

Instructional Digital Model to Promote Virtual Teaching and Learning for Autism Care Centres

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Abstract—The COVID-19 pandemic has led to temporary school closures affecting over 90% of students worldwide. This has exacerbated educational inequality, particularly for students with learning disabilities such as autism spectrum disorder (ASD), whose routines, services, and support they rely on have been disrupted. To address this issue, it is important to investigate virtual teaching and learning (VTL) strategies that can provide a more effective learning experience for these unique learners. The main objectives of this research are twofold: to investigate the challenges faced by teachers and students with ASD in Malaysia when adapting to online education, and to explore how the learning process occurs during the pandemic. Additionally, the study aimed to identify suitable VTL technology for autism care centres. Four autism care centres were visited for on-site observation activities, and interviews were conducted with the care centre principals. Two sets of online questionnaires were distributed to 10 autism care centres, where 6 principals and 16 teachers provided feedback. The data collected through on-site observations, interviews, and online questionnaires, were then analysed to construct an instructional digital model (IDM) for VTL. The model is very significant as a guide for the development of VTL platform for autism care centres. Finally, a VTL platform development framework was created, which provides a structure for system developers to conduct further research on the development of VTL platform based on the IDM. The framework aims to facilitate the successful implementation of the VTL.

Keywords—Instructional digital model; virtual teaching and learning; autism; online learning; pandemic

I. INTRODUCTION

In response to the COVID-19 pandemic, the government of Malaysia implemented the Movement Control Order (MCO) which resulted in the closure of all kindergartens, public and private schools, including day schools and full boarding schools [1]. This disruption in the traditional classroom setting meant that many students, including those with special needs, were unable to continue their studies [2]. In response, online learning was implemented at home, but this has caused concern about the quality and inclusiveness of education, and the risk of many students being left behind has increased. In this new environment, schools, teachers, students, and parents have had to adapt to a new norm and method of teaching and learning [3].

Due to the pandemic, students with learning disabilities have faced significant challenges as their communication with

teachers has been hindered, and their access to educational resources has been restricted [4]. Among them, students with autism spectrum disorder (ASD) require specialised support to ensure that they can learn the same material as their peers in a manner that suits their skills and abilities [5]. Thus, a novel education approach is necessary to address the distinct requirements of these students in this new situation.

The lack of educators specialised in teaching students with special needs, particularly those with autism, presents significant difficulties in providing effective education [6]. However, there is now a glimmer of hope for enhancing teaching and learning methods for students with ASD through the progress of digital technology. Assistive and instructional technology allows students on the autism spectrum to participate more fully in their education, whether it is in their home, school, or community, thereby providing equal opportunities for students with special needs and those without [7].

To support virtual teaching and learning (VTL) for students with ASD, a special platform should be considered to allow these students to gain the same knowledge as other students, and thus reduce the learning gap between them. The challenges of teaching and learning involving students with ASD should be studied to determine the Information and Communication Technology (ICT) needs for teachers at care centres. An instructional digital model (IDM) needs to be established to guide the development and effective implementation of VTL.

Thus, this study aimed to answer the following research questions:

- 1) What are the challenges encountered by teachers and students with ASD when adopting online education, and how does the learning process unfold during the pandemic?
- 2) What type of ICT environment is required to facilitate the inclusion of students with ASD in virtual learning, particularly during a pandemic?
- 3) How can an IDM for VTL be developed for students with ASD based on the gathered information on their needs and limitations?

In order to answer the research questions, on-site visits were made to four selected autism care centres to obtain visual insight and understand what types of ICT equipment and tools are available and utilized at those centres. During these visits,

in addition to observing the premises, principals were also interviewed. Online questionnaires were created and distributed to the teachers and principals. The questionnaire aimed to obtain information about the ICT facilities available at the centres, as well as to gather feedback from teachers and principals on their profiles, perceived ICT skills, experiences, problems and challenges during pandemic, and their opinions on the potential integration of VTL. The study data were analysed and used to construct an IDM specifically for autism care centres.

This research paper aims to investigate the challenges and potential benefits of utilizing VTL for autism care centres. The following sections begin with a review of related works in the field. The methodology section describes the approach taken to conduct the research, including data collection and analysis methods. The analysis and discussion section presents the findings and examines their implications. Based on the results, recommendations are provided for the construction and implementation of the proposed IDM for autism care centres. The paper concludes with a summary of the findings, future directions for research, and the potential impact of IDM on the field of virtual teaching and learning for students with autism.

II. RELATED WORKS

A. Efforts by International Organisations

The United Nations (UN) recognises that digital technologies can be a powerful tool for individuals with ASD to access educational and vocational opportunities. Digital learning technologies have been recognised as a cost-effective way of providing specialised training and support for individuals with ASD, and they can also help to create a more inclusive society by reducing barriers to learning and employment. In 2020, the UN launched a global initiative called the "Roadmap for Digital Cooperation," which aims to ensure that everyone has access to the benefits of digital technology, including individuals with disabilities such as autism. The roadmap highlights the importance of promoting digital literacy and skills, as well as the need for accessible and inclusive digital technologies [8]. Another significant initiative is the UN's Sustainable Development Goals (SDGs), which aim to achieve universal access to quality education, including for individuals with disabilities, by 2030. SDG 4.5 specifically calls for the elimination of gender disparities in education and the promotion of inclusive and equitable education for all, including individuals with disabilities such as autism [9]. In addition to these overarching initiatives, the UN has also developed specific programs and resources to support digital learning for individuals with ASD. For example, the UNICEF Office of Research-Innocenti, in partnership with the World Autism Organisation and the International Society for Autism Research, developed a toolkit in 2020 to support the implementation of digital technologies for children with ASD. The toolkit provides guidance on how to adapt existing digital learning resources to meet the needs of children with ASD, and it includes case studies and best practices from around the world [10].

The World Health Organisation (WHO) has been actively promoting digital health through its Global Observatory for eHealth (GOe) initiative. The WHO has also published several

reports and guidelines on digital health for children with disabilities, including autism. The report highlights the importance of using digital technologies to promote health equity of children with disabilities and provides recommendations for governments and education providers [11].

The World Autism Organisation (WAO) is a non-profit organisation that focuses on improving the quality of life for individuals with ASD worldwide. WAO has launched the Autism Connection, an online community for individuals with ASD and their families. The platform provides a safe and supportive space for individuals with ASD to connect with others and share their experiences. The platform also offers resources and information on autism, including virtual events and webinars. Additionally, WAO has launched a campaign to raise awareness of the importance of virtual learning and the need to ensure that individuals with ASD have access to quality education, regardless of their location or circumstances. Through these efforts, WAO is supporting the education and development of individuals with ASD and their families, as well as the wider community [12].

B. Online Education for Individuals with ASD in Malaysia

According to the World Health Organisation (WHO), approximately 1% of children worldwide have autism [13]. In Malaysia, research indicates that the prevalence of autism has increased, with an estimated ratio of 1 in 68 individuals without autism, and around 9,000 children are born with autism each year. The Ministry of Health (MOH) reports that the number of diagnoses for autism spectrum disorder has steadily risen over the last decade, with 589 children aged 18 and under diagnosed with ASD in 2021, a 5% increase from the previous year [14].

According to the Education Act 1996, students under the responsibility of the Ministry of Education (MOE) who have special needs are those with visual, hearing, and learning impairments. Learning disabilities refer to cognitive issues that are considered treatable and allow students to receive formal education. The Malaysian Education Development Plan (MEDP) 2013-2025 has outlined clear objectives to be met over a 13-year period concerning quality, equity, access to education, as well as educational management efficiency and effectiveness. Eleven strategic shifts have been formulated to transform the education system, with the first shift being to provide equal access to internationally recognised quality education. Students with special needs, such as those with autism, are included in this objective [15]. The Shared Prosperity Vision 2030 (SPV 2030) highlights people with special needs as a target group. The overarching principle of the new national policy is to promote the development of all communities in Malaysia [16].

