

The Process of Adopting Information and Communication Technology Innovations in Online Learning for Students with Autism Spectrum Disorder During the COVID-19 Pandemic

Dwi Firmansyah¹, Djuara P. Lubis², Pudji Muljono³, Ninuk Purnaningsih⁴

¹ Mercu Buana University, Awardee BUDI LPDP, Department of Science, Communication and Community Development, Faculty of Human Ecology IPB University.

^{2,3,4} Department of Science, Communication and Community Development, Faculty of Human Ecology IPB University

e-mail: dfi.firmansyah@gmail.com^{1*}; djuaralu@apps.ipb.ac.id²; pudjimuljono@gmail.com³; ninukpu@apps.ipb.ac.id⁴

*Corresponding author

ABSTRACT :

Online learning demands specific teacher preparation, particularly in the effective utilization of Information and Communication Technology (ICT) innovations tailored to the unique needs and capabilities of students with autism spectrum disorder (ASD). This study focused on the ICT innovations adopted by educators at the London School Beyond Academy (LSBA), a vocational school catering to autistic students in Jakarta, during the COVID-19 pandemic. A total of 8 main informants who are educators were selected by snowballing sampling. Data collection involved multiple methods, including in-depth interviews, observations, and literature reviews. Documentation included archiving interview recordings, interview transcripts, and observation notes. The data analysis technique was carried out by adopting the conceptual framework of "School Improvement" (Huberman & Miles, 1984). The findings revealed that the adoption of technological innovations at LSBA is a collaborative effort involving school administrators, educators, and academics, all of whom work together to tailor the use of ICT to the unique abilities of each ASD student. During the assessment of new students, psychologists and educators encountered challenges in conducting online observations. Consequently, this circumstance necessitated adjustments to the learning system to accommodate the diverse abilities of ASD students.

ARTICLE HISTORY

Submitted: 29 Agustus 2023

Revised: 4 Januari 2024

Accepted: 25 March 2024

KEYWORDS

autism spectrum disorder;
information and
communication technology;
innovation adoption; online
learning

INTRODUCTION

During the COVID-19 pandemic, the United Nations Human Rights (2020) expressed concern about the disproportionate impact of the crisis on students with disabilities, including those with autism. This was due to ecological constraints that were mirrored in pandemic responses. As a result of the pandemic, student learning shifted from physical face-to-face interactions to virtual platforms, including synchronous and asynchronous online courses and e-textbooks. Learning environments transformed into intangible virtual spaces, with schools existing not as physical buildings but as websites (Pacheco, 2020).

Online learning offers the advantage of reaching students with special needs who face challenges in attending traditional classes, whether due to geographical distance, personal difficulties, or time constraints, as it offers greater flexibility compared to conventional learning (Rahmawati & Sujono, 2021). However, online education for students with autism spectrum disorders (ASD) necessitates educators' specific preparation to tailor it to the unique needs and abilities of these students.

Creating a successful learning environment depends on three key factors: the role of educators, the role of students, and the integration of technology into the teaching and learning process. Currently, educators' roles are evolving from being the sole holders of knowledge and information to becoming facilitators who guide students through the learning process. Similarly, students' roles are shifting from passive recipients to active participants in the teaching and learning experience. Lastly, technology plays a crucial role in supporting educational materials and enhancing the learning environment (Tse-Kian, 2003). Educational technology not only serves as a medium for sharing ideas and experiences in the teaching and learning process but also facilitates communication among educators, students, and administrators. It allows for the exchange of knowledge and concerns, collaboration with experts and peers, and participation in joint projects (Jhurree, 2005).

Studies have shown that deficits in various cognitive functions can manifest in individuals with autism spectrum disorder (ASD), although it is important to note that not all individuals with ASD experience these deficits. Most individuals with autism have intellectual disabilities, necessitating a consideration of their cognitive abilities when planning the learning process (Buchnat & Wojciechowska, 2020). Even within a classroom exclusively for students with ASD, the teacher must adapt to the varying cognitive abilities of each student. Many students with mild intellectual disabilities struggle to comprehend verbal instructions for assignments and may not know how to seek relevant information. Therefore, it is crucial to prepare clear instructions, reading materials, or independent listening resources to ensure understanding among students (Buchnat & Wojciechowska, 2020). Autistic children are known for their reliance on routines, and introducing something new can require time for them to understand and adapt. Any sudden changes may lead to complaints and even tantrums. Tantrums, characterized by emotional outbursts, are often associated with children who struggle to manage their emotions. They may exhibit stubbornness, crying, defiance, screaming, nagging, anger, and resistance (Ayuningtyas et al., 2022).

