Learning through Online Synchronous and Asynchronous Communication among Adolescents with Autism Spectrum Disorder: A Conceptual Discourse

Aevent Koh Kian Seng, Jasmine Anak Jain, Logendra Stanley Ponniah, and Anasuya Jegathevi Jegathesan

***Abstract*—This is a conceptual paper on the review of literature related to adolescents with Autism Spectrum Disorder (ASD), online learning, and online synchronous and asynchronous communication for the use of future studies. It recognizes that social communication is essential in developing human relationships – and is needed for people with ASD to gain independence and acceptance into society, yet represents one of their most significant impairments, thus affecting the learning of other life skills. Online synchronous and asynchronous communication, along with technological advancement and modern trends, including various new online communication platforms (like Facebook and Discord) may offer alternative ways to support the learning experiences of people with ASD. However, there appears to be gaps in our understanding of how online communication benefits or supports those with ASD in a learning context, despite people with ASD having shown improved interest and motivation in interacting with one another in gaming and dating platforms. As adolescents with ASD often use online communication but lack skills that negatively affect their learning experience, this conceptual paper intends to provide new insights by compiling and discussing the review of past literatures and theories in hopes of supporting them in future. The discussions in this research paper are meant to supplement the literature of academics as reference for their research and attempts to extend the findings of past research studies. It also intends to extend the theory of social constructivist learning and apply it to the context of learning through online synchronous and asynchronous communication among adolescents with ASD. Hence, the creation of a new conceptual framework designed for reference in future studies. With the rising trend of online and hybrid learning modalities, continued research on the use of online communication, especially in an academic setting, could better support people with ASD and strengthen their communication abilities to improve their social connection and learning ability as the flexibility of the learning environment offered by online and hybrid learning modalities may lead to more powerful social connections while enhancing their learning.**

***Index Terms*—Adolescents, Autism Spectrum Disorder (ASD), online learning, online synchronous and asynchronous communication.**

Manuscript received February 19, 2022; revised May 8, 2022. This work is supported by the Taylor's Research Excellence Scholarship.

Aevent Koh Kian Seng, Jasmine Anak Jain, and Logendra Stanley Ponniah are with the Faculty of Social Sciences and Leisure Management, Taylor's University, Malaysia (e-mail: aeventkoh@gmail.com, jasmine.jain@taylors.edu.my, logendrastanley.ponniah@taylors.edu.my).

Anasuya Jegathevi Jegathesan is with the Faculty of Psychology and Social Sciences, University of Cyberjaya, Malaysia (e-mail: anasuya@cyberjaya.edu.my).

I. Introduction

Among the various types of special needs diagnosis, Autism is considered one of the most unique as its symptoms can occur in a spectrum, ranging from mild and a few to severe and many [1]. This is why autism is referred to as Autism Spectrum Disorder (ASD) in the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [1]. ASD covers a range of pervasive neurodevelopmental disorders and is usually characterized by persistent deficits in social communication and social interaction, along with the presence of restricted or repetitive patterns in behaviors, interests, or activities [1]-[3]. The main difficulty for people with ASD is an impairment in social skills [4]. For example, a lack of mutual sharing of interests, a lack of awareness and understanding of other people's thoughts or feelings, and atypical behaviours for attention [5]. Without adequate support, people with ASD tend to have difficulties in building and maintaining relationships, and obtaining and sustaining meaningful employment [4]. To improve their lives, the community – especially parents and educators requires better awareness and knowledge of supporting people with ASD. With that said, these factors can be considered the two most important concepts for supporting people with ASD: 1) understanding the complexity of an individual with ASD, and 2) the severity levels of ASD, which represent the support they need: low, medium, and high functioning [1].

Based on studies conducted over the past 50 years, the World Health Organization (WHO) [6] stated that the prevalence of ASD has been increasing worldwide, with the current number estimated at one in 160 children being positively diagnosed [6]. The number of reported cases continue to dramatically increase across most countries every year, including Malaysia [3], [7], [8]. For instance, in the United States, the number of children diagnosed with ASD has shockingly increased from one in 150 children in the year 2000 to one in 44 children in 2018; while in Malaysia, there was a reported 30% increase in the number of those seeking ASD related services across all age groups [9], [10]. Presently, no known local epidemiological studies have been done on the prevalence of ASD in Malaysia. However, a study in 2016 conducted by the Ministry of Health Malaysia about the prevalence of ASD among toddlers aged 18 to 36 months found that the prevalence of ASD was approximately 1.6 in 1000. As such, to better support people with ASD, it is vital that there is increased awareness of ASD among

doi: 10.18178/ijiet.2022.12.12.1765

communities while further studies are conducted in relevant fields in order to gain new insights. [11].

In fact, ASD is not a disease but a disorder. It does not require a "cure" but merely the necessary assistance for initiating social interactions to build better support systems and to enhance psychosocial well-being [12]. With enough professional support, people with ASD can maximize their full potential and fit into society by developing essential skills for managing reciprocal conversations, sustaining interactions through multiple social communication modes, and being welcomed into social groups [13]-[15]. While various interventions have been found to be effective in certain populations, it is evident that obtaining the "right" treatment is considered tricky, especially in the case of ASD – as every case, person, and background is different, with no two diagnoses being identical [16]. That being said, all treatments share similar goals by helping people with ASD regulate their thought, mood, and behavior, with the most crucial being – helping them improve their learning capabilities so that they are able to develop the necessary skills for building independence and gaining future employment [17]-[20].

It is believed that education is considered essential and should be made available to everyone, including students with disabilities [21]. To meet an ASD students' needs and help them achieve social inclusion, it is necessary to implement alternative ways of training for special education teachers and caregivers to create a more beneficial, and effective learning environment and outcome [21]-[23]. Unlike traditional or common educational programs based on typically developing students, inclusive education maximizes a student's learning outcome primarily by catering to each student's unique requirement [24]. Therefore, educators who serve students with ASD should be trained in the general knowledge of the complexity of ASD and the best type of strategy needed to support them.

Furthermore, the evolution of technology has impacted models of special education programs, increasing the implementation of computers and mobile devices to improve learning outcomes over the last 30 years [25]. Various educational and psychological interventions have also started using information and communications technology (ICT). For instance, the evolution of hardware and software allow the creation of features that cater to people with special needs to overcome their challenges during learning [18]. Besides, the internet also promotes a new way of communicating and provides tremendous support in assisting people in overcoming the difficulties of face-to-face communication, gaining more accessible access to information, and for use in the learning and participation of relevant activities – which, they would otherwise not be able to carry out [18].

Recent studies have also discovered that through technological advancements and modern trends, people with ASD have shown great interest and motivation in interacting with one another via online communications such as Facebook, Instagram, Discord, online dating forums and more [26], [27]. The main advantage of online communication is the presence of features including emoticons, Graphics Interchange Formats (GIF) and Grammarly that can be utilized to better express feelings and thoughts, which is sometimes not possible in face-to-face communication [26], [28]. However, there has been no research that explores the implementation of online communication in the context of learning. Hence, continued research on the use of online communication to support people with ASD, especially in an academic setting and in psychological interventions, could strengthen their ability to improve life skills and social connections, leading to better psychosocial wellbeing [17], [26].