Several organisations and bodies in Malaysia are responsible for providing support and assistance to individuals with ASD. One such organisation is the National Autism Society of Malaysia (NASOM), which aims to provide services and support to individuals with ASD and their families [17].

In recent years, the Malaysian government has made efforts to provide online education for individuals with ASD. One

such initiative is the MOE TV Pendidikan program, which provides online classes for students with special needs, including those with autism. The program includes subjects such as mathematics, science, and language, and is available for primary and secondary school students [18][19].

Another government initiative is the MyAutism Portal, which is an online platform that provides resources and information on autism for parents, caregivers, and educators. The portal includes various modules, such as early intervention, communication, and social skills. Additionally, the Malaysian Communications and Multimedia Commission (MCMC) has launched the JomBelajar@Home program, which provides online education for students with disabilities, including autism [20][21]. The program includes a range of subjects, including academic and vocational skills, and is accessible to students with disabilities nationwide. With the current COVID-19 pandemic situation, online education has become increasingly important for individuals with ASD who require special education.

C. Other Related Studies

The COVID-19 pandemic has presented numerous challenges for children with ASD and their families. It has increased the burden on caregivers of children with ASD, who may not have access to the necessary resources to manage their child's condition. This highlights the need for more resources and support for caregivers, who play a critical role in the care of children with ASD [22].

A study conducted by [23] surveyed parents of children with ASD in the United States and found that they faced several challenges related to the provision of education and support for their children. These challenges included lack of resources and difficulties in maintaining routines. To address these challenges, Stenhoff et al. [24] provided guidance for educators and caregivers on how to support children with ASD during the pandemic. They stressed the importance of maintaining routines and structure, providing clear communication, and using visual supports to help children understand and cope with the changes brought about by the pandemic. The researchers explored the challenges faced by parents of children with ASD in Taiwan during the pandemic and the strategies they used to overcome them. They found that parents faced difficulties in adapting to online learning and employed a variety of strategies to overcome these challenges.

Several studies have investigated the impact of the COVID-19 pandemic on the support and therapy available for children with ASD. Johnsson et al. [25] conducted a study in India and found that teletherapy could be an effective solution for children with ASD who may not have access to traditional therapies due to the pandemic. This highlights the potential of teletherapy to overcome the lack of access to traditional therapies and provide remote access to therapy. Similarly, Furar et al. [26] investigated the impact of the pandemic on social support for families of children with ASD in Greece and found that the lack of social support has significantly affected these families, who already have limited access to experts and resources. This emphasises the need for more support for families of children with ASD, particularly during times of crisis. Furthermore, Syriopoulou-Delli et al. [27] reviewed

technology-assisted services for individuals with ASD and found that while such services have the potential to provide additional resources and support, there is a need for more resources and expertise to ensure their effectiveness and accessibility.

III. METHODOLOGY

A. Overview

Research plays a vital role in gathering information and data to support the development of evidence-based practices. In the context of autism care centres, research is crucial for understanding the needs of children with ASD and developing effective care strategies. Hyett et al. [28] emphasized the importance of employing various research methods in autism care centres to gain a better understanding of the needs of children with ASD and to develop effective care strategies.

The purpose of this research was to investigate the challenges encountered by teachers and students with ASD when transitioning to VTL during the COVID-19 pandemic, and to explore how the learning process unfolds in this new context. Additionally, the use of ICT in the practices and services of several autism care centres in Malaysia was also part of the study. To achieve the research goals, several activities were undertaken, including literature review, on-site observations, interviews with principals, and an online questionnaire for both teachers and principals of the autism care centres. The literature review provided a theoretical framework for the study, while on-site observations allowed for a deeper understanding of the challenges faced by teachers and students with ASD during the pandemic. Interviews with principals provided insights into the strategies used by the centres to support VTL, and the online questionnaire helped gather information from the participating teachers about their experiences and challenges regarding VTL for students with ASD.

In summary, the research emphasises the significance of using diverse research techniques to comprehend the VTL requirements of children with ASD and to produce effective care and teaching strategies in the form of digital content. The outcomes of the study are expected to facilitate the construction of an Instructional Digital Model that can support the creation of a VTL platform specifically designed for autism care centres.

B. On-site Observation

Observation is a commonly used research method that involves direct observation and recording of behaviours and activities in a specific setting. In an autism care centre, observation can be used to study the interactions between teachers and students with ASD, the physical environment, and the effectiveness of different care strategies [29].

To conduct on-site observation in autism care centres, the researchers visited four different autism care centres from different organizations to prevent any bias. A guideline in the form of an on-site observation form was used to observe ICT facilities available at the centres. The form consisted of five sections that were specific to particular aspects of the facilities, including ICT infrastructure, security, storage, teaching and

learning, and administration. Each section required direct observation to record comments and judgments on the ICT aspects [30].

To ensure that no aspect was left unobserved, the researchers checked all required aspects on the form before concluding the observation. Through on-site observation, the researchers gained insight into the operations of the autism care centres and identified potential areas for improvement. Notes were taken, and practices or services that involved ICT were recorded.

C. Interviews

Interviews are widely used in research to explore a range of topics related to autism, including telehealth services [31], social communication challenges [32], and classroom-based interventions [33]. Interviews are a valuable research method for exploring the experiences and perspectives of those involved in autism care, as they provide detailed and nuanced insights into the topic [34].

In this study, interviews were conducted with the principals or managers of the four autism care centres during on-site observation activities. Informed consent was obtained from each participant prior to the interview, which was based on semi-structured questions covering various aspects of the premise facilities, teachers' profiles, skills, experiences, ICT tools used in teaching, and challenges faced during the pandemic. The semi-structured questions were designed to elicit detailed information from the participants about their experiences with ICT tools in teaching and their challenges during the pandemic. The interviews were conducted in person and lasted between 30 to 60 minutes, and the audio recordings were transcribed and analysed to identify themes and patterns in the data.

In conclusion, interviews are a valuable research method for exploring the experiences and perspectives of those involved in autism care. In this study, interviews with the principals or managers of the autism care centres provided valuable insights into the use of ICT tools in teaching and the challenges faced during the pandemic. The data collected from the interviews were used to support the findings of the research and to develop recommendations for improving the use of VTL in autism care centres.

D. Online Questionnaire

Online questionnaire is a research method that involves administering a set of questions to individuals through an online platform [35]. In an autism care centre, this method can be used to gather information from a large sample of individuals who related with students ASD, such as families, and caretakers. For instance, researchers can administer surveys to caretakers and families to understand their experiences with the care provided in the centre.

Similarly, surveys can be administered to staff members to gather information on their training needs, challenges, and suggestions for improving care. Through online surveys, researchers can collect data from a wide range of participants, providing a more comprehensive understanding of the needs of individuals with ASD [36].

This study utilized an online questionnaire as a data collection method due to time constraints and the pandemic situation that limited in-person meetings. The study used a convenience sampling technique to disseminate the questionnaire to potential respondents. The selection of autism care centres was based on their accessibility and proximity to the researcher, rather than a probability-based sampling method. The data collection platform used was Google Form, and link of questionnaire was distributed via email and the WhatsApp application to several autism care centres in Malaysia. Respondents could complete the online questionnaire on their laptop, desktop, tablet, or mobile phone, and it took approximately five minutes to finish.

The study developed two sets of online questionnaires: one for principals and another for teachers or caretakers of students with ASD who received care at the participating centres. The questionnaires were based on structured questions that covered various aspects of the participants' profiles, ICT skills, ICT experiences, ICT tools used in teaching, and challenges they faced during the pandemic [37]. The questionnaires were designed to be user-friendly and easily accessible through online platforms. The teachers and principals were provided with a link to the respective questionnaire through email and were given clear instructions on how to complete the questionnaire. The responses from the questionnaires were collected and analysed to identify themes and patterns in the data.

IV. ANALYSIS AND DISCUSSION

A. Overview of Research Findings

The flow of the research process to investigate the impact of the COVID-19 pandemic on teaching and learning in the selected autism care centres in Malaysia consists of several stages. A summary of the research findings based on the research process is as illustrated in Fig. 1.