The learning process is a constructivist endeavor, where knowledge is not simply absorbed but actively constructed based on individual experiences. Learning emerges through collaboration, reflection, and negotiation within a social context. The integration of technology in education has shifted the educational paradigm from knowledge transmission to knowledge construction. This research specifically examined the incorporation of video technology in the teaching and learning process. Multimedia technology, with its multisensory capabilities, serves as an educational tool capable of conveying concepts and ideas through various media, including text, images, animations, sounds, and videos (Tse-Kian, 2003). Professionals in the field of education have demonstrated a tendency to develop and employ innovations. Therefore, when educational institutions are tasked with utilizing digital media, they face no significant challenges in motivating students to engage with technology. The features of e-learning enhance knowledge acquisition, improve comprehension of course materials, and assist students in accessing resources and completing assignments (Wiradharma et al., 2021).

Previous research on learning during the COVID-19 pandemic for autistic students has been extensive. Donald M. Stenhoff, Robert C. Pennington, and Melissa C. Tapp conducted a review of school-based learning for individuals with ASD, which was disrupted by the pandemic. Consequently, schools had to transition from traditional services to teaching students in their homes using distance education strategies (Stenhoff et al., 2020). Nazli Hameed's research yielded results indicating that online teaching for ASD students can enhance the inclusivity of the teaching and learning process, not only during the COVID-19 pandemic (Hameed, 2020). Daruka Hyseni and Nagavci Zamira examined factors influencing the level of inclusion in education for children with disabilities both before and during the COVID-19 pandemic (Daruka & Nagavci, 2020). Anne L. Mendoza, Glennda K. McKeithan, and Deborah E. Griswold (2019) reviewed the phenomenon of parents and/or caregivers of children with autism spectrum disorder (ASD) expressing frustration with services provided through public school settings (Mendoza *et al.*, 2019). Ina Dewi Ardiyani, Nining Febriyana, Yunias Setiawati, and Royke Tony Kalalo (2020) emphasized the need for parent training during the COVID-19 pandemic as a means to provide information, education, and skills for parents to deliver intensive, comprehensive, and sustainable early intervention (Ardiyani et al., 2020).

This research focused on ICT innovations implemented by educators at the London School Beyond Academy (LSBA), a specialized vocational education institution for students with autism, during the COVID-19 pandemic. The term "college student" or simply "student" was used because the entry requirements for these individuals include a minimum of a high school diploma or equivalent. Government regulations mandating the shift from offline to online learning systems necessitated the adoption of technological innovations, especially by educators due to the communication challenges faced by ASD students. The purpose of this study was to explore the process of adopting information and communication technology innovations carried out by LSBA during the COVID-19 pandemic.

RESEARCH METHOD

This study falls within the realm of qualitative research, specifically exploratory research, operating under a constructivist paradigm. The research strategy employed was a case study approach conducted at the London School Beyond Academy (LSBA), a special-education institution. Cases are constrained by activity and time, while researchers gather comprehensive data based on multiple data gathering techniques over a defined period of time (Creswell, 2021). The case studied was the transition of ASD student learning from offline to online during the Covid-19 pandemic. The participants consisted of key and supporting informants. The key informants included the LSBA director, Chrisdina, followed by the selection of two informants, who were IT manager, Bilal Wegig Wirawan, and academic educator, Retno Wulandari, using a snowballing technique. Data collection involved multiple methods, including in-depth interviews, observations, and literature reviews. In-depth interviews were conducted face-to-face, recorded using a recorder, and transcribed verbatim afterward. In addition, observations were made through video recordings of the students' activities at the LSBA. Documentation included archiving interview recordings, interview transcripts, and observation notes. The data analysis technique was carried out by adopting the conceptual framework of "School Improvement" (Huberman & Miles, 1984).

Huberman and Miles introduced a framework known as the "Miles and Huberman Matrix" in their book "Innovation Up Close: How School Improvement Works" (1984) for the analysis of qualitative data in the context of school development. This framework encompasses several dimensions: (1) Purpose: This dimension focuses on identifying and comprehending the objectives of school improvement initiatives. It entails clarifying the desired outcomes and changes sought within educational settings. (2) Context: The context dimension involves an examination of the organizational, social, cultural, and political factors influencing the implementation of school improvement efforts. It considers the unique characteristics and challenges within the school and its environment. (3) Process: This dimension delves into the strategies, actions, and interventions undertaken to achieve the desired improvements. It involves a detailed examination of the specific steps taken to drive change within the school. (4) Results: This dimension centers on evaluating the effects and impacts of school improvement efforts. It entails assessing whether the intended goals have been realized and scrutinizing any unintended consequences or outcomes. Miles and Huberman's matrix provides a structured approach for analyzing qualitative data about school development.

