi & Gunnells, 2020). While many studies have explored the effectiveness of asynchronous communication in various fields, such as business and education, there is limited research on its application in inclusive education and special needs programs, which primarily employ synchronous learning (Pham, 2020; Swain et al., 2015). Notably, asynchronous communication has specific advantages for individuals with Autism Spectrum Disorder (ASD), offering them more time to process information, fewer distracting signals, and a reduced need to interpret non-verbal cues (Van Der Aa et al., 2016). Asynchronous communication creates spatial and temporal distance between communicators, allowing individuals with ASD to work at their own pace and convenience, addressing their specific needs and challenges.

Furthermore, research has shown that individuals with ASD benefit significantly from online asynchronous communication, improving relationship development, social skills, and mental health (Gavin, Rees-Evans & Brosnan, 2019; Raghavendra et al., 2018; Stone, Mills & Saggers, 2019; Tomczak, 2020; Vine Foggo, Webster & Dixon, 2020). For instance, online dating platforms, which often employ asynchronous communication, have allowed adults with ASD to navigate complex social interactions more comfortably (Gavin, Rees-Evans & Brosnan, 2019). Online forums and games have also enabled individuals with ASD to share experiences, engage in social interactions, and gradually develop social skills (Vine Foggo, Webster & Dixon, 2020; Gallup et al., 2016). These findings demonstrate that asynchronous communication can play a vital role in improving the social and communication skills of individuals with ASD in non-educational contexts. However, while these studies have highlighted the positive outcomes of asynchronous communication, it is crucial to investigate its impact in the context of learning and educational settings to enhance the independence and social inclusion of individuals with ASD during their educational journey.

3. Methodology

The design of the current research is a basic qualitative study. The term “basic qualitative study” (Merriam, 2009) refers to studies that focuses only on the generic, basic, and interpretive nature of a qualitative research approach with a primary goal to uncover and interpret meanings constructed by a particular group of people who make sense of their lives and their worlds in a particular phenomenon (Merriam, 2009). This study is a basic and interpretive qualitative research study that focuses on enhancing the understanding of problems through peoples’ subjective perception and understanding (Natalie, 2015; Stake, 2010).

The research employs purposive and snowball sampling methods to investigate the online learning experiences of high-functioning adolescents with Autism Spectrum Disorder (ASD), specifically focusing on both online synchronous and asynchronous modes of learning. The study targets adolescents between the ages of 13-18, a critical period according to Erikson's psychosocial development stages, as it's essential for the development of self-identity and social skills (Erikson, 1982; Erikson & Erikson, 1997; Shattuck et al., 2011). Participants must have a diagnosis of high-functioning ASD, falling into category/level one ASD, Asperger's syndrome, or Pervasive Developmental Disorder - Not Otherwise Specified (PDD-NOS), which necessitates minimal support as per the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria. Additionally, the participants should be able to communicate in English, Mandarin, or Bahasa Malaysia, as interviews are used for data collection. The study explores the general online learning experiences of participants and does not focus on specific subjects, considering the heterogeneous nature of ASD.

Data was obtained by interviewing (one-to-one semi-structured interview) eight high-functioning adolescents with ASD to capture the essence of the participants’ subjective perception of their online learning experiences. The whole process was conducted through three rounds of interviews which took approximately an hour with a 10-minute break in the middle of each session. The research employed a rigorous process to develop and validate the interview questions used in the study and was carried out as part of fulfilling a requirement at a private university. The interview questions were reviewed by the University’s Human Ethics Committee where subsequent amendments were made to

align the questions with ethical guidelines. They were further validated by a special needs education expert to confirm their relevance to the research objective and their ability to address the proposed research questions effectively. To guarantee the clarity and understandability of the questions, pilot testing was conducted through mock interviews with students who participants in the actual study were not. This meticulous process of question development and validation aimed to maintain the ethical standards, relevance, and clarity of the interview questions in the research.

The collected data was then analysed using thematic analysis (TA) with the help of NVivo, a qualitative data analysis software.

4. Findings and Discussions

From the analysis, six themes emerged in describing the experiences of online learning through online communication among high-functioning adolescents with ASD. The themes are presented and discussed below:

4.1 Ability to Self-express

Similar to a face-to-face learning environment, a key theme noticed among the participants of this study is the ability to self-express. This theme represents the notion of the participants' inability to adequately express themselves during their online learning classes resulting in – as well as from – difficulties communicating with others due to various reasons. For example,

> I find it a bit difficult to talk to my classmates. Actually, I have a lot of difficulties talking to them.
>
> (P2)

while P5 said,

> That's what I mean. I do not, I am not good at communication. I cannot explain things
>
> (P5)

P6 mentioned,

> I find it really hard to express my thoughts and feelings about not juggling it up.
>
> (P6)

As the participants struggled to communicate and were unable to explain what they were trying to say, they often felt like they were misunderstood.

> I feel hard to discuss a bit. Because they don't understand me
>
> (P3).

This inability to self-express represents a significant challenge for high functioning adolescents with ASD, especially for more outgoing ones. When probed, many of the other participants mentioned that despite trying hard to explain what they wanted to say, they were still unable to properly express themselves in a way that they were understood because they were unable to find the right words. This occurred even when participants made a conscious effort to think about it. For example, these notions were inferred by P3 as followed:

> They keep trying to explain. I am also keep trying to explain. But I feel a bit hard to explain. Because… uhm… because I don't, I don't, I can't find a word at all. Sometimes I cannot find the word about my feeling.
>
> (P3)

This theme aligns with numerous relevant past research studies. Misailidi and Papoudi (2009) emphasised that individuals with Autism Spectrum Disorder (ASD) experience challenges in social communication but still possess emotions and the ability to understand others' feelings, albeit differently from neurotypical individuals. The symptomatology of ASD often affects the integration of emotion and cognition, resulting in difficulties in comprehending emotional responses, managing personal emotions, and delivering appropriate emotional reactions (Misailidi & Papoudi, 2009). This suggests that individuals with ASD can express emotions and grasp others' emotions, albeit through a distinct subjective lens. Participants in our study echoed this sentiment, expressing their emotions and desires to communicate like their neurotypical peers. However, their unique perspectives often hindered effective self-expression, emphasising the importance of understanding and support from friends and teachers.