The initial stage in the research process flow is data collection, whereby the investigators employed three primary methods, namely on-site observations, interviews, and online questionnaires, to collect information. The second stage is data analysis and findings, where the researchers utilised NVIVO, a qualitative data analysis software, to organise and structure the data obtained. The information collected through on-site observations, interviews, and online questionnaires underwent analysis, and the outcomes were integrated to identify recurrent themes and patterns. During this phase, three themes emerged: 1) Challenges encountered during the pandemic; 2) ICT requirements; and 3) Instructional model.

The third stage comprises interpreting the data analysis results to gain a more profound comprehension of the difficulties, technology prerequisites, and instructional approaches employed by autism care centres during the pandemic. The interpretation process involves scrutinizing the data and recommendations based on the findings within the context of existing literature and theories associated with the influence of challenges on education and the utilization of technology to promote VTL. The outcome of this phase is the identification of VTL platform elements, recommended technologies, and digital platform features.

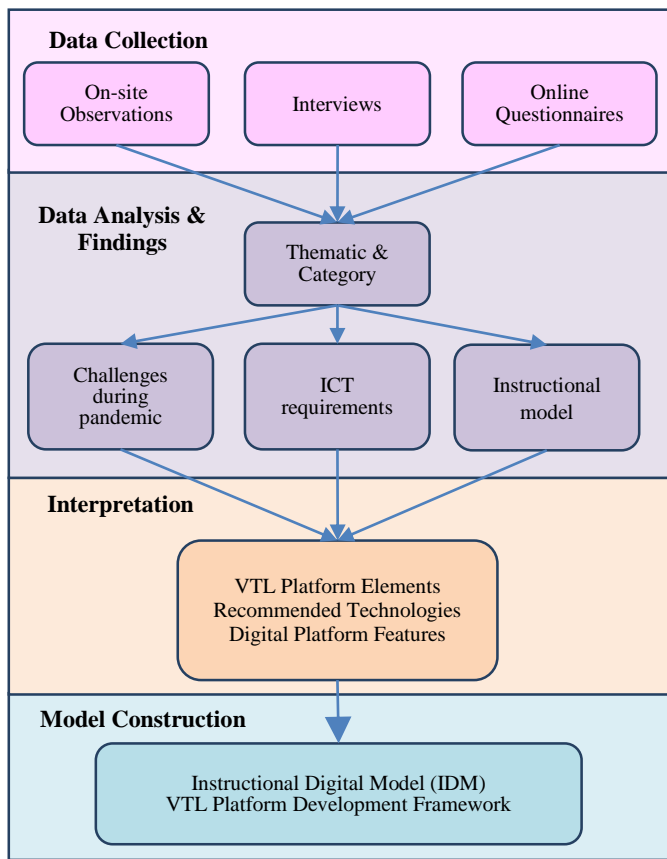


Fig. 1. Research process flow and findings.

In the research process, the ultimate step involves constructing a model where the researchers utilised the findings from earlier stages to create an IDM for VTL in autism care centres. The objective of the IDM is to tackle the issues caused by the COVID-19 pandemic and enhance the educational experience for children with ASD in the virtual environment. The core of IDM consists of strategies, methods, and skills tailored to meet the specific requirements of students with ASD in the VTL context. At this stage, the researchers also formulated the proposed framework for the VTL development.

B. Preliminary Analysis

Based on the online questionnaire that received responses from 16 teachers, the result revealed that 87.5% of the responding teachers were female, and 76% were under 36 years of age. Most of them had between 1-5 years of experience in teaching-learning related to autism, and only 31.3% had ever attended a course or had a special education certificate.

In terms of ICT skills, the result found that 62.5% of the responding teachers did not have any certification in ICT skills, and 93.8% had knowledge in Microsoft Office. WhatsApp was the most commonly used social media for communication with parents or guardians. The study revealed that there is a relatively large gap between teachers' knowledge and virtual learning skills, with the majority of the respondents having moderate or very little knowledge about VTL. Videos from YouTube were the most often software used for teaching,

followed by downloaded apps from the internet, Ms PowerPoint, and others.

C. Data Analysis

Table I shows the categories of information collected and structured using NVIVO application. The first source, on-site observations, captured information on ICT infrastructure, including internet and WiFi availability, ICT security measures such as CCTV cameras and door access, and ICT tools for teaching and learning such as PCs, laptops, tablets, LCD TVs, digital boards, projectors, social media, educational software, and related websites. The observations also covered ICT tools for administration, including MS Office, email, and accounting systems, as well as ICT storage tools such as file explorer, USB pen, and external HD.

The second source, interview transcriptions, captured information on the premise facilities, including classrooms, kitchens, and offices, as well as the students' demographic, staff resources, teaching content and modules, financial resources, and management and administration. The interviews also captured information on the problems and challenges encountered during the pandemic.

The third source, online questionnaires, captured information on the profiles of the teachers and caregivers, their skills and experiences, ICT tools used for teaching, problems and challenges encountered during the pandemic, and their views on VTL for students with ASD.

TABLE I. DATA SOURCES AND NODES

Sources	Nodes
On-site Observation	ICT Infrastructure (Internet, WiFi)
	ICT Security (CCTV Camera, Door Access)
	ICT for Teaching Learning (PC, Laptop, Handphone, Tablet, LCD TV, Digital board, Projector, Social media, Edu software, related websites)
	ICT for Administration (Ms Office, Email, Accounting System)
	ICT Storage (File Explorer, USB Pen, External HD)
Interview Transcription (principals)	Premise facilities (classroom, kitchen, office, etc)
	Students/children demographic
	Staff resources
	Teaching content and modules
	Financial resources
	Management and administration
Online Questionnaire (teachers, principals)	Problems and challenges during pandemic
	Profiles
	Skills
	Experiences
	ICT tools used for teaching
	Views

Overall, the table shows that the study collected a wide range of information related to the impact of the pandemic on teaching and learning in autism care centres. The information is structured in a way that enables easy comparison and analysis, making it easier to draw conclusions and make recommendations based on the findings.

Three themes emerged from the data analysis were: teachers’ challenges during the pandemic, ICT requirements for online teaching and learning, and an instructional model for students with ASD. The following sections provide analysis of each theme and its implications for teaching and learning in the context of the pandemic.

D. Theme 1: Challenges during the Pandemic

The first theme that emerged from the data analysis was the challenges that teachers faced during the pandemic. This theme is directly related to the first research question as stated in the initial section. Useful information acquired through interview sessions with participants, observations and online questionnaire were taken into account as evidence and inputs for data analysis.

Table II shows the challenges faced by teachers of the care centres in teaching children with ASD during the pandemic. As the pandemic has affected many aspects of daily life, it has also brought challenges to teaching and learning for children with ASD.

TABLE II. CHALLENGES IN TEACHING CHILDREN WITH ASD (TEACHERS’ FEEDBACK)

Challenges	Description of findings
Cooperation from parents	Parents play a critical role in supporting their children's education, especially during the pandemic when much of the learning takes place at home. Ensuring cooperation from parents is important to maintain the continuity of education.
Funds for activities	Activities outside the classroom are essential for children with ASD, and the pandemic has limited the opportunities for these activities. Funding can be a challenge for carrying out these activities in a safe and effective manner.
Communication and behavioural problems	Children with ASD often struggle with communication and behaviour, and these challenges have been amplified during the pandemic due to the disruption of routines and increased stress levels.
Managing emotions and behaviours	Children with ASD may have difficulty managing their emotions and behaviours, and this can be exacerbated by the pandemic.
Repetition of teaching methods	Children with ASD often require repetition of teaching methods to achieve satisfactory learning outcomes, and this can be a challenge for educators during the pandemic when resources may be limited.
Cultivating discipline	Daily routines are essential for children with ASD, and cultivating discipline in performing these routines can be challenging during the pandemic when routines may be disrupted.
Children tantrums	Children with ASD may have tantrums, and these can be exacerbated by the pandemic due to increased stress levels.
Sexual development of autistic adolescents	Adolescents with ASD may have difficulty understanding sexual development and behaviours, and this can be a challenge for educators during the pandemic when access to resources may be limited.
Self-management and use of toilet	Children with ASD may require support in self-management and using the toilet, and this can be a challenge for educators during the pandemic when resources may be limited.