In addition, all children with ASD go through adolescence before reaching adulthood. Yet, most studies focused only on children or adults with ASD. According to Erikson's stages of psychosocial development, adolescence is one of the most crucial stages for developing self-identity and social skills [26], [29], [30]. This means that even adolescents with ASD value deep interpersonal relationships and require support in developing their social skills. Supporting them in obtaining better communication skills will improve their mental health, and learning effectively.

II. Problem Statement

Although research studies on educational interventions such as inclusive education and special needs programs are widespread in supporting people with ASD, most of these interventions do not focus on the channels of communication used [31]-[33]. In recent years, there has been a rapid increase in the numbers of virtual learning (online classes) and hybrid learning (a combination of both online and offline classes), making it essential to explore how online communication in learning can support people with ASD [31], [34]. Presently, there appears to be a gap in our understanding of how online communication benefits or supports those with ASD in a learning context [26], [35]. While some research studies suggested that online communication may be useful for people with ASD, more recent research studies have discovered that online communication may, in fact, not be suitable, as misinterpretation during these sessions can occur [36]-[39]. Due to these contradictions, there is an urgent need for additional research to deepen the knowledge of online communication for people with ASD.

As mentioned earlier, people with ASD mainly suffer from persistent deficits in social communication. Despite synchronous communication being ineffective in many circumstances, most interventions and programs were still created based on it as it requires experts to conduct and handle the session in real-time [40]. On the other hand, some recent research studies have found that online asynchronous communication channels such as weblogs, online dating websites, online video games, and online forums could greatly benefit people with ASD [5], [26], [41], [42]. And yet none of these studies focused on the context of learning, which could eventually lead to people with ASD acquiring the skills needed to overcome their difficulties.

Regardless, it has been noted that the benefits of online asynchronous communication are effective in improving the quality of work and productivity in the field of business, so it has been adopted by newer research studies in the field of education, as well as in an educational setting [31], [43]-[45].

Yet, online asynchronous communication has not been implemented in the context of inclusive education or special needs programs as we lack the knowledge of how it can support people with ASD. Even if online asynchronous communication has a positive impact in the academic setting [31], it does not mean that it will be the same in special needs education as the students have different needs and abilities.

With the rising prevalence of ASD in Malaysia, it is clear that there is a growing need for more research in the field of ASD [46]. However, only limited research studies examine ASD within developing, low to middle income, and non-Western countries – including Malaysia [47], [48]. A further study in Malaysia will help increase awareness of ASD while gaining new insights and providing culturally informed, evidence-based research [49].

III. Discussion of the Literature Review

A. Persistent Deficits in Social Communication

In relation to this topic, it is noted that social communication is essential for developing human relations, which is the core of one's psychosocial wellbeing [50]. Unfortunately, it is also one of the most significantly impaired aspects of people with Autistic Spectrum Disorder (ASD) [1]. These impairments in social communication often led to the absence of or low-quality social relationships, which is correlated to the symptoms of psychological distress – primarily depression and anxiety [5]. People with ASD often reported feeling lonely, resulting in decreased life satisfaction and self-esteem [51]. In fact, WHO [6] reported that globally, people with ASD are often faced with the problems of stigmatization and discrimination, thus resulting in the lack of necessary services and support [6].

The core deficit in ASD is persistent deficits in social communication and social interaction [52]. This also significantly impacts a student's learning in school negatively [52]. This is especially true from high school onwards, as despite having basic academic skills, students with ASD may still risk failure because of the demand for high executive functions, self-regulation, and group work [52]. Students with ASD often face challenges in social-emotional reciprocity ranging from a lack of initiation and an unorthodox approach in a social context, to failure in reciprocal conversations, including limited interest in sharing emotional and affective responses [53]. Affective response (AR) refers to the general psychological state of an individual, including but not limited to, emotions and moods, within a given situation [54]. They also have trouble integrating verbal (spoken) and nonverbal (use of body language to express a message) communication abilities that contribute to social interactions, including abnormal eye contact and lack of gestures and facial expressions [55]. This, therefore, hinders or delays the development of language and communication as those with ASD are unable to interpret the language used in a social context, such as understanding the meaning of words and recognizing the tone of voice, or in developing the ability to formulate a response such as answering and asking questions or offering ideas [56].

Without good language and communication skills, students with ASD will not be able to learn effectively and obtain the necessary support from their peers in school. As such, it is vital to detect and identify the symptoms of ASD as early as possible – so that professionals can carry out early intervention to train people with ASD in the areas of social emotion and cognition, communication development, visual-spatial recognition, vocabulary, receptive identification, and gross motor imitation skills [57]. Various past studies have also provided a strong claim that these skills can be taught and will transform the lives of people with ASD [58], [59].

B. Role of Communication in Learning (Theoretical Framework)

It is imperative that we understand the theories behind how learners obtain knowledge. Constructivism theory, an immensely popular theory amongst the fields of psychology and education, believes that learners are actively constructing their knowledge and meaning from their past experiences rather than based on how information is received, processed, organized, retrieved, and stored as proposed by the theory of cognitivism [60]. According to Phillips [61], we construct new knowledge and modify existing knowledge firmly based on our prior knowledge [61]. Von Glasersfeld [62], on the other hand, proposed four principles of constructivism: 1) knowledge is not passively accumulated, but the result of active construction by the individual, 2) cognition is an adaptive process that happens when confronting new experiences or when an experience does not match a prior experience, 3) cognition organizes, analyses, and makes sense of one's experience, but is not a process of gaining knowledge, 4) learning is not only influenced by cognition but also the environment, such as that of social and cultural interactions [62].

Since an academic setting usually involves teachers and classmates or friends, many educational researchers have made efforts to further study social constructivism to create a high-quality learning environment, sometimes known as a constructivist classroom [63]. Tam [63] proposed four essential characteristics of a constructivist learning environment for the implementation of teaching strategies: 1) knowledge is shared between teachers and students, 2) teachers and students share authority in the process of learning, 3) a teacher plays the role of a facilitator or guide, and 4) small learning groups established by a small number of heterogeneous students are used to complement each other's weaknesses [63].

The founder of social constructivist theory, Lev Vygotsky [64] stated that learning happens with the assistance of other people through interactions. He also pointed out that if the given task is too difficult for an individual to master alone, it can be mastered with the assistance or guidance of others who are more experienced and skilled [64]. If we can find ways to improve communication and understanding between the learner and educator, learning can thus, be more efficient and effective. At present, there are many teachers, parents, and educators trying to help people with ASD learn; however, because face-to-face communication is the most significant impairment of people with ASD, it is difficult as assistance cannot be established due to their feeling of discomfort. As a

result, it is challenging for them to gain enough independence to comfortably survive in society [14].