6.2 Ability to Understand Others

Despite several of the participants having difficulties expressing themselves, all of them felt that they were at least able to somewhat understand others during online learning, hence the theme's ability to understand others. This theme refers to the participants' ability to perceive, comprehend, and interpret the words and intentions of others when interacting online. This is mentioned by several participants – although some participants may have expressed higher confidence than others.

> I no problem answer teachers' questions. I can understand
>
> (P1)

> Nope. I don't have any problem understanding others. I know what teachers and friends trying to say or ask. Everything is good. Maybe because my communication skill is not too bad. (P4)
> That's... usually most of the time, like... most of the time if it's communicating, it's like in group work that one I'm fine, because I have to do the thing. I understand, understand what others, what I need to do. My communication problem is not, not about I cannot understand what others say, but, for some reason... I cannot explain. I know what they mean.
>
> (P5)

In a nutshell, the ability to understand others was a clear theme that arose from the participants' responses regarding their online learning experiences through online communication.

This theme diverges from much of the past research on ASD, which predominantly emphasised difficulties in comprehending others' thoughts, emotions, and behaviours. Our participants, however, challenge this narrative. It is essential to acknowledge that all participants in our study were high-functioning adolescents with ASD, possessing adequate language and social communication abilities—a departure from many previous studies that encompassed a wider range of functioning levels and age groups.

The close relationship between language ability and social communication skills and the development of the theory of mind is well-established (Astington & Jenkins, 1999; Bauminger-Zviely, 2013; Steele, Joseph & Tager-Flusberg, 2003). Empirical studies and reviews, such as the one by Yael Kimhi (2014), have consistently pointed to deficits in the theory of mind among individuals with ASD (Mathersul, McDonald & Rushby, 2013; Peterson, Wellman & Slaughter, 2012). These individuals often struggle to comprehend and relate to others' thoughts and behaviours, misinterpreting verbal and nonverbal cues, such as tone of voice, sarcasm, jokes, and body language (Bauminger-Zviely, 2013; Klin et al., 2002).

However, our findings challenge this consensus, suggesting that high-functioning adolescents with ASD may possess a higher level of theory of mind than their lower-functioning counterparts. This divergence may be attributed to their language and social communication abilities. It is crucial to recognize that the context of our study is online learning, which could offer a more structured and predictable environment for high-functioning students, making it easier for them to understand others. The use of technology in an academic setting may provide a more familiar and controlled context for students with ASD, reducing cognitive challenges associated with more unpredictable social interactions (Huang et al., 2017; Kimhi, 2014; Dritschel et al., 2010). While these studies primarily

focused on non-academic settings, our research adds a layer of complexity by highlighting the potential advantages of high-functioning individuals with ASD in an academic context. The use of both synchronous and asynchronous online communication enhances their ability to understand others.

6.3 Sense of Physical Presence

Like all situations, the use of online communication has both its pros and cons. In this theme, the sense of physical presence proves to be a significant factor in the use of online communication. This theme refers to the physical presence of a teacher or classmate which is a significant reason for preferring online or offline classes, with a lack of presence in a virtual setting being particularly noticeable. For many of the participants, they missed physically going to class as they preferred socialising by talking and playing with their friends in person.

> I prefer talking to my friend face-to-face because I miss them, talking to them face-to-face. I feel more comfortable talking to them face-to-face…talking face-to-face is different where we are able to see each other physically. Feel a lot closer. We will we are also able to play with each other and hang out too. There are a few days we could just visit our friends house.
>
> (P2)

> I think… It's going back to school now. One is because I have been staying in my home for way too long. My second reason is, I thought I can meet up back with my friends, best friends especially. Because we like, didn't meet in a long time. I mean physically. I think it is important meeting someone physically because it makes new friend much more properly than making friends online.
>
> (P4)

When asked about how being physically together was preferred, several participants shared the sense of instant gratification especially in terms of immediate response such as in synchronous communication, for example, P3 echoed this notion:

> I talk to friends only face-to-face because they can respond immediately. If cannot go to school, I like online class video call like this. I also prefer video call and not message chat. Chat is too slow.
>
> (P3)

Overall, a majority of the participants shared that meeting physically is crucial and that just meeting up online or having a phone call was insufficient to feel closer to one another. Instead, they missed socialising and interacting with their teachers and friends in person as going to school. When asked to further describe their experiences of why they appreciated physical presence so much, the participants mentioned that the aspects of having another's physical presence (energy) were the main difference when compared to online interaction.

This theme reinforces the importance of social presence and physical presence in developing high-quality social relationships, as corroborated by numerous past research studies. Social relationships and well-being are closely intertwined, supported by the social baseline theory (SBT) (Beckes & Coan, 2011; Coan & Sbarra, 2015). SBT highlights that social contact reduces the demands of emotional regulation and threat assessment, as evidenced by lower neural activation in response to familiar and predictable others (Beckes & Sbarra, 2022). Being alone places a greater adaptive challenge on the social brain, leading to increased emotional and threat-related demands (Lieberman, 2013).

Prior research has illustrated the positive impact of physical presence and social proximity on physiological arousal, pain responses, and the perception of the physical environment (Bourassa, Ruiz & Sbarra, 2019; Gross & Proffitt, 2013; Gross & Medina-Devilliers, 2020; Lopez-Sola et al., 2019; Saxbe et al., 2020; Oishi, Schiller & Gross, 2013; von Mohr et al., 2018). Social proximity,

characterised by trust based on friendship, kinship, and experience, plays a pivotal role in fostering relationships (Boschma, 2005). These findings align with our study, where participants deeply missed the sense of physical presence that enriched their educational experiences and social connections in face-to-face classes.