RESULTS AND DISCUSSION

The adoption and application of innovation within an organization or system, as outlined in the conceptual framework "School Improvement" by Huberman and Miles (1984), are influenced by the following key factors:

1. Impinging Factors: These are external forces or conditions that exert an influence on the adoption and implementation of an innovation. Such factors can encompass economic, technological, social, political, or environmental changes. For example, alterations in government regulations, shifts in economic conditions, or advancements in technology

can significantly impact an organization's decisions regarding the adoption and integration of innovations.

2. **Internal Context as a "Host":** The term "internal context" refers to the specific environment within an organization where innovation is to be implemented. This encompasses factors like organizational culture, structure, available resources, leadership, and employee attitudes. A positive internal context, characterized by a supportive culture, adequate resources, and engaged leadership, can greatly facilitate the successful adoption and implementation of innovations. In this context, "host" represents the organization or system considering the adoption of an innovation. The readiness and willingness of the host to embrace change play pivotal roles in the adoption process. Factors such as an organization's mission, vision, values, and strategic goals will shape its receptivity to new ideas and technologies.
3. **Adoption Decision:** This phase pertains to the process by which an organization determines whether to accept and incorporate an innovation into its operations. Several factors influence this decision-making process, including the perceived benefits of the innovation, potential risks, compatibility with existing practices, and the organization's capacity to successfully implement the innovation.
4. **Cycle of Transformation:** This concept refers to the stages an organization undergoes when adopting and implementing an innovation. These stages typically include awareness, interest, evaluation, trial, adoption, implementation, and integration. Each stage presents distinct challenges and opportunities as the organization progresses from initial awareness of the innovation to its full integration into operations.
5. **Outcomes (Results):** This category encompasses the results and impacts stemming from the adoption and implementation of innovations. These outcomes can be both intentional and unintentional, and they may have positive or negative consequences. Organizations need to meticulously monitor and evaluate the effects of innovations to gauge their effectiveness and pinpoint areas for improvement.

The COVID-19 Pandemic as an Impinging Factor

When the Indonesian government implemented Large-Scale Social Restrictions (Indonesian: *Pembatasan Sosial Berskala Besar* [PSBB]) followed by the Imposition of Community Activity Restrictions (Indonesian: *Pemberlakuan Pembatasan Kegiatan Masyarakat* [PPKM]) due to the COVID-19 Pandemic, community activities and mobility became severely limited. The Indonesian government also introduced online education, which affected teaching and learning activities at the London School Beyond Academy (LSBA). According to an interview with the Director of LSBA, Chrisdina, on September 20, 2022, the learning process, including the assessment of new students and the teaching-and-learning process, shifted to an online format. This adjustment aimed to facilitate adaptation and alignment among students, educators, and parents as companions. The condition of the COVID-19 pandemic serves as an external factor necessitating the implementation of online learning policies.

Internal Context as the "Host"

Government regulations mandating educational institutions to transition from offline to online learning compelled LSBA to follow suit. These changes in the learning system at LSBA take into consideration the unique characteristics of autistic students who exhibit traits associated with autism spectrum disorders (ASD), characterized by triad impairments in socialization, communication, and imagination. Current diagnoses of ASD adhere to the Diagnostic and Statistical Manual of Mental Disorders (DSM-5), issued by the American Psychological Association (APA) in 2013, or the International Classification of Diseases (ICD-10), issued by the World Health Organization (WHO) in 1993. The diagnostic criteria for ASD, as outlined in the DSM-5 (Marty, Meghan & Segal, 2017), include (1) Persistent Lack of Communication and Social Interaction: This is manifested by deficiencies in social and emotional communication skills and disruptions in nonverbal communication behaviors used for social interaction; (2) Restricted and Repetitive Behavior Patterns, Interests, or Activities: At least two of the following behaviors are exhibited: (a) Stereotyped or repetitive motor movements, use of objects, or language; (b) Excessive attachment to sameness, rigid routines, or ritualized patterns of verbal or non-verbal behavior; (c) Highly focused interests with abnormal intensity or focus; (d) Atypical reactions to sensory input or unusual interest in sensory aspects of the environment. In the DSM-5, Autistic Disorder, Asperger's Disorder, and PDD-NOS have been replaced by the broader diagnosis of autism spectrum disorders (ASD). Additionally, the DSM-5 distinguishes socially related elements of autism into social communication disorder and repetitive/limited behavior. However, the terms "Asperger" and "PDD-NOS" are still commonly used in society.