Recently, Pham [31] pointed out that there has been a rapid increase in the numbers of virtual learning (online classes) and that there is a need for additional studies on how to best achieve high-quality educational outcomes through it [31]. He combined the Community of Inquiry Model (COI) and social constructivist theory to explain how vital the channels of communication (chat boxes, text messages, and video chat) can be in constructing knowledge in an online learning setting. According to Pham [31], the COI model focuses on three critical components of the online educational experience in shaping a student's educational process – a sense of belonging to a learning community (social presence), the conscious engagement with the course's learning content (cognitive presence), and tangible support from an instructor (teaching presence). However, the origin of the COI model did not consider the context of online learning. Therefore, Pham [31] conducted a study to close the knowledge gap through a qualitative analysis of student experiences in an online course. He concluded that educators could make use of online synchronous and asynchronous communication to develop and maintain these three components from the COI model to improve their students' engagement further, hopefully leading to improved knowledge construct [31].

From the results of Pham's [31] study, he strongly encourages educators to pay attention and make full use of different channels as students value these modes of communication as a means of interacting with one another, which would assist in their construction of knowledge. He strongly believes that without a student's engagement, no learning will occur [31]. It is therefore important to extend his research findings in the field of special needs and inclusive education which support students with ASD. Investigating how online communication can support people with ASD in their learning could help them overcome their difficulties encountered during face-to-face communication, which is a necessary process for the successful learning of essential life skills. Detailed information for the proposed framework for the future study will be discussed in later sections.

C. Online Communication for People with ASD

Many research studies agree on the role of communication in the process of learning and its correlation with academic performance [32]. So much so, that many educational institutions now focus on training educators and parents – in hopes that through effective communication, they will be able to improve a student's learning process [32], [33]. According to Ndongko & Agu [32], if successful and effective communication between the teacher and the student occurs, the teacher is then able to identify the student's needs, address these needs, and thus, create a better learning environment that may include activities which can improve learning outcomes [32]. On top of that, better communication would also promote active participation, which would help students construct and internalize what they have learnt [33]. When teaching students with ASD, having effective communication is vital; unlike typically developing students, most students with ASD have increased difficulties in learning due to language impairments from their disorder [35]. And yet, while many past studies have been focused on the field of ASD, there is still a lack of research related to the channels of communication used or how these channels would impact effective communication amongst adolescents with ASD. Therefore, it is vital to conduct further studies to discover new insights into how the channels of communication (online vs offline) provide different benefits to people with ASD.

Although various theories and past research studies have proven that people with ASD suffer from persistent deficits in social communication and social interaction, Newton, Kramer & Mclntosh [65] argued otherwise, pointing out in their research that the similarity in language usage between ASD and neurotypical (not characterized by any neurologically atypical patterns of thought or behaviour) bloggers suggest that the deficits in social communication are likely due to the social context in which their communication skills are tested rather than their language ability [1], [3], [4], [65], [66]. Through the Linguistic Inquiry and Word Count (LIWC) program, Newton, Kramer & Mclntosh [65] discovered that the groups of neurotypical (NT) bloggers and individuals with ASD used nearly identical words, causing them to strongly believe that if people with ASD are given enough time to process socio-emotional information (conversations, thoughts, and emotions) and are not required to practice or interpret non-verbal communication, there would be no significant difference between NT and people with ASD [65].

"The internet has been to the autistic community what sign language has been to the deaf community; a channel of communication that allows them to speak for themselves.", said Justin Muggleton, a blogger with ASD [65]. With online communication, there are many ways that people with ASD could take advantage of situations that would not be possible in the context of face-to-face communication. For example, some software features and web applications can enhance the learning process of children with ASD [67]; the system of creating profiles could provide a better understanding of people with ASD and others to avoid unnecessary social judgment or miscommunication [68]; and the absence of "social rules" could allow people with ASD to feel safe, freely express themselves, and talk to someone interested in building a relationship with them [41]. It was also noted that online video games as a hobby and communicating with others in the gaming platform could immensely help young adults with ASD improve various aspects of their life, including their social development, emotional awareness and regulation, cognitive and physical skills, academic or career skills, creativity, and as a coping mechanism by escaping the "real world" [41].

On the other hand, several recent studies have discovered that while online communication may benefit people with ASD in social interaction, it may also result in unpleasant outcomes. Phillips and Anderson [37] mentioned that adolescents with ASD may be more vulnerable to cyberbullying and that there is a higher chance of misinterpretations during online communication, possibly because they do not use programs and services that have been tailored specifically for people with ASD, along with a lack

of awareness on how to navigate the online environment safely and responsibly [36]. Additionally, as there are many different engagement styles of social interaction, it is very difficult for adolescents with ASD to understand all online information presented and engage with people who use different communication styles [35].

People with ASD, especially in the high-functioning category, also reported high levels of satisfaction with their online social life and made many friends online. However, as a majority of their online social life is based on games and the internet, they have a low level of satisfaction with their real lives from the overuse of computer-mediated communication rather than more conventional ways of interaction, such as face to face communication and letter writing [38], [69]. Various past research studies have also stated the negative impact of spending too much time on games and the internet [70], [71]. One example is that as ASD has prevalent neurological symptoms and people with ASD tend to have a higher risk of getting heart diseases, diabetes, and obesity due to their sedentary lifestyle, it is recommended that people with ASD – especially children who are developing motor coordination and cardiovascular fitness – engage in physical exercises and activities to improve not only their physical health but also their mental health [39], [72]. It has also been proven that exercise can reduce the levels of frustration, stress, anxiety, and depression of people with ASD [73], [74]. Unfortunately, the more time people spend online, the less they engage in physical activities. As such, more studies are required to find a better balance between utilizing the benefit of online communication while still engaging in physical activity for supporting people with ASD.

D. Online Synchronous and Asynchronous Communication for People with ASD

Unlike the conventional way of classifying channels of communication as verbal and non-verbal communication, communication can now be classified as online and offline (face to face communication), and further into synchronous and asynchronous communication [43], [44]. To better explain, synchronous communication happens when you send a message and the recipient processes and responds immediately; while asynchronous communication happens when you send a message without expecting an immediate response, such as through an email or a discussion forum [75]. Hence, many research studies have investigated the effectiveness of asynchronous communication and how to implement it in different fields such as that of business and education – as it may be even more efficient than synchronous communication (communication that occurs in "real-time") in certain aspects [43]-[45]. However, as online asynchronous communication is still a relatively new area, it is not studied and implemented in inclusive education and special needs programs, although some conventional classroom education programs have started to convert their systems into that of hybrid learning (a combination online and offline learning) [31], [34].

Since there is a growing trend of hybrid learning, both educational and psychosocial organizations have implemented online programs rather than just a conventional classroom [31]. However, since the concept of asynchronous communication such as discussion forums, weblogs, emails, and social media messaging is relatively new in the field of education and psychology, as well as uncommon in a conventional offline setting, many recent research studies have begun to explore its effectiveness [31], [43]-[45]. These research studies, however, only explored how asynchronous communication is implemented in either typical education or outside an ASD centric educational setting – creating a gap in our understanding of how it may benefit people with ASD in the context of online learning.

Presently, there are three significant differences between online synchronous and asynchronous communication that could influence the communication skills of people with ASD. These include online asynchronous communication allowing users to have more time to process the received information and reply with their responses; fewer distracting signals – which could affect people with ASD due to their atypical sensory processing; and the lack of requirement for the practice and interpretation of non-verbal communication such as facial features or tone of voice [38], [65]. With the absence of an instant response and non-verbal communication, online asynchronous communication provides a spatial and temporal distance between communicators and allows one to work at one's convenience and pace – thus, fitting the needs of people with ASD [38].