6.4 Feelings of Warmth

Interestingly, it was noted that even in the context of online learning – which as mentioned earlier, has the disadvantage of the absence of physical presence – all participants reported that they appreciated the feelings of warmth received. In this theme, feelings of warmth infer responses mentioning any activity, action, or displays of emotions and encouragement that made the participants feel supported psychologically, emotionally, or both.

Throughout the conversations held, all participants expressed feelings of warmth and kindness as being key factors towards their comfort and positive emotions towards others. This included their impression of both their teachers and their peers. Among the types of feelings of warmth, being helpful and supportive appears to be some of the most significant forms of encouragement for high-functioning adolescents with ASD during online learning. According to P3,

> I like my therapist. She always following me in school and help out if I have difficulties. She also join my online classes
>
> (P3)

and the others:

> I like Mr. V. He accept me as what I am. He know my problem. He know I have autism. He helped me a lot despite my autism. Whenever I have a problem, I always come to him. I feel I can communicate with him better.
>
> (P2)

One participant in particular gave a comprehensive explanation of how a helpful and supportive environment encourages him versus an unsupportive one like what he experienced in an earlier schooling environment – whereby he was not only scolded but sometimes even insulted. It appears that kindness and patience are important and an environment that encourages the students to ask questions is favoured.

> Err… I just don't have like favourite uhm… not particularly a favourite teacher because like all of them are quite quite good, good at their job. So, I would say, all of them is okay. They are very kind and they understand me. They always encourage me. Most of them are good and friendly. Generally quite good. They are very supportive. Very different you know…Teachers in my centre they don't they don't mind explain again and again as long as they get the point across. They are very patient. They will not mind to explain and like that one particular student as twelves times, or something like that. They are also not judgmental.
>
> (P5)

All participants expressed feelings of warmth as being key factors towards their comfort and positive emotion towards others. This feeling is essential during online learning as they often struggle due to the inherent nature of ASD involving communication difficulties.

This theme "Feelings of Warmth" resonates with the broader literature emphasising the positive impact of warmth on mental health development, especially in children and adolescents (Kochanska et al., 2004). Warmth in the form of empathy, encouragement, and patience significantly enhances cooperation, communication, and behavioural outcomes (Llias et al., 2017). Our participants also echoed these findings by expressing profound appreciation for the warmth shown by their teachers and peers, including the feelings of being understood, encouraged, and patient with, contributing to the sense of warmth and inclusiveness.

Recent research has shed light on the significance of feeling understood in the context of education, with a focus on the role of teacher-student interactions (Klem, Connell & Wagenaar, 2001). Our theme extends these implications by underscoring the constructive impact of patience, especially in an online learning environment (Klem, Connell & Wagenaar, 2001). The importance of patience in the context of ASD was further substantiated by the findings of Nind and colleagues (2013), where teachers' and support staff's patience were a key factor in facilitating positive interactions and learning outcomes for children with autism.

6.5 Useful Software Features

Aside from the earlier mentioned benefits of online communication, the participants also stated the usefulness of online features in facilitating their online learning as reasons for their enjoyment of a virtual learning environment. Many of the participants felt that the use of online search tools such as Google and translation tools was particularly useful for them as it allowed them to gain more information and a better understanding of a specific subject or topic. For example,

> Well, attending online class it's easy to learn. I can search anything online. If I don't understand anything, I can just go to google and type out the word or google translate
>
> (P2)

> I only use Wikipedia and google search. I use them if I don't understand certain things. It is very helpful. Using these is better than studying in face-to-face class
>
> (P3)

Other than information and translation-based tools, some of the participants also shared more specific details about other forms of online tools and software features that have made their online experience more enjoyable. This included the use of online meeting platforms, online documentation, educational videos, and customisation tools.

> I like both online and face-to-face classes but prefer online as they provide us videos. The teachers use educational videos that are easy to understand. You can also make your own video by recording the screen. I also always use YouTube, Google search and Google translate to find more information and if I do not understand something. I use translate to translate things I do not understand and YouTube to gain meaning and answers. I also like to write in Google document more than paper as I can customise the document by changing the fonts, size, add shapes and more – and just type instead of using my hand to write.
>
> (P7)

In summary, a thorough investigation of the participants' experiences of online learning using online communication tools reveals useful software features as a key theme of this study. The use of additional features such as the conveniences of online meeting platforms, virtual spaces such as GatherTown, online documentation, educational videos, and customisation tools was also part of the reasons why the participants enjoyed using online communication tools and preferred online lessons.

This theme aligns with the ongoing trend of utilising technology to support individuals with ASD in various contexts, particularly education (Gallup et al., 2016). Technology provides flexibility and creativity, accommodating the diverse learning styles and preferences of individuals with ASD. Our participants found various online software tools to be beneficial for enhancing their online learning experience, such as virtual environments, video explanations, and visual aids. This aligns with existing literature emphasizing the benefits of visual supports, video modeling, and virtual reality in promoting learning and social interaction in individuals with ASD (Fletcher-Watson et al., 2014; Gallup et al., 2016).

Moreover, the use of technology may provide individuals with ASD a sense of control and familiarity. This aligns with the findings of Van der Geest and colleagues (2019), who emphasized the importance of predictability in online education, catering to the needs of students with ASD. The

availability of technology can provide a structured and supportive environment, compensating for the challenges often faced by individuals with ASD in traditional educational settings (Van der Aa et al., 2016).

6.6 Effects of Negative Past Experiences

Despite the clear benefits of online communication and its effectiveness in helping high-functioning adolescents with ASD communicate with others, negative past experiences have significantly affected the confidence and sensitivity of many of the participants. As such, while many of the participants feel that communicating online may be easier, they are still hesitant to reach out or communicate with their peers and teachers even in an online learning environment.