The teachers feedback provided a range of problems, including the lack of adequate training on online teaching, limited access to ICT infrastructure and resources, and difficulties in maintaining student engagement and motivation.

Table III outlines the significant difficulties and obstacles encountered by autism care centres amid the pandemic, as identified through a comprehensive analysis and feedback from principals.

TABLE III. CHALLENGES OF AUTISM CARE CENTRES DURING THE PANDEMIC (OVERALL ANALYSIS)

Challenges	Description of findings
Limited access to therapy and services	Many autism care centres had to temporarily close or reduce their services due to the pandemic. This has resulted in limited access to therapy and services for individuals with ASD, which can have a significant impact on their progress and development.
Staffing shortages	Some autism care centres have experienced staffing shortages due to illness, quarantine, or personal reasons. This has made it challenging to provide education, adequate care and support for individuals with ASD.
Financial difficulties	The pandemic has resulted in financial difficulties for the autism care centres, as they have had to incur additional expenses related to Personal Protective Equipment (PPE), cleaning, and sanitisation. This has led to reduced services and increased financial burden on the centres.
Changes in routine	Individuals with ASD thrive on routine and predictability. However, the pandemic has disrupted routines and introduced uncertainty, which can cause distress and anxiety for individuals with ASD.
Social isolation	Individuals with ASD may already struggle with social skills and communication, and the pandemic has made social isolation more prevalent. This can lead to increased feelings of loneliness, anxiety, and depression.
Technology challenges	All autism care centres have to adapt to virtual care and therapy, which can be challenging for individuals with ASD who may struggle with technology or have difficulty engaging in virtual sessions.

In conclusion, autism care centres in Malaysia have faced significant challenges during the COVID-19 pandemic. These challenges have affected the delivery of care and support as well as teaching and learning for individuals with ASD, resulting in increased stress and difficulties for both individuals with ASD and their caregivers.

E. Theme 2: ICT requirements for online teaching and learning

The second theme that emerged from the data analysis was the ICT requirements for online teaching and learning. The results of this data analysis have helped a lot to answer the second research question and shed light on the specific ICT needs in the context of autism care.

To gather comprehensive information regarding the ICT facilities available in autism care centers, an online questionnaire was administered due to the limitations posed by conducting on-site observations. This questionnaire was thoughtfully designed to elicit feedback on the utilization of

ICT tools and the overall capabilities of the care centers in integrating technology into their educational practices. The questionnaire received responses from 16 participants, including teachers and principals, representing six different autism care centers.

The gathered feedback, as described in Table IV, provided significant insights into the current state of ICT implementation within the participating autism care centers.

TABLE IV. ICT FACILITIES IN AUTISM CARE CENTRES

Type of Information	Description of findings
Age of autism care centre	Four centres had been operating for less than five years, one for less than ten years, and one for more than ten years.
Number of teachers	Most centres had more than five teachers. Four centres had between 10 and 20 children, while the other two had between 30 to 50. None of the centres could accommodate more than fifty children.
ICT skills	All centres had at least two teachers with ICT skills or who had attended ICT courses.
ICT infrastructure	All centres had Internet, Wi-Fi, PCs, and laptops. They also had their own websites, but most lacked multimedia and teaching-learning applications.
Software systems	None of the centres had specific software systems for administration, teachers, and learning schedules.
Network community	Three centres had a network community, while the other three did not.
Virtual teaching	Five centres frequently conducted virtual teaching-learning during the pandemic, while one did it rarely.
Communication media	WhatsApp was the most common communication medium between administrators of care centres and parents. Facebook and telephone were also frequently used.
Information communicated to parents	Invitations were the most common form of information communicated to parents, followed by news and notifications.
ICT needs	PCs and laptops were the ICT needs that all care centres stated they most wanted to help the teaching/learning process. Most centres also needed teaching-learning software, digital screen boards, and multimedia tools.
ICT knowledge and skills	Two centres stated they needed skills in using software that can help management. Two centres stated they did not need any ICT skills. The other two centres each stated they needed basic ICT technology skills and skills in using software that can aid teaching.
Digital storage	All centres used File Explorer, USB Pen Drives, Google Drive, Facebook, and YouTube for digital storage.

The teachers responded that they required a range of digital tools and resources to support online teaching, including learning management systems, video conferencing platforms, and digital content. They also responded to the need for reliable internet connectivity, devices such as laptops or tablets, and appropriate software.

The findings suggest that the autism care centres need to invest in the necessary ICT infrastructure and resources to support online teaching and learning. This includes providing teachers and students with the necessary hardware and

software and ensuring that they have reliable access to the internet. The autism care centres should also invest in developing or adopting learning management systems and video conferencing platforms that are user-friendly and accessible.

F. Theme 3: Instructional Model

The third theme that emerged from the data analysis was the instructional model being practiced by the autism care centres during the pandemic. Based on compilation of data collection through the on-site observation, interviews, and online questionnaires, not many autism care centres have transitioned to VTL to continue providing educational and therapeutic services to children with autism. Based on the findings, the weaknesses of VTL practice in those autism care centres are described in Table V.

TABLE V. FINDINGS OF INSTRUCTIONAL PRACTICE IN THE AUTISM CARE CENTRES

Findings	Description of findings
Lack of access to necessary digital tools	The feedback obtained from teachers indicated a need for a range of digital tools and resources to support online teaching, including learning management systems, video conferencing platforms, and digital content. Some autism care centres have no necessary funds or infrastructure to provide these tools to their teachers and students.
Poor internet connectivity	Reliable internet connectivity is essential for online teaching and learning, but some autism care centres may be located in areas with poor internet infrastructure, making it difficult for teachers and students to access online resources and participate in virtual classes.
Limited availability of devices	Teachers and students require laptops or tablets to access digital resources and participate in virtual classes, but not all autism care centres have enough devices to meet the needs of all their students.
Lack of training	Some teachers may not have the necessary skills and training to effectively deliver online instruction and may require additional training and support to adapt to the new virtual teaching environment.
Difficulty in engaging students	Some students with ASD may struggle with the lack of face-to-face interaction and find it challenging to engage with online instruction, which could hinder their learning progress. Teachers may need to adapt their teaching strategies to keep students engaged and motivated.

The findings suggest that the autism care centres should explore virtual platforms as a viable alternative to traditional classroom-based learning. This includes developing and implementing strategies that promote student engagement and motivation, such as gamification and collaborative learning activities. The autism care centres should also ensure that students have the necessary skills and resources to support online learning, such as digital literacy skills and access to appropriate ICT resources.

V. RESULTS AND RECOMMENDATION

A. Proposed VTL Platform Elements

The proposed elements of a VTL platform for children with ASD should be meticulously designed to address the

distinctive needs of these learners, as illustrated in Fig. 2. By integrating these elements into a VTL platform, it is envisaged that children with ASD will benefit from a customized and effective learning experience tailored to their specific requirements.

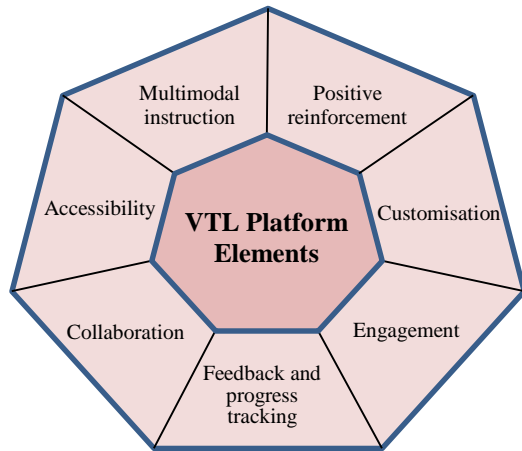


Fig. 2. VTL Platform elements for Autism Care Centres

Table VI describes the proposed elements of a VTL platform for autism care centres.