Asynchronous communication is particularly beneficial as people with ASD often face the difficulties of being unable to process information quickly, recognize others' emotions and nonverbal cues, respond quickly, and more in face-to-face communication [76]. In 2009, Newton, Kramer, and Mclntosh discovered that individuals with ASD have begun to enjoy using weblogs via the internet for personal expression. They also pointed out that communicating in weblogs would not only bypass deficits in social interaction but also introduce asynchronous communication, so that people with ASD could take their time in processing communicated information and expressing their thoughts and feelings [65]. In fact, various studies have also discovered that people with ASD enjoy using online asynchronous communication as it greatly benefits them in different ways, such as improved relationship development, social skills, and mental health [12], [43], [77]-[79].

On top of that, Tomczak [43] mentioned that one possible solution for overcoming the communication problems of employees with ASD is to implement a digitized work environment and replace conventional interpersonal communication with electronic forms of communication. Wu [44] and Goh, Di Gangi and Gunnells [45] also investigated this area and tried to implement online asynchronous communication in teaching Team-Based Learning (TBL) and English as a Foreign Language (EFL) to contribute to hybrid learning in school. However, among all the relevant studies between the year of 2015 to 2020 in the Scopus indexed journals, none have been focused on how online asynchronous communication can benefit people with ASD in learning or in the implementation of online asynchronous communication into inclusive education and special needs programs.

Furthermore, it has been noted that people with ASD have been communicating with others using an online

asynchronous communication platform as they are motivated to maintain an interpersonal relationship [26], [78], [79]. Three recent studies were conducted in different contexts by different researchers yet resulted in the same conclusion as above. Among them, Gavin, Rees-Evans, and Brosnan [78] discovered that adults with ASD have started online dating, as dating face to face involves a range of complex social skills that people with ASD often find challenging. Online dating often uses an asynchronous communication style, helping people with ASD overcome the difficulties of face-to-face communication [78]. Vine Foggo, Webster, and Dixon [79] found that online forums, an asynchronous communication platform, enabled people with ASD to share their social experiences. Participants from their study showed high frequency and quality of responses, and they motivated each other for reciprocal conversation and the discussion of new topics [79]; while Gallup and colleagues [26] discovered that people with ASD showed the desire to socialize, interact, and frequently communicated in online games, thereby slowly learning social skills which can be transferred into real-life [26]. Hence, although people with ASD face difficulty in social communication, they are still interested in building and maintaining interpersonal relationships. Thus, supporting them by helping them cope with their social disabilities will improve not only their social life but also their psychological well-being [80].

That being said, it is important to note that while the earlier studies have shown how online asynchronous communication have greatly supported people with ASD, it may be because of other reasons such as the biological nature and tendency of people to look for a romantic partner, common and interesting shared topics, and the enthusiasm of gaming rather than the direct impact of online asynchronous communication. It is also important to mention that while these studies have shown positive results, it does not mean that the same may apply to the context of learning – one of the most important aspects that could change the lives of people with ASD. If we can find a way to improve the learning of people with ASD during their educational process, they would be able to become more independent and better fit into society during their adulthood. Therefore, it is crucial to explore how online asynchronous communication facilitates learning among people with ASD.

E. Adolescents with ASD

Among the Asia Pacific region, Malaysia has one of the highest numbers of social media users, consisting of 53% of the population [81]. To be more specific, 80.3% of these social media users are aged 13-34; with 16.3% of them being between the ages of 13-17, 34.5% between the ages of 18-24, and 29.5% between the ages of 25-34 [82]. These users frequently access social media such as Facebook and Instagram daily, as it serves them different functions – including socialization, education, entertainment, work, and information seeking [83], [84]. It is evident that the trend of using online communication begins in adolescence, so this opportunity should be taken to improve programs and support people with ASD, as face-to-face communication is one of their greatest difficulties.

On top of that, recent studies have found that self-injurious behaviours (SIB) have a higher prevalence at the adolescent age (13-19 years old) for people with ASD and occur more frequently than any other type of intellectual disability [85]-[87]. Duerden and colleagues [88] found that slightly less than half of younger children with ASD (0-6 years old) and more than half of the older children and adolescents with ASD (7-19 years old) committed acts of self-injury in the past [88]. In their study, it appears that atypical sensory processing and the need for sameness were the largest factors that contributed to SIB; followed by low cognitive ability and low socialization skills; while age, impairments of functional communication (communicating one's basic wants and needs), and ritualized behaviour did not significantly contribute to SIB [88]. Atypical sensory processing refers to the sensory deficits across multiple aspects, including vision, hearing, touch, olfaction, gustation, and multisensory integration [89]. A malfunction in these processes will greatly and negatively affect social skills and interpersonal relationships [89]. Need for sameness refers to the insistence of a person's environment (including contexts, items, and people) to remain the same in appearance and sequence [90]. Although there is nothing wrong with the need for sameness, it often resulted in a restricted range of activities, rigidity of behaviours, resistance to change, and insistence on performing idiosyncratic rituals and routines [90]. As such, since most clinicians presently work on supporting adolescents with ASD manage their atypical sensory processing, it is critical for more studies on the exploration of better and more creative ways to support those with ASD in overcoming their communication impairment [88]. This is because an improved communication ability could lead to improving their social communication and reduce the need for sameness which produces anxiety, thus improving mental health [88].

Besides that, it appears that while individuals with ASD tend to excel at typical high school education subjects focused on science, technology, engineering, and mathematics (STEM) due to their innate ability for solving complex problems, high attention to detail, and an ability to hyper-focus on selected tasks; they continue to underperform in comparison to their peers due to a lack of socializing skills and the ability to collaborate with others [91]. Based on the findings of past studies, encouraging students with ASD to develop skills such as making eye contact, listening to others, and emotional recognition would provide them with the necessary support needed [91], [92]. While the development of communication skills appears to occur naturally without any effort, for most of us, it requires great effort to learn not only how to convey your message to others, but also in understanding how people use messages to generate meaning within and across various contexts, cultures, channels, and media [93]. Unfortunately, people with ASD appear unable to develop these communication skills without support [53]. Hence, communication education plays a significant role in fostering the learning of communication skills by enhancing the quality of classroom instructions and educational environments [94].

IV. Conceptual Model Development

This conceptual paper attempts to understand the learning experiences among people with ASD through online synchronous and asynchronous communication, and will be based on literature reviews from past research studies and theories. The Fig. 1 illustrates the conceptual framework for the reference of future studies. It combines the findings of studies mentioned earlier, and attempts to extends the findings of Pham [31] by investigating the context of online learning for adolescents with ASD instead of focusing on neurotypical students. The foundation of this framework is built based on the theory of social constructivism.

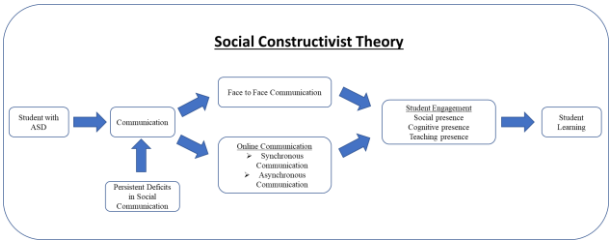

Fig. 1. Conceptual framework.