Amongst the type of negative past experiences, one major factor appears to be a lack of response from the contacted party. P3 for example, mentioned

> I don't message. I don't type message to my friends anymore. Because they're only busy. They always don't respond
>
> (P3)

At times, the participants also felt like they were being a nuisance to others. On top of not getting a response, their attempts at communicating would sometimes be met with unpleasant reactions or a scolding, thus creating a sense of discomfort and possibly even fear such as that demonstrated by the following statements.

> Last time people always, always, get… angry because they don't know what I am saying, and, say like I am bothering them a lot. So, so now I just don't bother them too much
>
> (P5),

> Well, not, well, I am not kind of scared of teachers scolding me. The outcomes vary. Either they would answer my question or basically just, or just not be pleasant at all
>
> (P6)

Some of the participants were also concerned about their impression on others. P6 for example, does not like attention as he does not want to be viewed in a negative context.

> I… I… don't, I don't really like a lot of attention focus on me. Because, because they, they will think that... I... I am weird. So, I generally try to, I try to focus on my own and use online resources instead of asking teacher questions.
>
> (P6)

Despite the numerous benefits of online communication in the facilitation of online learning, the effects of negative past experiences appear to be a recurring theme in the participants' responses. As beneficial as online communication is for people with ASD, most of the participants shared that they still hesitated to reach out or communicate with their teachers and peers as their negative past experiences have significantly affected their confidence and sensitivity. Being ignored or lacking responses from others, being misunderstood, being considered a nuisance or disturbing others, and having unpleasant reactions from others have led the participants to become overly sensitive towards the concerns of others, including their potential impression towards others.

Even though most of the negative past experiences happened in the context of face-to-face communication, the participants are undoubtedly still affected by them even in an online learning environment as they are afraid of having history repeat.

This theme highlights the profound impact of negative past experiences on individuals with ASD. These experiences, such as isolation, discrimination, and feeling misunderstood, can lead to significant distress, anxiety, depression, and even trauma, influencing both mental health and learning (Rohner, 2004). Our participants shared their personal experiences of rejections, bullying, and negative repercussions in face-to-face settings, which contributed to their hesitance to engage with others, even in an online learning context. These findings echo the outcomes of previous studies examining the long-

term consequences of negative social experiences on the social and emotional functioning of individuals with ASD (Rohner, 2004). It is imperative to note that negative experiences are particularly detrimental for individuals with ASD due to their heightened vulnerability to stress and anxiety (Bauminger & Yirmiya, 200).

The availability of software features such as the ability to rewatch lessons and edit messages can play a crucial role in helping individuals with ASD overcome the challenges posed by negative past experiences. This aligns with the findings of Golan and Baron-Cohen (2006), emphasising the potential of video modelling in autism intervention, and Parsons and Mitchell (2002), who highlighted the utility of technology in promoting social interaction among children with autism. By facilitating review and modification, these software features can empower individuals with ASD, providing a sense of control, predictability, and, most importantly, a way to correct misunderstandings or missteps, reducing the anxiety associated with social interaction (Gallup et al., 2016).

8. Conclusion and Recommendations

By synthesising and contextualising the study's themes within the existing body of research, we gain a more comprehensive understanding of the nuances and complexities of high-functioning adolescents with ASD in an online learning environment. These findings not only underscore the unique experiences of individuals with high-functioning ASD but also reveal the potential of technology to support and enhance their social communication and learning experiences. In the context of online learning, participants appreciated useful software features like visual aids, emojis, and text messages. Visual explanations were particularly effective for students with ASD, aligning with prior research emphasising their visual learning strengths (Alberta Learning, 2003; Diener et al., 2015). While past negative experiences hindered their social interactions, the study highlighted that software features can support them in overcoming these challenges, enabling reengagement in social interactions. This study provides a preliminary exploration of the online learning experiences of high-functioning adolescents with ASD. While the findings are not specific to particular subjects or grades, they establish a foundational understanding for future research and interventions aimed at enhancing the support provided to this group. The study suggests multiple areas for further investigation, including the ideal balance between online and face-to-face learning, the impact of IT knowledge and skills on online learning, and the unique experiences of high-functioning adolescents with ASD in specific learning environments.

9. Limitations and recommendations

The limitation of this study stemmed from the consent of teachers and parents which limited participant numbers. Some parents hesitated due to past experiences or concerns about discomfort for their children during interviews. Additionally, demands by teachers or parents for monetary compensation for participation in the study further reduced participation. The permission required from the parents and teachers filtered quite a large number of potential participants who may have been able to provide more valuable data to the research. Secondly, voluntary participation led to self-selection bias by the targeted participants which may have potentially skewed the data towards those better at communication, despite the importance of understanding all perspectives. Lastly, the diverse nature of ASD means findings may not be generalised due to variations in speech, language, and other developmental aspects among participants.

Given that this study provides a foundational understanding but lacks specificity in subjects and grades. Future research should delve deeper into specific subjects and grades to provide more comprehensive insights into online learning experiences among high-functioning adolescents with ASD. This will enable researchers to address specific challenges and tailor interventions accordingly. Besides that, many questions remain unanswered regarding the implementation of hybrid learning for adolescents with ASD. Future research should focus on determining which parts of the curriculum are best suited for online and face-to-face delivery to optimise learning outcomes. Understanding the dynamics of hybrid learning can inform educational practices and policies. Finally, a critical examination of online learning experiences from alternative theoretical perspectives, such as

experiential or behavioural learning theories, can offer new insights and approaches to support adolescents with ASD in their educational journey.

While this study focused on adolescents with ASD, the findings hold relevance for higher education settings, particularly in understanding the challenges faced by university students with similar needs. The self-selection bias observed in this study could also manifest at the university level, where students with ASD may self-exclude from participating in online or hybrid learning environments. Besides that, the need for tailored interventions based on specific courses becomes even more critical in a university context, where diverse academic demands may exacerbate the challenges faced by students with ASD. By expanding research to include university students with ASD, future studies can offer insights into how online and hybrid learning models can be optimized to support inclusive education, address communication barriers, and provide appropriate accommodations to improve learning outcomes.