Overall, the design and implementation of a comprehensive VTL platform specifically tailored for children with ASD have the potential to revolutionize their learning experience, ensuring that they receive the individualized support and resources they need to thrive academically and socially.

TABLE VI. PROPOSED ELEMENTS OF A VTL PLATFORM FOR AUTISM CARE CENTRES

Elements	Description
Accessibility	VTL platform and tools should be accessible to children with different abilities and disabilities. Accessibility features such as text-to-speech, closed captioning, and audio descriptions should be available.
Customisation	VTL platform should allow for customisation based on the individual needs of each child with ASD. This may include adapting the pace and difficulty of instruction, providing visual aids, and accommodating sensory preferences.
Multimodal instruction	VTL platform should provide instruction using multiple modes, such as visual, auditory, and kinesthetic, to meet the diverse learning needs of children with ASD.
Engagement	VTL platform should be designed to actively engage children with ASD in the learning process. Interactive and multimedia materials such as videos, games, and simulations can be used to enhance engagement and maintain attention.
Collaboration	VTL platform should provide opportunities for collaboration and communication between teachers, parents, and children with ASD. Online forums, chat rooms, and video conferencing can be used to facilitate collaboration and social interaction.
Feedback and progress tracking	VTL platform should include features that allow for feedback and progress tracking. Teachers and parents should be able to monitor the child's progress and provide feedback to support learning and development.
Positive reinforcement	VTL platform should include positive reinforcement strategies to motivate and encourage children with ASD. This may include rewards and praise for completing tasks and achieving goals.

B. Proposed Technology and Digital Platform Features

During the COVID-19 pandemic, there are several technologies that can be used in various ways to support individuals with ASD. Immersive learning has been identified as a promising approach to address the learning challenges faced by students with ASD [38]. Immersive learning utilises virtual and augmented reality (VR and AR) technologies to create engaging and interactive learning environments that can be customised to meet the individual needs of students with ASD [39].

The immersive learning environment can be customised to meet the unique sensory processing needs of students with ASD, which provides a comfortable and engaging learning experience. Moreover, immersive learning environments can improve communication and social skills by allowing students to interact with virtual characters and environments [38]. Immersive learning has also been shown to be an effective tool for teaching a range of skills, including academic content, vocational skills, and life skills [40][41][42]. This versatility makes immersive learning a valuable tool for educators who work with students with ASD. Studies have shown that immersive learning can be effective in improving the social, communication, and vocational skills of students with ASD [43]. Therefore, immersive learning should be considered an important tool for educators who are working with students with ASD.

In summary, there are several technologies that can be used in various ways to support individuals with ASD. Some suggestions are described in Table VII.

TABLE VII. RECOMMENDED TECHNOLOGIES FOR AUTISM CARE CENTRES

Components	Description
Teletherapy	Many therapists and educators have turned to teletherapy, which uses videoconferencing technology to provide therapy and instruction remotely. This allows individuals with ASD to continue receiving therapy and support during the pandemic, even if they are unable to leave their homes or attend in-person appointments.
Virtual classrooms	Virtual classrooms have been used to provide instruction and support for individuals with ASD during the pandemic, allowing them to continue their education and social interaction from home.
Social media and communication apps	Social media and communication apps have been used to provide social interaction for individuals with ASD, who may have difficulty with face-to-face interactions.
Augmented Reality and Virtual Reality	These technologies have been used to provide immersive, interactive experiences for individuals with ASD, which can be especially beneficial for those who have difficulty with traditional learning methods.
Assistive technology	Assistive technology, such as speech-to-text and text-to-speech software, can be used to support individuals with ASD in their communication and learning.
Mobile apps	There are mobile apps designed for individuals with ASD which provide educational and behavioural support, as well as for communication and social skills development.
Adaptive devices	Adaptive devices, such as switches and joysticks, have been used to provide access to technology for individuals with ASD who may have difficulty using standard input devices.

Overall, technology plays an important role in supporting individuals with ASD during the COVID-19 pandemic, by providing flexible, customised learning opportunities, and social interaction, as well as providing access to therapeutic and educational resources.

As for the features of digital platform, they are listed and described in Table VIII.

TABLE VIII. FEATURES OF DIGITAL PLATFORM

Features	Description
Flexibility	Digital platform allows individuals with ASD to learn at their own pace and on their own schedule, which can be especially beneficial for those who have difficulty with traditional classroom settings.
Customisation	Digital platform can be customised to meet the specific needs of individuals with ASD, such as providing visual aids, audio support, and other accommodations.
Social interaction	Digital platform can provide opportunities for social interaction for individuals with ASD, who may have difficulty with face-to-face interactions. Virtual classrooms, social media and other online platforms can provide a safe and comfortable environment for socialisation.
Access to resources	Digital platform can provide access to a wide range of resources and materials that can be used to support the learning of individuals with ASD, such as videos, interactive activities, and simulations.
Remote learning	Digital platform can be done remotely, which can be beneficial for individuals with ASD who may have difficulty traveling to a physical location, or who may benefit from the reduced social interaction that remote learning provides.
Access to specialised teachers	Digital platform can provide access to specialised teachers, such as those trained in autism education, who can provide individualised instruction and support.
Access to global resources	With digital platform, individuals with ASD can access resources and educational materials from around the world, which can be beneficial for those who live in areas with limited resources.

In summary, the use of digital platforms can offer a multitude of benefits for individuals with ASD. It can provide a flexible and customizable learning experience that can be tailored to the specific needs and preferences of the learner, a safe and comfortable learning environment, social skills development, and access to a wider range of learning opportunities. This is particularly important for individuals with ASD, who may have different learning styles and sensory preferences. As such, digital platforms should be considered as an important tool for educators and caregivers who are working with individuals with ASD.

C. Proposed Instructional Digital Model

Students with ASD have been notably impacted by the COVID-19 pandemic, which has caused considerable disruptions to traditional classroom-based learning. To address this challenge and promote VTL in autism care centres, an IDM has been proposed based on the challenges and needs, which are part of findings of this research study. The IDM for VTL aims to enhance the learning experience for children with ASD, making it more effective and engaging.

As depicted in Fig. 3, the proposed IDM for VTL comprises of three core components: VTL Strategies, VTL Methods, and VTL Skills.

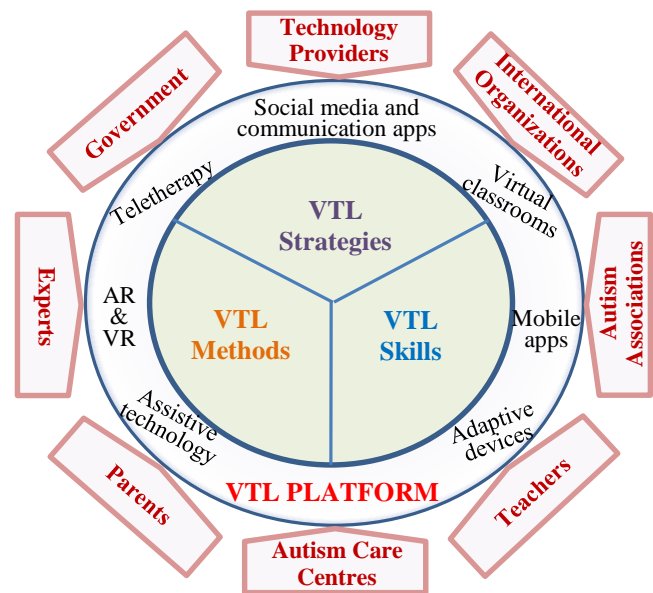


Fig. 3. Instructional Digital Model (IDM) for VTL

VTL Strategies: The first component of the IDM is VTL Strategies. These strategies refer to the various ways in which teaching is organised and delivered to students with ASD. They involve a range of approaches designed to enhance learning, such as the use of visual aids, repetition, and positive reinforcement. VTL Strategies also include ways to address specific needs of students with ASD, such as social skills training, sensory integration, and behaviour management.