This conceptual framework proposes that students must communicate via face to face or online communication during student engagement activities such as group assignments, exams and discussions among one another (teachers, students, classmates, etc.) to successfully learn effectively. The three critical elements in student engagement are key to creating a positive and effective educational experience and include interactions with peers (social presence), interactions with content (cognitive presence), and interactions with an educator (teaching presence) [95]. This is indeed consistent with the theory of social constructivism by Vygotsky [64], that the ultimate goal of the presence of social, content, and teaching is to create more opportunities for student engagement – which will eventually lead to enhancing a student's learning. In addition, this framework is suitable to be implemented in the high school education as high school education provides the perfect opportunity for student engagement which often requires group assignments, written exams and discussions between parties including the teachers, students and their classmates or friends, thus providing these opportunities for learning.

However, due to the nature of the persistent deficits in social communication in ASD, even high functioning students face challenges in communication, thus leading to low quality of student engagement. These days however, with technological advancements, students can utilize the benefits of online communication to overcome their challenges in social communication rather than relying solely on face-to-face communication in engagements. In addition, future studies should also extend the analysis of student engagement into two different categories – online synchronous and asynchronous communication. It is crucial to investigate the synchronicity (synchronous vs asynchronous) of communication as it provides a different set of advantages and disadvantages which would affect the targeted population differently. This is especially true for people with ASD, as they face many difficulties in face-to-face communication and synchronous communication, yet are able to gain support through online communication and asynchronous communication [5], [41], [78], [79].

V. Implication

This conceptual paper intends to provide new insights by compiling and discussing the review of past literatures and theories. This paper attempts to further extend the application of the social constructivist learning theory and the findings of Pham [31] to better understand the aspect of learning through online synchronous and asynchronous communication among adolescents with ASD [31]. In addition, this conceptual paper also discusses the main difficulty (persistent deficit in social communication) of people with ASD and some relatively new insights regarding the support that people with ASD received through the exploration of the use of online communication, online synchronous and asynchronous communication. This conceptual paper attempted to apply these insights to the context of learning. This is also because it was found that there is a higher prevalence of SIB in adolescents with ASD and their lack of socialization skills negatively impacts their learning experience. Yet, there is an increasing trend in the use of online communication amongst them – hence, the creation of a new conceptual framework for the reference of future studies. The discussions in this research paper are meant to supplement the literature for academics as a reference for their research. It is recommended that further studies examine the ideas and concepts of this paper by collecting empirical data for use in their research.

VI. Conclusion

While there has indeed been great strides in providing support for students with ASD, such as studies about improving educational systems and the use of inclusion education [12]; involving parents and family members in interventions [20]; and training teachers and caregivers to better support students with ASD [33] – it is still a widely complex area that requires more work as no single method can account for and provide the necessary support for everyone with ASD. Besides, several studies have proven that people with ASD have the motivation to form relationships, especially romantic ones [5], [34], [96], [97]. The main reason for them not having a relationship is often because of their inability to form and maintain them due to social impairments rather than a lack of desire.

According to the communication theory and most learning theories such as cognitivism, constructivism, and humanism, communication is one of the most crucial parts of learning, and the power of communication within the learning process should never be underestimated [98]. Not only does it reflect personal motivation and needs, but good communication also dictates the effectiveness of learning, rather than vice versa [98]. It is also important to note that not only is communicating through language essential, but also the mediums used [99].

Although many educational and psychological interventions exist, the addition of new ways to better support

people with ASD are always welcomed as these may help them effectively learn how to become more independent. Since both online synchronous and asynchronous communication are implemented into most academic programs, mainly due to COVID-19, the flexibility of the learning environments offered by online and hybrid learning modalities may lead to more powerful social connections while enhancing the learning of individuals with ASD. This is especially important for adolescents with ASD as helping them improve their learning capabilities can help them develop the necessary skills for building independence and gaining future employment.

This conceptual paper intends to provide new ideas and concepts for future studies in the fields of education and psychology to better support people with ASD. It is also recommended that future studies study the learning experiences through online synchronous and asynchronous communication of people with ASD – a relatively new area– as it may provide better support for people with ASD, thus possibly allowing them to become independent, blend into society, and better maximize their full potential [13]-[15].

CONFLICT OF INTEREST

The authors declare no conflict of interest regarding the publication of this paper

AUTHOR CONTRIBUTIONS

Aevent Koh is mainly in charge of the research and analysis work as it is a part of his Ph.D. dissertation; Dr. Jasmine is the main supervisor, Dr. Logendra is the co-supervisor, and Assoc. Prof. Anasuya is the external co-supervisor of the research, and all authors have approved the final version.

ACKNOWLEDGMENT

This study is conducted under the Taylor's Research Excellence Scholarship (Ph.D.).

REFERENCES

[1] American Psychiatric Association (APA), *Diagnostic and Statistical Manual of Mental Disorders, 5th ed.* Arlington, VA: American Psychiatric Publishing, 2013.

[2] Early Autism Project (EAP). (2019). The hope project. [Online]. Available: https://www.autismmalaysia.com/the-hope-project/

[3] C. Küpper, S. Stroth, N. Wolff, F. Hauck, N. Kliewer, T. Schad-Hansjosten *et al.*, "Identifying predictive features of autism spectrum disorders in a clinical sample of adolescents and adults using machine learning," *Scientific Reports*, vol. 10, no. 1, article 4805, 2020.

[4] P. Howlin, *Autism: Preparing for Adulthood*, London: Routledge, 1997.

[5] M. E. Roth and J. M. Gillis, "Convenience with the click of a mouse: A survey of adults with Autism Spectrum Disorder on online dating," *Sexuality and Disability*, vol. 1, p. 133, 2015.

[6] World Health Organization. (2019). Autism spectrum disorders. [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders

[7] J. Baio, L. Wiggins, D. L. Christensen *et al.*, "Prevalence of autism spectrum disorder among children aged 8 years — Autism and developmental disabilities monitoring network, 11 sites, United States," *MMWR SurveillSumm 2018*, vol. 67, no. 6, pp. 1-23, 2018.

[8] L. Joanna. (2015). Living with autism in Malaysia. *IDEAS*. [Online]. Available: http://ideas.org.my/wp-content/uploads/2017/02/living-with-autism.pdf

[9] Centers for Disease Control and Prevention (CDC). (2021). Data & statistics on autism spectrum disorder. [Online]. Available: https://www.cdc.gov/ncbddd/autism/data.html

[10] National Autism Society of Malaysia (NASOM). (2021). Autism. [Online]. Available: http://www.nasom.org.my/autism/

[11] Ministry of Health Malaysia (MOH). (2014). Clinical practice guidelines: Management of autism spectrum disorder in children and adolescents. [Online]. Available: http://www.moh.gov.my/moh/attachments/CPG%202014/CPG%20Management%20of%20Autism%20Spectrum%20Disofer%20in%20Children%20and%20Adolescents.pdf

[12] B. G. Stone, K. A. Mills, and B. Saggers, "Online multiplayer games for the social interactions of children with autism spectrum disorder: A resource for inclusive education," *International Journal of Inclusive Education*, vol. 2, p. 209, 2019.