10. Co-author contribution

The first author contributed to the writing of this paper and reviewed the study design and data analyses of this study. The second author collected the data and performed preliminary data analyses of this study. All authors contributed to the manuscript revision, read, and approved the submitted version.

11. Acknowledgement

The authors extend their heartfelt gratitude to the participants of this study for their invaluable insights and enthusiastic engagement.

12. References

Abdul Halim, F. S., Luaran, J. & Lee, S.S. (2024). Unravelling Challenges of Higher Education Institutions in Implementing Effective Micro-Credentials: A Multi-Stakeholder Qualitative Study. *Asian Journal of University Education, 20*(1), 114-126. doi: https://doi.org/10.24191/ajue.v20i1.25738

Alberta Learning (2003). *Teaching Students with Autism Spectrum Disorders*. CA: Alberta Learning, Special Programs Branch.

Anderson, A., & Phillips, A. L. (2019). Getting basic information isn't as helpful as the nuanced advice we can give each other: Teens with autism on digital citizenship education. *Journal of Research on Libraries & Young Adults, 10*(3), 1-27.

American Psychiatric Association (APA). (2013). *Diagnostic and statistical manual of mental disorders (5th ed.).* Arlington, VA: American Psychiatric Publishing.

Assouline, S., Foley Nicpon, M., & Dockery, L. (2012). Predicting the academic achievement of gifted students with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 42*(9), 1781-1789. doi: 10.1007/s10803-011-1403-x

Astington, J., & Jenkins, J. (1999). A longitudinal study of the relation between language and theory of mind development. *Developmental Psychology, 35,* 1311-1320. doi: 10.1037//0012-1649.35.5.1311

Barger, T. S. (2020). Turning robots into teacher's aides: Christian Wanamaker's robotics software helps students on the autism spectrum-careers. *IEEE Spectrum, 57*(3). doi: 10.1109/MSPEC.2020.9014452

Bauminger-Zviely, N. (2013). Social cognitive and emotional competence. *Social and academic abilities in HF-ASD,* 31-58. NY: Guilford Press.

Beckes, L. & Coan, J. A. (2011). Social baseline theory: The role of social proximity in emotion and economy of action. *Social and Personality Psychology Compass, 5*(12), 976-988. doi: 10.1111/j.1751-9004.2011.00400.x

Borkowski, J. G., Ramey, S. L., & Bristol-Power, M. (2002). *Parenting and the child's world: Influences on academic, intellectual, and social-emotional development*. Mahwah, NJ: Erlbaum

Boschma, R. (2005). Proximity and innovation: A critical assessment. *Regional Studies, 39*(1), 61-74. doi: 10.1080/0034340052000320887

Bourassa, K. J., Ruiz, J. M., & Sbarra, D. A. (2019). The impact of physical proximity and attachment working models on cardiovascular reactivity: Comparing mental activation and romantic partner presence. *Psychophysiology, 56*(5). doi: 10.1111/psyp.13324

Brady, N. C., Storkel, H. L., Bushnell, P., Barker, R. M., Saunders, K., Daniels, D., & Fleming, K. (2015). Investigating a multimodal intervention for children with limited expressive vocabularies associated with autism. *American Journal of Speech-Language Pathology, 24*(3), 438-459. doi: 10.1044/2015_AJSLP-14-0093

Bravou, V., & Drigas, A. (2019). A Contemporary View on Online and Web Tools for Students with Sensory & Learning Disabilities. *International Journal of Online & Biomedical Engineering, 15*(12), 97-105. doi: 10.3991/ijoe.v15i12.10833

Cappadocia, M. C., Weiss, J. A., & Pepler D. (2012). Bullying experiences among children and youth with autism spectrum disorders. *Journal of Autism and Developmental Disorders, 42*(2), 266-277. doi: 10.1007/s10803-011-1241-x

Centers for Disease Control and Prevention (CDC) (2018). *Data & Statistics on Autism Spectrum Disorder*. Retrieved from https://www.cdc.gov/ncbddd/autism/data.html

Centers for Disease Control and Prevention (CDC) (2019). *What is Autism Spectrum Disorder*? Retrieved from https://www.cdc.gov/ncbddd/autism/facts.html

Cinquin, P. A., Guitton, P., & Sauzéon (2019). Online e-learning and cognitive disabilities: A systematic review. *Computers and Education, 130*, 152-167. https://doi.org/10.1016/jcompedu.2018.12.004

Coan, J. A., & Sbarra, D. A. (2015). Social baseline theory: The social regulation of risk and effort. *Current Opinion in Psychology, 1*, 87-91. doi: 10.1016/j.copsyc.2014.12.021

Diener, M., Wright, C., Dunn, L., & Wright, S. D. (2015). A creative 3D design programme: Building on interests and social engagement for students with autism spectrum disorder (ASD). *International Journal of Disability Development and Education, 63*(2). doi: 10.1080/1034912X.2015.1053436

Doolittle, P. E. (2020). *Constructivism and Online Education*. Retrieved from http://www.trainingshare.com/resources/doo2.htm.

Dritschel, B., Wisely, M., Goddard, L., Robinson, S., and Howlin, P. (2010). Judgements of self-understanding in adolescents with Asperger syndrome. *Autism, 14*, 509-518. doi: 10.1177/1362361310368847

Early Autism Project (EAP) (2019). *The Hope Project*. Retrieved from https://www.autismmalaysia.com/the-hope-project/

Erikson, E. H. (1982). *The life cycle completed*. New York, NY: Norton.

Erikson, E. H., & Erikson, J. M. (1997). *The life cycle completed: Extended version*. New York: Norton.