VTL Methods: The second component of the IDM is VTL Methods. This component refers to the specific techniques and tools used to deliver instruction in a virtual learning environment. VTL Methods include the use of multimedia, interactive tools, and virtual reality. They also include adaptations of traditional teaching methods to suit the online environment, such as the use of digital whiteboards, chat rooms, and video conferencing.

VTL Skills: The third component of the IDM is VTL Skills. These refer to the specific abilities that teachers and students with ASD need to acquire to be successful in a VTL environment. VTL Skills may include the ability to navigate digital platforms, use of assistive technologies, and self-regulation techniques. Additionally, students with ASD may need support in developing social skills and self-advocacy skills to interact with their teachers and peers in the online classroom.

In summary, the IDM for VTL proposes to enhance the learning experience for teachers and children with ASD by incorporating strategies, methods, and skills designed to meet the specific needs of this population. By leveraging the strengths of technology, the IDM aims to create a more effective and engaging learning experience for students with ASD, even in the face of disruptions caused by the COVID-19 pandemic.

D. Proposed VTL Platform Development Framework

Developing and implementing a VTL platform for autism care centres requires a framework to ensure its effectiveness and success. The framework provides a structured approach to developing and implementing the VTL, ensuring that all aspects of the learning experience are accounted for and that they align with the specific needs of students with ASD.

The framework for developing the VTL platform for autism care centres is depicted in Fig. 4.

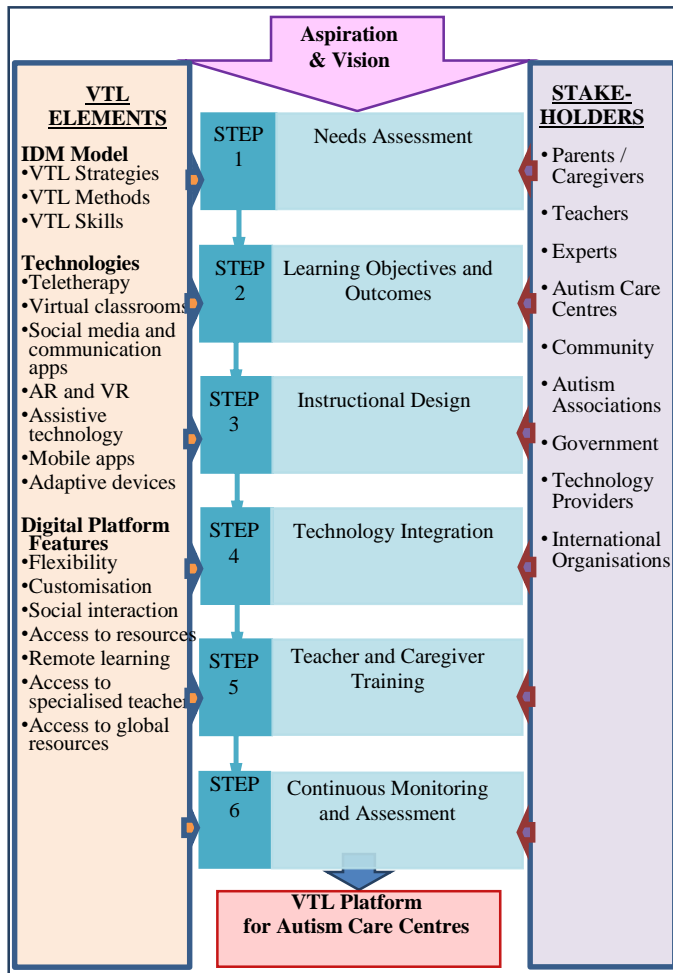


Fig. 4. VTL Platform Development Framework for Autism Care Centre

The framework also enables a standardised approach to be adopted, ensuring that the VTL is consistent across different care centres and teaching environments. Additionally, it provides a mechanism for evaluating the effectiveness of the VTL, identifying areas for improvement and ensuring that the IDM continues to evolve to meet the changing needs of students with ASD.

Details of the VTL platform development framework are described in Table IX.

In summary, the VTL platform for autism care centres is anticipated to provide a more effective and engaging learning experience for children with ASD in autism care centres in Malaysia. By following the steps outlined in this proposal,

autism care centres can develop a customised VTL platform that addresses the specific learning needs and challenges of children with ASD, while integrating appropriate technology tools and methods for VTL. The framework also includes training and ongoing support for teachers and caregivers, as well as a process for continuous monitoring and assessment of the effectiveness of VTL. Overall, the framework is essential for the successful development and implementation of the VTL platform for autism care centres, providing a roadmap for its creation and ensuring that it is effective and responsive to the needs of students with ASD.

TABLE IX. PROPOSED VTL PLATFORM DEVELOPMENT FRAMEWORK FOR PROMOTING VTL

Activity	Description
Step 1: Needs assessment	The first step in developing a VTL platform is to conduct a needs assessment to identify the specific learning needs and challenges of children with ASD in the centre. The needs assessment should also take into account the resources and technology available at the centre. This information can be collected through surveys, interviews, and observation.
Step 2: Learning objectives and outcomes	Based on the needs assessment, clear learning objectives and outcomes should be developed to guide the development of instructional materials and strategies. These learning objectives should be specific, measurable, achievable, relevant, and time-bound (SMART).
Step 3: Instructional design	The next step in developing a VTL platform is to design the instructional materials and strategies that will be used for VTL. The instructional design should be tailored to the specific learning needs of children with ASD and take into account their learning preferences, strengths, and challenges. Instructional materials and strategies should be engaging, interactive, and relevant to the learning objectives and outcomes.
Step 4: Technology integration	The development should include the integration of appropriate technology tools and platforms for VTL. This may include platforms such as Zoom, Google Classroom, or Microsoft Teams, as well as assistive technology tools such as text-to-speech or speech-to-text software. The technology integration should be aligned with the instructional design and the specific learning needs of children with ASD.
Step 5: Teacher and caregiver training	To ensure the successful implementation of VTL, it is important to provide training to teachers and caregivers on how to use the instructional materials, strategies, and technology tools effectively. This training should include best practices for VTL for children with ASD, as well as strategies for addressing technical issues and providing ongoing support to children and their families.
Step 6: Continuous monitoring and assessment	The operation of VTL should include a process for continuous monitoring and assessment of the effectiveness of VTL. This may include regular check-ins with children and their families, as well as ongoing assessment of learning outcomes and progress towards the learning objectives. This information should be used to adjust the instructional materials, strategies, and technology tools as needed to ensure the best possible learning experience for children with ASD.

E. Comparison of IDM and other similar platforms

To assess the potential performance of the platform based on the proposed IDM, two popular platforms that provide learning needs for students with ASD were selected, and a comparison was made using the IDM criteria as described in Table X.

This comparison table provides an overview of the different features offered by the proposed IDM, Autism Speaks Learn@Home, and Therapy Tribe, helping to identify their strengths and weaknesses in relation to VTL platform elements, VTL platform technology, and digital platform features.

Under the category of VTL Platform Elements, the table compares the accessibility, customisation, multimodal instruction, engagement, collaboration, feedback and progress tracking, and positive reinforcement. The proposed IDM scores high in accessibility, customisation, engagement, collaboration, and offers positive reinforcement. Autism Speaks Learn@Home and Therapy Tribe also have high accessibility but score lower in customisation and collaboration.