[13] L. K. Koegel, K. Sarah, K. S. Anjileen, and L. K. Robert, "Improving generalization of peer socialization gains in inclusive school settings using initiations training," *Behavior Modification*, vol. 36, no. 3, pp. 361-377, 2012.

[14] L. Watkins, M. O'Reilly, M. Kuhn, C. Gevarter, G. Lancioni, J. Sigafoos, and R. Lang, "A review of peer-mediated social interaction interventions for students with autism in inclusive settings," *Journal of Autism and Developmental Disorders*, vol. 45, no. 4, pp. 1070-1083, 2015.

[15] K. Ozerk, "Prevalence of autism/ASD in the capital city of Oslo, Norway," *International Electronic Journal of Elementary Education*, vol. 11, no. 1, pp. 23-30, 2018.

[16] L. Wing, "The continuum of autistic characteristics," *Diagnosis and Assessment in Autism*, Springer: Berlin, 1988, pp. 91-110.

[17] G. Casey and T. Evans, "Designing for learning: Online social networks as a classroom environment," *International Review of Research in Open and Distance Learning*, vol. 12, no. 7, pp. 1-26, 2011.

[18] D. Bjekić, S. Obradović, M. Vučetić, and M. Bojović, "E-teacher in inclusive e-education for students with specific learning disabilities," *Procedia - Social and Behavioral Sciences*, vol. 128, pp. 128-133, 2014.

[19] J. Roberts and K. Simpson, "A review of research into stakeholder perspectives on inclusion of students with autism in mainstream schools," *International Journal of Inclusive Education*, vol. 20, no. 10, pp. 1084-1096, 2016.

[20] G. Yakubova, E. Hughes, and B. Chen, "Teaching students with ASD to solve fraction computations using a video modeling instructional package," *Research in Developmental disabilities*, vol. 101, no. 103637, 2020.

[21] V. Bravou and A. Drigas, "A contemporary view on online and web tools for students with sensory & learning disabilities," *International Journal of Online & Biomedical Engineering*, vol. 15, no. 12, pp. 97-105, 2019.

[22] P. A. Cinquin, P. Guitton, and Sauzéon, "Online e-learning and cognitive disabilities: A systematic review," *Computers and Education*, vol. 130, pp. 152-167, 2019.

[23] L. Scott and P. Temple, "A conceptual framework for building UDL in a special education distance education course," *Journal of Educators Online*, vol. 14, no. 1, 2017.

[24] P. Vidhya and J. Meena Kumari, "Analysis and evaluation of computer Apps for special education," *International Journal of Advanced Research*, vol. 4, no. 4, pp. 1620-1625, 2016.

[25] M. W. Ok, M. K. Kim, E. Y. Kang, and B. R. Bryant, "How to find good apps: An evaluation rubric for instructional apps for teaching students with learning disabilities," *Intervention in School and Clinice*, vol. 51, no. 4, pp. 244-252, 2016.

[26] J. Gallup, C. Duff, B. Serianni, and A. Gallup, "An exploration of friendships and socialization for adolescents with autism engaged in Massively Multiplayer Online Role-Playing Games (MMORPG)," *Education & Training in Autism & Developmental Disabilities*, vol. 51, no. 3, pp. 223-237, 2016.

[27] D. Moore, Y. Cheng, P. McGrath, and N. J. Powell, "Collaborative virtual environment technology for people with autism," *Focus on Autism and Other Developmental Disabilities*, vol. 20, pp. 231-243, 2005.

[28] T. Lersilp and S. Lersilp, "A guideline of using assistive technologies and educational services for students with disabilities in higher education," *American Journal of Applied Sciences*, vol. 14, no. 5, pp. 526-532, 2017.

[29] E. H. Erikson, *The Life Cycle Completed*, NY: Norton, 1982.