Estes, A., Rivera, V., Bryan, M., Cali, P., & Dawson, G. (2011). Discrepancies between academic achievement and intellectual ability in higher- functioning school-aged children with autism spectrum disorder. *Journal of Autism and Developmental Disorders, 41*(8), 1044-1052. doi: 10.1007/s10803-010-1127-3

Ertmer P. A., & Newby, T. J. (1993). Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 6*(4), 50-72. doi: 10.1111/j.1937-8327.1993.tb00605.x

Freeth, M., Milne, E., Sheppard, E., & Ramachandran, R. (2014). Autism across cultures: Perspectives from non-western cultures and implications for research. *Handbook of autism and pervasive developmental disorders, 2, 997-1013.*

Gallup, J., Duff, C., Serianni, B., & Gallup, A. (2016). An Exploration of Friendships and Socialization for Adolescents with Autistism Engaged in Massively Multiplayer Online Role-Playing Games (MMORPG). *Education & Training in Autism & Developmental Disabilities, 51*(3), 223-237.

Gavin, J., Rees-Evans, D., & Brosnan, M. (2019). Shy geek, likes music, technology, and gaming: An examination of autistic males' online dating profiles. *Cyberpsychology, Behavior, and Social Networking, 22*(5), 344-348. doi: 10.1089/cyber.2018.0607

Goh, S. H., Di Gangi, P. M., & Gunnells, K. (2020). Teaching tip: Applying team-based learning in online introductory information systems courses. *Journal of Information Systems Education, 31*(1), 1-11.

Gross, E. B., & Proffitt, D. (2013). The economy of social resources and its influence on spatial perceptions. *Frontiers in Human Neuroscience, 7*, 772. doi: 10.3389/fnhum.2013.00772

Gross, E. B., & Medina-Devilliers, S. E. (2020). Cognitive processes unfold in a social context: A review and extension of social baseline theory. *Frontiers in Psychology, 11*, 378. doi: 10.3389/fpsyg.2020.00378

GSI Teaching & Resource Center (2016). *Teaching guide for GSI, Learning: Theory and research*. Retrieved from http://gsi.berkeley.edu/media/Learning.pdf.

Gul, S. O., & Vuran, S. (2015). Children with special needs' opinions and problems about inclusive practices. *Education and Science, 40*(180), 169-195. doi: 10.15390/EB.2015.4205

Hartley, C., Bird, K., & Monaghan, P. (2020). Comparing cross-situational word learning, retention, and generalization in children with autism and typical development. *Cognition, 200*. doi: 10.1016/j.cognition.2020.104265

Hickey, E. J., Rodriguez, G., Bolt, D. M., & Hartley, S. L. (2020). Bidirectional relations between parent warmth and criticism and the symptoms and behaviour problems of children with autism. *Journal of Abnormal Child Psychology, 48*(9). doi: 10.1007/s10802-020-00628-5

Howlin, P. (1997). *Autism: Preparing for Adulthood*. London: Routledge.

Huang, A. X., Hughes, T. L., Sutton, L. R., Lawrence, M., Chen, X., Ji, Z. & Zeleke, W. (2017). Understanding the self in individuals with autism spectrum disorders (ASD): A review of literature. *Frontiers in Psychology, 8*, 1422. doi: 10.3389/fpsyg.2017.01422

Hudson, C., Hall, L., & Harkness, K. (2018). Prevalence of Depressive Disorders in Individuals with Autism Spectrum Disorder: A meta-analysis. *Journal of Abnormal Child Psychology, 47*, 165-175. doi: 10.1007%2Fs10802-018-0402-1

Hulusic, V., & Pistoljevic, N. (2012). "LeFCA": Learning framework for children with autism. *Procedia Computer Science, 15*. doi: 10.1016/j.procs.2012.10.052

Jain, J., Lee, Y.L. & Mok, S.J. (2024). A Systematic Review of Pedagogical Content Knowledge for Teaching Nature of Science. *Asian Journal of University Education, 20*(1), 138-151. doi: https://doi.org/10.24191/ajue.v20i1.25738

Jain, J. & Luaran, J.E. (2020). Conceptualisation of Scientific Theory-Law Relationship among pre-service Teachers with different academic abilities in Science. *Asian Journal of University Education, 16*(3), p. 208-219. ISSN 2600-9749. doi: https://doi.org/10.24191/ajue.v16i3.10275

Keen, D., Webster, A., & Ridley, G. (2016). How well are children with autism spectrum disorder doing academically at school? An overview of the literature. *Autism, 20*(3), 276-294. doi: 10.1177/1362361315580962

Kerns, C. M., Newschaffer, C. J., & Berkowitz, S. J. (2015). The differential diagnosis of an anxiety disorders in cognitively-able youth with autism. *Cognitive and Behavioral Practice, 23*(4), 530-547. doi: 10.1016/j.cbpra.2015.11.004

Kimhi, Y. (2014). Theory of mind abilities and deficits in autism spectrum disorders. *Topics in Language Disorders, 34*(4), 329-343. doi: 10.1097/TLD.0000000000000033

Klin, A., Jones, W., Schultz, R., Volkmar, F., & Cohen, D. (2002). Defining and quantifying the social phenotype in autism. *American Journal of Psychiatry, 159*(6), 895-908. doi: 10.1176/appi.ajp.159.6.895

Kochanska, M., Waller, G., Kim, S., Boldt, L. J., & Yoon, J. E. (2013). Children's callous-unemotional traits moderate links between their positive relationships with parents at preschool age and externalizing behavior problems at early school age. *Journal of Child Psychology and Psychiatry, 54*(11), 1251-1260. doi: 10.1111/jcpp.12084

Kraus, B. (2015). The life we live and the life we experience: Introducing the epistemonological difference between "lifeworld" (lebenswelt) and "life conditions" (lebenslage). *Social Work & Society, 13*(2).