TABLE X. COMPARISON OF IDM AND OTHER PLATFORMS

Feature	ProposedIDM	Autism Speaks Learn@Home	Therapy Tribe
VTL Platform Elements			
Accessibility	High	High	High
Customisation	High	Moderate	Moderate
Multimodal Instruction	Yes	Yes	Yes
Engagement	High	High	High
Collaboration	High	Low	High
Feedback and Progress Tracking	Yes	Yes	Yes
Positive Reinforcement	Yes	Yes	Yes
VTL Platform Technology			
Teletherapy	Yes	No	Yes
Virtual Classrooms	Yes	Yes	Yes
Social Media and Communication Apps	Yes	No	No
Augmented Reality and Virtual Reality	High	None	Low
Assistive Technology	Yes	No	Yes
Mobile Apps	Yes	Yes	Yes
Adaptive Devices	Yes	No	Yes
Digital Platform Features			
Flexibility	High	Low	Low
Customisation	Yes	No	No
Social Interaction	Yes	No	Yes
Access to Resources	High	High	High
Remote Learning	High	Low	Moderate
Access to Specialized Teachers	Yes	No	Yes
Access to Global Resources	Yes	No	No

Moving on to VTL Platform Technology, the table compares teletherapy, virtual classrooms, social media and communication apps, augmented reality and virtual reality, assistive technology, mobile apps, and adaptive devices. The proposed IDM supports teletherapy, virtual classrooms, social media and communication apps, and has a high presence of augmented reality and virtual reality. Autism Speaks Learn@Home lacks teletherapy and social media apps, while Therapy Tribe lacks virtual classrooms and has a low presence of augmented reality and virtual reality.

In terms of Digital Platform Features, the table compares flexibility, customisation, social interaction, access to resources, remote learning, access to specialized teachers, and access to global resources. IDM excels in flexibility, customisation, social interaction, access to resources, remote learning, and access to specialized teachers. Autism Speaks Learn@Home has lower flexibility and lacks customisation, while Therapy Tribe also lacks customisation and access to global resources.

In summary, it can be concluded that the proposed IDM offers a comprehensive virtual learning platform for autistic students. In comparison, Autism Speaks Learn@Home and Therapy Tribe exhibit strengths in certain areas but may have limitations in terms of customisation, collaboration, and access to specific technologies. While all three platforms aim to support autistic students in their virtual learning journey, the proposed IDM distinguishes itself with its inclusive features and advanced technologies designed to address the specific needs of autistic learners.

VI. CONCLUSION AND FUTURE WORKS

A. Conclusion

This report has presented the findings of a case study on the impact of the COVID-19 pandemic on teaching and learning of autism care centres in Malaysia. The research methods used in this study provided valuable insights into the practices and services of several autism care centres. On-site observation, interviews, and online questionnaire were all effective methods for gathering data. The findings of the study identified three main themes, including teachers' challenges during the pandemic, ICT requirements for online teaching and learning, and instructional model.

The findings suggest that autism care centres need to invest in training teachers on online teaching and the use of ICT resources provide the necessary ICT infrastructure and resources to support online teaching and learning, and explore digital models as a viable alternative to traditional classroom-based learning. These findings have important implications for teaching and learning in the context of the pandemic and beyond.

A special fund for autism care centres needs to be proposed and established to upgrade their ICT facilities, especially in digital content development. Regarding future research, further studies on innovative tools using advanced technology such as virtual reality (VR) and augmented reality (AR) have to be carried out to include them as part of the VTL platform. More interviews and detailed discussions with the autism experts and technologists on new methods of digital teaching and learning

for autism need to be conducted to generate comprehensive ICT requirements for the development of VTL platform.

In conclusion, the IDM proposed for promoting VTL in autism care centres in Malaysia provides a promising solution for addressing the unique learning needs of children with ASD. By following the steps outlined in the proposed framework, autism care centres can develop a customised VTL platform that addresses the specific learning needs and challenges of children with ASD, while integrating appropriate technology tools and methods for VTL. The VTL platform can provide a more effective and engaging learning experience for children with ASD and may improve their social, communication, and vocational skills. With the VTL platform's potential benefits, it could be considered an essential tool for educators who are working with children with ASD in autism care centres in Malaysia.

B. Future Works

To ensure the effective implementation of the VTL platform in autism care centres, several key steps can be taken as potential suggestions for future works. These steps involve conducting a pilot study with a small sample of students with ASD, their teachers, and caregivers to evaluate the usability, acceptability, and efficacy of the VTL based on the proposed IDM. If successful, the VTL could be expanded to other locations, including different countries, to observe its performance in diverse cultural and linguistic contexts.

Additionally, incorporating emerging technologies such as artificial intelligence into the IDM can enhance the learning experience for students with ASD. Long-term outcomes of the VTL should also be assessed, including academic and social achievements, to determine its effectiveness over an extended period. Collaboration with stakeholders such as policymakers, education leaders, and technology providers can ensure the sustainability and widespread adoption of the VTL, while also integrating new technologies into the platform.

Furthermore, developing training programs for teachers and caregivers is crucial to equip them with the necessary skills to implement the VTL effectively and address any challenges that may arise. Evaluating the cost-effectiveness of the VTL platform and incorporating teachers and parents' feedback throughout the development process are important aspects to consider for the ongoing improvement and relevance of the VTL in meeting the needs of students with ASD.

In summary, future research of IDM to promote VTL for autism care centres holds significant promise for further advancements and improvements. By providing a comprehensive and individualized learning experience, IDM has the potential to enhance academic achievements, social skills development, and overall well-being for autistic students. The use of advanced technologies like AI and AR/VR, combined with the customization features of IDM, can create engaging and inclusive learning environments. Moreover, IDM's collaborative and interactive features foster peer interactions, socialization, and the development of essential life skills. Ultimately, IDM has the potential to revolutionize the field of VTL for autism by offering an effective and accessible platform for tailored instruction, promoting inclusive

education, and empowering autistic students to reach their full potential.

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REFERENCES

- [1] N. Yahya, M. A. Mahadi, M. A. M. Taib, N. Jomhari, R. Ahmad, & E. M. M. Yusof, "A Preliminary Study on the ICT Facilities and Teachers' View on Virtual Teaching and Learning for Autistic Students in Malaysia during Pandemic", *International Journal of Academic Research in Progressive Education and Development*, 11(4), 1058–1071, Dec. 2022. C. Smith, "Challenges and Opportunities for Teaching Students with Disabilities During the COVID-19 Pandemic", *JIMPHE*, vol. 5, no. 1, pp. 167–173, Jan. 2021. DOI:10.6007/IJARPED/v11-i4/16083.
- [2] C. Smith, "Challenges and opportunities for teaching students with disabilities during the COVID-19 pandemic," *International Journal of Multidisciplinary Perspectives in Higher Education*, vol. 5, no. 1, pp. 167–173, Jan. 2021. doi:10.32674/jimphe.v5i1.2619.
- [3] X. Xie, K. Siau, and F. F.-H. Nah, "Covid-19 pandemic – online education in the New Normal and the next normal," *Journal of Information Technology Case and Application Research*, vol. 22, no. 3, pp. 175–187, Nov. 2020. doi:10.1080/15228053.2020.1824884.
- [4] G. M. Francom, S. J. Lee, and H. Pinkney, "Technologies, challenges and needs of K-12 teachers in the transition to distance learning during the COVID-19 pandemic - techrends," SpringerLink, Jun. 2021. <https://link.springer.com/article/10.1007/s11528-021-00625-5>.
- [5] S. Hernandez, "Autism spectrum disorder and remote learning: Parents' perspectives on their child's learning at home," *Digital Scholarship@UNLV*, Aug. 2021. Retrieved from <https://digitalscholarship.unlv.edu/thesesdissertations/4246/>.
- [6] M. Börner-Ringleb, G. Casale, and C. Hillenbrand, "What predicts teachers' use of digital learning in Germany? examining the obstacles and conditions of digital learning in special education," *European Journal of Special Needs Education*, vol. 36, no. 1, pp. 80–97, Jan. 2021. doi:10.1080/08856257.2021.1872847.
- [7] N. A. Suhaila and N. M. Nordin, "Assistive technology for autism spectrum disorder: Systematic literature review," *International Journal of Advanced Research in Education and Society*, Jun. 2022. <https://myjms.mohe.gov.my/index.php/ijares/article/view/18609>.
- [8] "Secretary-General's Roadmap for Digital Cooperation." United Nations, Jun. 2020. <https://www.un.org/en/content/digital-cooperation-roadmap/>.
- [9] "Sustainable Development Goal 4 and Its Targets." UNESCO, May 2021. <https://en.unesco.org/education2030-sdg4/targets>.
- [10] "The provision of assistive technology to children with disabilities in Humanitarian Settings", Feb. 2022. Retrieved from <https://www.unicef-irc.org/publications/pdf/The-Provision-of-Assistive-Technology-to-Children-with-Disabilities-in-Humanitarian-Settings.pdf>.
- [11] Global strategy on Digital Health 2020-2025 - World Health Organization, 2021. Retrieved from <https://apps.who.int/iris/bitstream/handle/10665/344249/9789240020924-eng.pdf>.
- [12] "Autism." World Autism Organisation, Apr. 2023. Retrieved from <https://worldautismorganisation.com/autism/>.
- [13] "Autism." World Health Organization, Mar. 2023. Retrieved from <https://www.who.int/news-room/fact-sheets/detail/autism-spectrum-disorders>.
- [14] CodeBlue, "Malaysia's Autism Rate Steadily Rising since 2010." CodeBlue, Apr. 2022. Retrieved from <https://codeblue.galencentre.org/2022/04/06/malysias-autism-rate-steadily-rising-since-2010/>.