[30] P. T. Shattuck, G. I. Orsmond, M. Wagner, and B. P. Cooper, "Participation in social activities among adolescents with an Autism Spectrum Disorder," *PLoS One*, vol. 4, no. 11, 2011.
[31] L. Pham. (2020). Peabody online Ed.D. in leadership and learning in organizations. [Online]. Available: https://www.vanderbilt.edu/bold/docs/peabody-online-ed-d-in-leadership-and-learning-in-organizations/
[32] T. Ndongko and A. Agu, "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*, vol. 31, no. 1, pp. 205-221, 1985.
[33] M. Zhou and D. Brown, *Educational Learning Theories*, 2nd ed., Education Open Textbook, 2015.
[34] D. Swain, A. Scarpa, S. White, and E. Laugeson, "Emotion dysregulation and anxiety in adults with ASD: Does social motivation play a role?" *Journal of Autism & Developmental Disorders*, vol. 45, no. 12, pp. 3971-39771, 2015.
[35] C. Hartley, K. Bird, and P. Monaghan, "Comparing cross-situational word learning, retention, and generalization in children with autism and typical development," *Cognition*, vol. 200, 2020.
[36] A. Anderson, and A. L. Phillips, "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*, vol. 10, no. 3, 2019.
[37] A. L. Phillips, and A. Anderson, "Cyberbullying, digital citizenship, and youth with autism: LIS education as a piece in the puzzle," *Library Quarterly*, vol. 90, no. 3, pp. 264-282, 2020.
[38] C. Aa, M. M. H. Pollmann, A. Plaat, and R. J. Gaag, "Computer-mediated communication in adults with high-functioning autism spectrum disorders and controls," *Research in Autism Spectrum Disorders*, vol. 23, pp. 15-27, 2016.
[39] E. Yarimkaya and O. L. Esenturk, "Promoting physical activity for children with autism spectrum disorders during coronavirus outbreak: benefits, strategies, and examples," *International Journal of Developmental Disabilities*, 2020.
[40] H. Abbas, F. Garberson, S. Liu-Mayo, E. Glover, and D. P. Wall, "Multi-modular AI approach to streamline autism diagnosis in young children," *Scientific Reports*, vol. 10, no. 1, 2020.
[41] E. H. Finke, B. D. Hickerson, and J. M. D. Kremkow, "To be quite honest, if it wasn't for video games I wouldn't have a social life at all: Motivations of young adults with autism spectrum disorder for playing video games as leisure," *American Journal of Speech-Language Pathology*, vol. 27, no. 2, pp. 672-689, 2018.
[42] J. Gallup, M. E. Little, B. Serianni, and O. E. Kocaoz, "The potential of virtual environments to support soft-skill acquisition for individuals with autism," *Qualitative Report*, vol. 22, no. 9, pp. 2509-2532, 2017.
[43] M. T. Tomczak, "Employees with autism spectrum disorders in the digitized work environment: Perspectives for the future," *Journal of disability policy studies*, vol. 31, no. 4, 2020.
[44] Z. Wu, "Tracing EFL writers' digital literacy practices in asynchronous communication: A multiple-case study," *Journal of Second Language Writing*, vol. 50, 2020.
[45] S. H. Goh, P. M. Gangi, and K. Gunnells, "Teaching yip applying team-based learning in online introductory information system courses," *Journal of Information Systems Education*, vol. 31, no. 1, pp. 1-11, 2020.
[46] S. Ramachandram, "Clinical characteristics and demographic profile of children with Autism Spectrum Disorder (ASD) at child development clinic (CDC), Penang Hospital, Malaysia," *Medical Journal of Malaysia*, vol. 74, no. 5, pp. 372-376, 2019.
[47] M. Freeth, E. Milne, E. Sheppard, and R. Ramachandran, "Autism across cultures: Perspectives from non-western cultures and implications for research," *Handbook of Autism and Pervasive Developmental Disorders*, vol. 2, pp. 997-1013, 2014.
[48] T. T. X. Neik, L. W. Lee, H. M. Low, N. K. H. Chia, and A. C. K. Chua, "Prevalence, diagnosis, treatment, and research on autism spectrum disorders (ASD) in Singapore and Malaysia," *International Journal of Special Education*, vol. 29, pp. 82-92, 2014.
[49] K. Llias, J. H. J. Liaw, K. Cornish, M. Sang-Ah Park, and K. J. Golden, "Wellbeing of mothers of children with "A-U-T-I-S-M" in Malaysia: An interpretative phenomenological analysis study," *Journal of Intellectual & Developmental Disability*, vol. 42, no. 1, pp. 74-89, 2017.
[50] C. Psaltis, A. Gillespie, and A. Perret-Clermont, *Social Relations in Human and Societal Development*, UK: Palgrave Macmillan, 2015.
[51] M. O. Mazurek, "Loneliness, friendship, and well-being in adults with autism spectrum disorders," *Autism*, vol. 18, no. 3, pp. 223-232, 2014.
[52] L. E. Hewitt, "Perspectives on support needs of individuals with autism spectrum disorders: Transition to college," *Top Lang Disorders*, vol. 31, no. 3, pp. 273-285, 2011.
[53] P. J. Prelock and N. W. Nelson, "Language and communication in autism: An integrated view," *Pediatric Clinics of North America*, vol. 59, no. 1, pp. 129-145, 2012.
[54] L. Haile, M. J. Gallagher, and R. J. Robertson, *Perceived Exertion Laboratory Manual*, NY: Springer, 2015.
[55] P. Mundy and J. Stella, "Joint attention, social orienting, and nonverbal communication in autism," *Autism Spectrum Disorders: A transactional Developmental Perspective*, vol. 9, pp. 55-77, 2000.
[56] S. Baron-Cohen, *Mindblindness: An Essay on Autism and Theory of Mind*, US: Bradford Books, 1995.
[57] R. J. Landa, K. C. Holman, and E. Garrett-Mayer, "Social and communication development in toddlers with early and later diagnosis of autism spectrum disorders," *Arch Gen Psychiatry*, vol. 67, no. 7, pp. 853-864, 2007.
[58] C. Whalen and L. Schreibman, "Joint attention training for children with autism using behavior modification procedures," *J. Child Psychol. Psychiatry*, vol. 44, no. 3, pp. 456-468, 2003.
[59] C. Whalen, L. Schreibman, and B. Ingersoll, "The collateral effects of joint attention training on social initiations, positive affect, imitation, and spontaneous speech for young children with autism," *J. Autism Dev. Disord.*, vol. 36, no. 5, pp. 655-664, 2006.
[60] P. A. Ertmer and T. J. Newby, "Behaviorism, cognitivism, constructivism: Comparing critical features from an instructional design perspective," *Performance Improvement Quarterly*, vol. 6, no. 4, pp. 50-72, 1993.
[61] D. C. Phillips, "The good, the bad, the ugly: The many faces of constructivism," *Educational Researcher*, vol. 24, no. 7, pp. 5-12, 1995.
[62] E. von Glasersfeld, "An introduction to radical constructivism," *The Invented Reality*, NY: Norton, 1984, pp. 17-40.
[63] M. Tam, "Constructivism, instructional design, and technology: Implications for transforming distance learning," *Educational Technology and Society*, vol. 3, no. 2, 2000.
[64] L. S. Vygotsky, *Mind in Society: The Development of Higher Psychological Processes*, Cambridge, MA: Harvard University Press, 1978.
[65] T. Newton, A. D. I. Kramer, and D. N. Mclntosh, "Autism online: A comparison of word usage in bloggers with and without autism spectrum disorders," *Conference on Human Factors in Computing Systems – Proceedings*, pp. 463-466, 2009.
[66] L. C. Lee, R. A. Harrington, B. B. Louie, and C. J. Newschaffer, "Children with autism quality of life and parental concerns," *Journal of Autism and Developmental Disorders*, vol. 38, no. 6, pp. 1147-1160, 2008.
[67] L. R. Silva, A. P. Silva, N. C. Elias, and S. Isotani, "Computational approaches for literacy of children with autism: A systematic mapping," *Interactive Learning Environments*, 2020.
[68] S. Nichols, *Girls Growing Up on the Autism Spectrum: What Parents and Professionals Should Know About the Pre-Teen and Teenage Years*, London: Jessica Kingsley Publishers, 2009.
[69] C. Finkenauer, M. M. Pollmann, S. Begeer, and P. Kerkhof, "Brief report: Examining the link between autistic traits and compulsive internet use in a non-clinical sample," *Journal of Autism and Developmental Disorders*, vol. 42, no. 10, pp. 2252-2256, 2012.
[70] K. Y. A. McKenna and J. A. Bargh, "Plan 9 from cyberspace: The implications of the internet for personality and social psychology," *Personality and Social Psychology Review*, vol. 4, no. 1, pp. 57-75, 2000.
[71] M. S. Sheeks and Z. P. Birchmeier, "Shyness, sociability, and he use of Computer-Mediated Communication in relationship development," *CyberPsychology & Behavior*, vol. 10, no. 1, pp. 64-70, 2007.
[72] World Health Organization. (2008). The world health report 2008 — Primary health care (Now more than ever). [Online]. Available: https://www.who.int/whr/2008/en/
[73] D. B. Allison, V. C. Basile, and R. B. MacDonald, "Brief report: Comparative effects of antecedent exercise and lorazepam on the aggressive behavior of an autistic man," *Journal of Autism and Developmental Disorders*, vol. 21, pp. 89-94, 1991.
[74] A. Hillier, D. Murphy, and C. Ferrara, "A pilot study: Short-term reduction in salivary cortisol following low level physical exercise and relaxation among adolescents and young adults on the autism spectrum," *Stress and Health*, vol. 27, pp. 395-402, 2011.
[75] F. P. Lim, "An analysis of synchronous and asynchronous communication tools in e-learning," *Conference: ASTL proceedings of*