Küpper, C., Stroth, S., Wolff, N., Hauck, F., Kliewer, N. & Schad-Hansjosten, T. et al. (2020). Identifying predictive features of autism spectrum disorders in a clinical sample of adolescents and adults using machine learning. *Scientific Reports, 10*(1). doi: 10.1038/s41598-020-61607-w

Lieberman, M. D. (2013). *Social: Why our brains are wired to connect*. UK: Oxford University Press

Llias, K., Liaw, J. H. J., Cornish, K., Sang-Ah Park, M., & Golden, K. J. (2017). Wellbeing of mothers of children with "A-U-T-I-S-M" in Malaysia: An interpretative phenomenological analysis study. *Journal of Intellectual & Developmental Disability, 42*(1), 74-89. doi: 10.3109/13668250.2016.1196657

Lopez-Sola, M., Geuter, S., Koban, L., Coan, J. A., & Wager, T. D. (2019). Brain mechanisms of social touch-induced analgesia in females. *Pain, 160*, 2072-2085. doi: 10.1097/j.pain.0000000000001599

Mathersul, D., McDonald, S., & Rushby, J. A. (2013). Understanding advanced theory of mind and empathy in high-functioning adults with autism spectrum disorder. *Journal of Clinical and Exp*erimental Neuropsychology, 35, 655-668.

Mayes-Dickerson, S., & Calhoun, S. (2008). WISC-IV and WIAT-II profiles of children with high-functioning autism. *Journal of Autism and Developmental Disorders, 38*(3), 428-439. doi: 10.1007/s10803-007-0410-4

McDougal, E., Riby, D. M., & Hanley, M. (2020). Teacher insights into the barriers and facilitators of learning in autism. *Research in Autism Spectrum Disorders, 79.* doi: 10.1016/j.rasd.2020.101674

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation.* US: Jossey-Bass.

Ministry of Health Malaysia (MOH) (2016). *Clinical practice guidelines: Management of autism spectrum disorder in children and adolescents.* Malaysia. Retrieved from http://www.moh.gov.my/moh/attachments/CPG%202014/CPG%20Management%20of%20Autism%20Spectrum%20Disofer%20in%20Children%20and%20Adolescents.pdf

Misailidi, P., & Papoudi, D. (2009). Expression, perception, and understanding of emotions in autism: Psychological and neurological findings. *Step in Social Sciences, 54*, 127-145.

Mok, S.J. & Jain, J. (2023). Malaysian In-Service Science Teachers' Conception of Nature of Science (NOS). In M. Koc, O. T. Ozturk & M. L. Ciddi (Eds.), *Proceedings of ICRES 2023-- International Conference on Research in Education and Science* (pp. 1049-1062), Cappadocia, Turkiye. ISTES Organization.

National Autism Society of Malaysia (NASOM) (2018). *Autism*. Retrieved from http://www.nasom.org.my/autism/

Natalie, P. (2015). *A basic interpretive study of the experiences of university students who have dropped or failed an online course*. FIU Electronic Theses and Dissertations, 1828. doi: 10.25148/etd.FI15032166

Ndongko, T., & Agu, A. (1985). The impact of communication on the learning process: A study of secondary schools in Calabar municipality, cross river state of Nigeria. *International Review Of Education, 31*(1), 205-221. doi: 10.1007/bf02262577

Neik, T. T. X., Lee, L. W., Low, H. M., Chia, N. K. H., & Chua, A. C. K. (2014). Prevalence, diagnosis, treatment, and research on autism spectrum disorders (ASD) in Singapore and Malaysia. *International Journal of Special Education, 29*(3), 1-10.

Newton, T., Kramer, A. D. I., & Mclntosh, D. N. (2009). Autism online: A comparison of word usage in bloggers with and without autism spectrum disorders. *Conference on Human Factors in Computing Systems – Proceedings,* 463-466. doi: 10.1145/1518701.1518775

Oishi, S., Schiller, J., & Gross, E. B. (2013). Felt understanding and misunderstanding affect the perception of pain, slant, and distance. *Social Psychological and Personality Science, 4*(3), 259-266. doi: 10.1177/1948550612453469

Orsmond, G. I., Sheltzer, M. M., Krauss, M. W., & Hong, J. (2003). Behavior problems in adults with mental retardation and maternal well-being: Examination of the direction of effects. *American Journal on Mental Retardation, 108*(4), 257-271. doi: 10.1352/0895-8017(2003)108<257:BPIAWM>2.0.CO;2

Overbeek, G., Stattin, H., Vermulst, A., Ha, T., & Engels, R. C. M. E. (2007). Parent-child relationships, partner relationships, and emotional adjustment: A birth-to-maturity prospective study. *Developmental Psychology, 43*(2), 429-437. doi: 10.1037/0012-1649.43.2.429

Pawlett, J. (2017). Removing barriers to learning for children with autism spectrum disorder. *Bu Journal of Graduate Studies in Education, 9*(2).

Peterson, C. C., Wellman, H. M., & Slaughter, V. (2012). The mind behind the message: Advancing theory-of-mind scales for typically developing children, and those with deafness, autism, or Asperger syndrome. *Child Development, 83*(2), 469-485. doi: 10.1111/j.1467-8624.2011.01728.x

Pham, L. (2020). Peabody online Ed.D. in leadership and learning in organizations. Retrieved from https://www.vanderbilt.edu/bold/docs/peabody-online-ed-d-in-leadership-and-learning-in-organizations/

Phillips, D. C. (1995). The good, the bad, the ugly: The many faces of constructivism. *Educational Researcher, 24*(7), 5-12. doi: 10.3102/0013189X024007005

Phillips, A. L., & Anderson, A. (2020). Cyberbullying, digital citizenship, and youth with autism: LIS education as a piece in the puzzle. *Library Quarterly, 90*(3), 264-282. doi: 10.1086/708957

Qian, S., Xu, X., Wang, Y., Li, J., Li, J., Jia, R., & Xu, Y. (2020*). Association between autistic traits and home nurture environment: A community-based study.* Manuscript submitted for publication. doi: 10.21203/rs.3.rs-18754/v1

Raghavendra, P., Hutchinson, C., Grace, E., Wood, D., & Newman, L. (2018). "I like talking to people on the computer": Outcomes of a home-based intervention to develop social media skills in youth with disabilities living in rural communities. *Research in Developmental Disabilities, 76,* 110-123. doi: 10.1016/j.ridd.2018.02.012

Ramachandram, S. (2019). Clinical characteristics and demographic profile of children with Autism Spectrum Disorder (ASD) at child development clinic (CDC), Penang Hospital, Malaysia. *Medical Journal of Malaysia, 74*(5), 372-376.