- [15] Malaysia Education Development Plan 2015-2025 - mohe.gov.my. <https://jpt.mohe.gov.my/portal/index.php/en/corporate/development-plan/16-malaysia-education-development-plan-2015-2025>.
- [16] Mygov - the government of Malaysia's Official Portal. Retrieved from <https://www.malaysia.gov.my/portal/content/30901>.
- [17] National Autism Society of Malaysia. About Us. Retrieved from <http://www.nasom.org.my/index.php/about-us/>.
- [18] Ministry of Education Malaysia. TV Pendidikan, 2021. Retrieved from <https://www.moe.gov.my/tpendidikan>.
- [19] Group, Rev Media. "DidikTV KPM." Didik TV. Retrieved from <https://didik.tv/>.
- [20] Jom Belajar, Mar. 2023. Retrieved from <https://jombelajar.com.my/>.
- [21] Malaysian Communications and Multimedia Commission. JomBelajar@Home. 2020. Retrieved from https://www.mcmc.gov.my/skmmgovmy/media/General/pdf/JomBelajar_At_Home.pdf.
- [22] A. A. Eshraghi *et al.*, "Covid-19: Overcoming the challenges faced by individuals with autism and their families," *The Lancet Psychiatry*, vol. 7, no. 6, pp. 481–483, Jun. 2020. doi:10.1016/s2215-0366(20)30197-8.
- [23] S. B. Mukherjee, Neelam, S. Kapoor, and S. Sharma, "Identification of essential, equivocal and complex autism by the Autism Dysmorphology Measure: An observational study," *Journal of Autism and Developmental Disorders*, vol. 51, no. 5, pp. 1550–1561, Aug. 2020. doi:10.1007/s10803-020-04641-x.
- [24] D. M. Stenhoff, R. C. Pennington, and M. C. Tapp, "Distance Education support for students with autism spectrum disorder and complex needs during COVID-19 and school closures," *Rural Special Education Quarterly*, vol. 39, no. 4, pp. 211–219, Aug. 2020. doi:10.1177/8756870520959658.
- [25] G. Johnsson and K. Bulkeley, "Practitioner and service user perspectives on the rapid shift to teletherapy for individuals on the autism spectrum as a result of COVID-19," *International Journal of Environmental Research and Public Health*, vol. 18, no. 22, p. 11812, Nov. 2021. doi:10.3390/ijerph182211812.
- [26] E. Furar *et al.*, "The impact of COVID-19 on individuals with ASD in the US: Parent perspectives on social and support concerns," *PLOS ONE*, vol. 17, no. 8, Aug. 2022. doi:10.1371/journal.pone.0270845.
- [27] C. K. Syriopoulou-Delli and A. Stefani, "Applications of assistive technology in Skills Development for people with autism spectrum disorder: A systematic review," *Research, Society and Development*, vol. 10, no. 11, Aug. 2021. doi:10.33448/rsd-v10i11.19690.
- [28] N. Hyett, A. Kenny, V. Dickson-Swift. "Methodology or Method? A Critical Review of Qualitative Case Study Reports." *International journal of qualitative studies on health and well-being*, May 2014. <https://pubmed.ncbi.nlm.nih.gov/24809980/>.
- [29] L. Moore, "The 3 Descriptive Research Methods of Psychology." *Psych Central*, May 2022. <https://psychcentral.com/health/types-of-descriptive-research-methods#recap>.
- [30] M. R. Roller and P. J. Lavrakas, *Applied Qualitative Research Design: A Total Quality Framework Approach*. Guilford Publishers, 2015.
- [31] M. M. Alfuraydan, Exploring the potential use of telehealth technology to improve the diagnostic process of autism spectrum disorder (ASD) in Wales, United Kingdom, Jan. 2021. doi:10.23889/suthesis.58840.
- [32] "Autism Spectrum Disorder: Communication Problems in Children." National Institute of Deafness and Other Communication Disorders. <https://www.nidcd.nih.gov/health/autism-spectrum-disorder-communication-problems-children>.
- [33] Dang K;Bent S;Lawton B;Warren T;Widjaja F;McDonald MG;Breard M;O'Keefe W;Hendren RL, "Integrating autism care through a school-based intervention model: A pilot study," *Journal of clinical medicine*, Oct. 2017. <https://pubmed.ncbi.nlm.nih.gov/29048365/>.
- [34] A. A. Kuo, T. Crapnell, L. Lau, K. A. Anderson, and P. Shattuck, "Stakeholder perspectives on research and practice in autism and transition," *Pediatrics*, vol. 141, no. Supplement_4, Apr. 2018. doi:10.1542/peds.2016-4300f.
- [35] P. R. Regmi, E. Waithaka, A. Paudyal, P. Simkhada, and E. Van Teijlingen, "Guide to the design and application of online questionnaire surveys," *Nepal Journal of Epidemiology*, vol. 6, no. 4, pp. 640–644, Dec. 2016. doi:10.3126/nje.v6i4.17258.
- [36] H. L. Ball, "Conducting online surveys," *Journal of Human Lactation*, vol. 35, no. 3, pp. 413–417, May 2019. doi:10.1177/0890334419848734.
- [37] J. König, S. Heine, D. Jäger-Biela, and M. Rothland, "ICT integration in teachers' lesson plans: A scoping review of empirical studies," *European Journal of Teacher Education*, pp. 1–29, Oct. 2022. doi:10.1080/02619768.2022.2138323.
- [38] E. Dick, "The promise of Immersive Learning: Augmented and Virtual Reality's potential in education," *RSS*, Aug. 2021. <https://itif.org/publications/2021/08/30/promise-immersive-learning-augmented-and-virtual-reality-potential/>.
- [39] C. Micah, "Assistive Technology in the Classroom Empowers Students with Disabilities." *Technology Solutions That Drive Education*, Apr. 2022. <https://edtechmagazine.com/k12/article/2020/03/using-assistive-technology-empower-students-disabilities-perfcon>.
- [40] C. Oister, "How to Support Students with Autism: Virtual Learning Environment." *Autism Speaks*, Aug. 2020. Retrieved from <https://www.autismspeaks.org/blog/how-support-students-autism-virtual-learning-environment>.
- [41] D. Sengupta, "How to Incorporate Immersive Learning into Your Digital Learning Program." *eLearning Industry*, May 2021. <https://elearningindustry.com/incorporate-immersive-learning-experiences-digital-program>.
- [42] "5 Microsoft Education Tools for an Inclusive Classroom." *Microsoft Education Blog*, Oct. 2022. <https://educationblog.microsoft.com/en-us/2022/10/5-microsoft-education-tools-for-an-inclusive-classroom>.
- [43] M. Zhang, H. Ding, M. Naumceska, and Y. Zhang, "Virtual Reality Technology as an educational and intervention tool for children with autism spectrum disorder: Current perspectives and Future Directions," *Behavioral Sciences*, vol. 12, no. 5, p. 138, May 2022. doi:10.3390/bs12050138.