the 9th International Conference on Advanced Science and Technology, vol. 143, 2017.
[76] C. K. Duff and J. J. Flaterry Jr, "Developing mirror self-awareness in students with Autism Spectrum Disorder," *Journal of Autism and Developmental Disorders*, vol. 44, pp. 1027-1038, 2014.
[77] P. Raghavendra, C. Hutchinson, E. Grace, D. Wood, and L. Newman, "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*, vol. 76, pp. 110-123, 2018.
[78] J. Gavin, D. Rees-Evans, and M. Brosnan, "Shy geek, likes music, technology, and gaming: An examination of autistic males' online dating profiles," *Cyberpsychology, Behavior, and Social Networking*, vol. 22, no. 5, pp. 344-348, 2019.
[79] R. S. Vine Foggo, A. A. Webster, and R. Dixon, "Utilisation of an online forum to engage adolescents with autism in direct participation in qualitative research," *British Journal of Special Education*, vol. 47, no. 2, pp. 208-229, 2020.
[80] Y. Ishizaki, "Psychosomatic symptoms among children and adolescents and development disabilities," *Shinshin-lgaku*, vol. 57, pp. 39-43, 2017.
[81] Go-globe. (2015). Social media usage in Asia Pacific — Statistics and trends. [Online]. Available: http://www.go-globe.com/blog/social-media-asia
[82] N. Mahadi. (2013). 13.3 million Malaysians are Facebook users. *The Borneo Post*. [Online]. Available: https://www.theborneopost.com/2013/06/16/13-3-million-msians-are-facebook-users/
[83] N. Ismail. (2014). "Young people's use of new media through communities of practice," Ph.D. dissertation, Monash University, Australia.
[84] B. Subramaniam. (2014). On the social media circuit. *The Star*. [Online]. Available: https://www.thestar.com.my/News/Education/2014/01/05/On-the-social-media-circuit/
[85] K. C. Dominick, N. O. Davis, J. Lainhart, H. Tager-Flusberg, and S. Folstein, "Atypical behaviors in children with autism and children with a history of language impairment," *Research in Developmental Disabilities*, vol. 28, pp. 145-162, 2007.
[86] J. L. Matson and M. Nebel-Schwalm, "Assessing challenging behaviors in children with autism spectrum disorders: A review," *Research in Developmental Disabilities*, vol. 28, pp. 567-579, 2007.
[87] O. C. Mudford, A. Arnold-Saritepe, K. Phillips, J. M. Locke *et al.*, "Challenging behaviors," *Clinical Assessment and Intervention for Autism Spectrum Disorders*, pp. 267-297, Elsevier Science, Inc., Oxford, 2008.
[88] E. G. Duerden, H. K. Oatley, K. M. Mak-Fan, P. A. McGrath, M. J. Taylors, P. Szatmari *et al.*, "Risk factors associated with self-injurious behaviors in children and adolescents with autism spectrum disorders," *Journal of Autism and Developmental Disorders*, vol. 42, pp. 2460-2470, 2012.
[89] M. Thye, H. Bednarz, A. Herringshaw, and E. Sartin, "The impact of atypical sensory processing on social impairments in autism spectrum disorder," *Developmental Cognitive Neuroscience*, vol. 29, 2017.
[90] F. R. Volkmar, *Encyclopedia of Autism Spectrum Disorders*, New York, NY: Springer-Verlag, 2013.
[91] X. Wei, J. W. Yu, P. Shattuck, M. McCracken, and J. Blackorby, "Science, technology, engineering, and mathematics (STEM) participation among college students with an Autism Spectrum Disorder," *Journal of Autism and Development Disorders*, vol. 43, pp. 1539-1546, 2013.
[92] M. Fessenden, "Students with autism gravitate toward STEM majors," *Scientific American*, pp. 2-4, 2013.
[93] C. J. Korn, S. P. Morreale, and M. Boileau, "Defining the field: Revisiting he ACA 1995 defining of communication studies," *Journal of the Association for Communication Administration*, vol. 29, pp. 40-52, 2000.
[94] S. Morreale and J. Pearson, "Why communication education is important: The centrality of the discipline in the 21st century," *Communication Education*, vol. 57, pp. 224-240, 2008.
[95] D. R. Garrison, T. Anderson, and W. Archer, "The first decade of the community of inquiry framework: A retrospective," *The Internet and Higher Education*, vol. 13, no.1-2, pp. 5-9, 2010.
[96] S. M. Eacl, C. A. Mazefsky, and N. J. Minshew, "Misinterpretation of facial expressions of emotion in verbal adults with autism spectrum disorder," *Autism*, vol. 19, no. 3, pp. 308-315, 2015.
[97] M. A. Patriquin, A. Scarpa, B. H. Friedman, and S. W. Porges, "Respiratory sinus arrhythmia: A marker for positive social functioning and receptive language skills in children with autism spectrum disorders," *Developmental Psychobiology*, vol. 55, no. 2, pp. 101-112, 2013.
[98] UKEssays, UK. (2018). Learning and communication theories. [Online]. Available: https://www.ukessays.com/essays/education/learning-and-communication-theories.php
[99] B. V. Ruler, "Communication theory: An underrated pillar on which strategic communication rests," *International Journal of Strategic Communication*, vol. 12, no. 4, pp. 367-381, 2018.

Aevent Koh Kian Seng is a PhD candidate in the School of Education, Taylor's University, Malaysia. He earned his master's in counseling and bachelor in psychology from HELP University, Malaysia. He is currently a licensed and registered counselor in Malaysia. He is passionate and specializes in couple, marriage, and family therapy.

Jasmine Anak Jain holds a PhD and serves as a senior lecturer of education at Taylor's University. As an advocate for literacy, she leads research projects and publishes widely in areas related to learning and literacy. Besides overseeing curriculum and program development at the postgraduate level, Jasmine is also a Google Certified Trainer, which allows her to experiment various ways of integrating technology in education. Jasmine is currently the Associate Head for Research Centre of Future Learning, and the Research Coordinator for "Education for all" Impact Lab at Taylor's University, Malaysia.

Logendra Stanley Ponniah has worn many hats in Taylor's. He started his career with Taylor's as an academic staff in 2005 and received his PhD in education in 2006. In Taylor's, he has held roles, notably as, head of teaching educational development, acting director of teaching & learning and most recently, head of School for the School of Education.

Dr Logen was strongly involved in the setting up of the School of Education and contributed significantly to the development of the programmes in the School, especially the Master of Teaching & Learning and the Post Graduate Certificate in Teaching & Learning. His focus in teaching and research is in Scholarship of teaching and Learning, Curriculum, Mathematics Education and Problem-Solving

Anasuya Jegathevi Jegathesan is currently the the Dean of Psychology at Social Sciences at the University of Cyberjaya. Previously she was the Director of the Center for Human Excellence and Develop and the Program Director for the Master of Counselling at Taylors University, School of Liberal Arts and Sciences. She earned her Doctorate in Counselling from the University of South Australia, she is a licensed and practicing counsellor in Malaysia for over 15 years. She is a certified trainer in Reality Therapy and a Thanatologist and sits on the National Advisory Council for Counselling 2017-1018.

She gives talks and workshop on issues of mental health in the workplace, looking especially at practical applications and crisis interventions. She has sat on the Boards of numerous NGOs. She has conducted workshops internationally and for numerous corporations such as ROCHE, Bank Negara Malaysia, Royal Selangor, MIDF and many others. She volunteers her time as the Counsellinng Supervisor for numerous NGOs such as Kechara Soup Kitchen, PT Foundation and Malaysian Invisible Illness Association.