Rohner, R. P. (2004). The parental "acceptance-rejection syndrome": Universal correlates of perceived rejection. *American Psychologist, 59*(8), 830-840. doi: 10.1037/0003-066X.59.8.830

Roth, M. E., & Gillis, J. M. (2015). "Convenience with the Click of a Mouse": A Survey of Adults with Autism Spectrum Disorder on Online Dating. *SEXUALITY AND DISABILITY, 1*, 133.

Santos, M. I., Breda, A., & Almeida, A. M. (2016). Learning environment for autism spectrum disorders: a universal approach to the promotion of mathematical reasoning. *Conference: The 7th International Conference*, 162-169. doi: 10.1145/3019943.3019967

Saxbe, D. E., Beckes, L., Stoycos, S. A., & Coan, J. A. (2020). Social allostasis and social allostatic load: A new model for research in social dynamics, stress, and health. *Perspectives on Psychological Science, 15*(2), 469-482. doi: 10.1177/1745691619876528

Shattuck, P. T., Orsmond, G. I., Wagner, M., & Cooper, B. P. (2011). Participation in social activities among adolescents with an Autism Spectrum Disorder. *PLoS One, 6*(11). doi: 10.1371/journal.pone.0027176.

Stake, R. (2010). *Qualitative research: Studying how things work*. New York: The Guildford Press.

Steele, S., Joseph, R. M., & Tager- Flusberg, H. (2003). Developmental change in theory of mind abilities in children with autism. *Journal of Autism and Developmental Disorders, 33*, 461-467. doi: 10.1023/A:1025075115100

Stone, B. G., Mills, K. A., & Saggers, B. (2019). Online multiplayer games for the social interactions of children with autism spectrum disorder: A resource for inclusive education. *International Journal of Inclusive Education, 23(2), 209-228.* doi: 10.1080/13603116.2018.1426051

Sugai, G., Horner, R. H., Dunlap, G., Hieneman, M., Lewis, T. J., Nelson, C. M., Ruef, M. (2000). Applying positive behavior support and functional behavioral assessment in schools. *Journal of Positive Behavior Interventions, 2*(3), 131-143. doi: 10.1177/109830070000200302

Swain, D., Scarpa, A., White, S., & Laugeson, E. (2015). Emotion Dysregulation and Anxiety in Adults with ASD: Does Social Motivation Play a Role? *Journal of Autism & Developmental Disorders, 45*(12), 3971-3977. doi: 10.1007/s10803-015-2567-6

Tomczak, M. T. (2020). Employees with autism spectrum disorders in the digitized work environment: Perspectives for the future. *Journal of disability policy studies, 31*(4). doi: 10.1177/1044207320919945

Van Heijst, B., & Geurts, H. (2014). Quality of life in autism across the lifespan: A meta-analysis. *Autism, 19*(2), 158-167. doi: 10.1177/1362361313517053

Van Der Aa, C., Pollmann, M. M. H., Plaat, A., & Van Der Gaag, R. J. (2016). Computer-mediated communication in adults with high-functioning autism spectrum disorders and controls. *Research in Autism Spectrum Disorders, 23*, 15-27. doi: 10.1016/j.rasd.2015.11.007

Vellonen, V., Karna, E., & Virnes, M. (2013). *Supporting the strengths and activity of children with autism in a technology-enhanced learning environment.* Conference: Proceedings of the IADIS International Conference on Cognition and Exploratory Learning in Digital Age (CELDA 2013).

Vine Foggo, R. S., Webster, A. A., & Dixon, R. (2020). Utilisation of an online forum to engage adolescents with autism in direct participation in qualitative research. *British Journal of Special Education, 47*(2), 208-229. doi: 10.1111/1467-8578.12305

von Glasersfeld, E. (1984). An introduction to radical constructivism. *The invented reality*, 17-40. NY: Norton.

von Mohr, M., Krahe, C., Beck, B., & Fotopoulou, A. (2018). The social buffering of pain by affective touch: A laser-evoked potential study in romantic couples. *Social Cognitive and Affective Neuroscience, 13*(11), 1121-1130. doi: 10.1093/scan/nsy085

Waller, R., Gardner, F., Viding, E., Shaw, D. S., Dishion, T. J., Wilson, M. N., & Hyde, L. W. (2014). Bidirectional associations between parental warmth, callous unemotional behavior, and behavior problems in high-risk preschoolers. *Journal of Abnormal Child Psychology, 42*(8), 1275-1285. doi: 10.1007/s10802-014-9871-z

Watkins, L., O'Reilly, M., Kuhn, M., Gevarter, C., Lancioni, G., Sigafoos, J., & Lang, R. (2015). A Review of Peer-Mediated Social Interaction Interventions for Students with Autism in Inclusive Settings. *Journal of Autism and Developmental Disorders, 45*(4), 1070-1083. doi: 10.1007/s10803-014-2264-x

World Health Organization (2019). *Autism Spectrum Disorders*. Retrieved from https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders

Zeedyk, S. M., Rodriguez, G., Tipton, L. A., Baker, B. L., & Blacher, J. (2014). Bullying of youth with autism spectrum disorder, intellectual disability, or typical development: Victim and parent perspectives. *Research in Autism Spectrum Disorders, 8*(9), 1173-1183. doi: 10.1016/j.rasd.2014.06.001

Zhou, M., & Brown, D. (2015). *Educational Learning Theories*: 2nd Edition. Education Open Textbook.