One of the strategies employed by LSBA involves inviting lecturers to create educational videos. However, the challenge lies in the limited time available for producing and translating these videos into learning modules. Adaptation is necessary among lecturers to effectively carry out this task. For those lecturers who are technologically proficient, they receive support from assistants in video production. The transition from offline to online learning necessitates adaptation not only for students and parents but also for educators (lecturers). Lectures primarily focus on utilizing technology to create educational videos during this adaptation process. Lecturers, especially those less familiar with video production technology, seek assistance from teaching assistants for creating these videos. Furthermore, they established guidelines for online communication and interaction with students (Interview with Chrisdina on September 20, 2022).

"When the government first implemented PSBB, we had a very short time to adapt from offline to online learning. we were forced to learn to make learning videos, not just teach online through Zoom. But the problem is, that lecturers have to convert offline learning materials into different online learning modules. Anyway, within 2 weeks we must be able to make learning videos. Another problem that arises is that at that time the learning equipment for students was at school, while students studied online at home. So we also have to change it all so that the tools that are commonly used at school can also be used at home. We were forced to send some equipment and materials for learning practices to the homes of each student". (CR)

To communicate the changes and technological adaptations to lecturers, instructions are provided on managing online classes. This includes guidance on sharing slide shows via Zoom and ensuring that students attending virtually can see the direction the lecturer is providing. Communication with lecturers occurs through various channels, such as WhatsApp groups, hotlines, and email. Notably, even lecturers who may initially be technologically inexperienced have not refused to teach online. Instead, they expressed a desire for more intensive technology training (Interview with Retno Wulandari on September 20, 2022).

"Initially, the LSBA manager did not facilitate practitioner lecturers to make learning videos, because at that time the COVID-19 pandemic was high. All activities were closed, so each lecturer made their own learning videos, while learning editing by themselves, the important thing is that there are videos that ASD students can watch from home. After the second semester, when COVID-19 began to decline and activities began to open even though they were limited, the school helped the practitioner lecturers make better videos. By providing cameras, lighting, studio space, and editing assistance by professionals". (RW)

Teaching assistants play a crucial role, especially at the outset of the transition from offline to online learning. They assist practicing lecturers in utilizing ICT for teaching purposes. During the adaptation process, teaching assistants are instrumental in helping lecturers with various tasks, including handling attendance, providing student support, and even acting as mediators for students experiencing tantrums or reluctance to attend class. Teaching assistants work to ensure that students remain engaged and participate in lessons. Typically, lecturers delegate student support to teaching assistants. Another challenge arises during online learning, as not all students have access to the necessary equipment at home. To address this, LSBA arranges for the required materials to be sent to students' homes. Additionally, LSBA conducts meetings with parents who serve as student companions to teach them how to access YouTube, as learning videos are often hosted on this platform, and how to use Google Classroom.

Adoption Decision

Bilal Wegig Wirawan, the IT Division Coordinator at LSBA, explained the shift in the learning approach before the COVID-19 pandemic, which was primarily face-to-face, transitioning to online learning. Before the pandemic, students engaged in learning activities in computer laboratories covering various subjects. Billal provided an example of how ASD students were taught to utilize computer applications, such as Microsoft Office, including Word and Excel, and to create presentations using PowerPoint. Additionally, there were courses in basic publishing software like Photoshop, Illustrator, InDesign, and others. Learning in the computer laboratory was facilitated by lecturers and teaching assistants during offline sessions.

However, with the onset of the COVID-19 pandemic, LSBA transitioned from offline to online learning. Students began to participate in computer-based learning from the comfort

of their homes. The IT division utilized the AnyDesk application, enabling lecturers to remotely access students' computers to guide them on using learning applications. Notably, parental assistance became crucial for ASD students, especially those who faced challenges in maintaining focus while using computers due to autism spectrum disorders. The process of adapting to this new technology took approximately six months, allowing lecturers, teaching assistants, and students to effectively utilize ICT (Interview with Bilal Wegig Wirawan on September 20, 2022).

"The use of computers for presentation courses, for example, students learn how to make presentations using various software such as PowerPoint, Microsoft Word, and Excel. For those who design, there are basic publishing courses, namely learning Photoshop, Illustrator, InDesign, and so on. During offline learning, they are still accompanied by lecturers and teaching assistants. But during the pandemic, they switched to online learning. To help students who have difficulty operating various software on their home computers, IT staff help using any desk application by remoting student computers from school computers". (BW)

The vocational learning process for ASD students at LSBA comprises several stages. The initial stage involves the selection of students through assessments and observations conducted by psychologists. The second stage involves the admission of students, followed by the actual learning process. During the learning process, ASD students require support from both LSBA educators and parents. The third stage involves evaluating students' progress and assessing their performance throughout the learning period. These three stages underwent significant changes during the COVID-19 pandemic.

The use of ICT has been integrated from the very beginning of the process, which involves assessing prospective students. According to Chrisdina, the assessment process underwent a significant transformation during the COVID-19 pandemic, shifting from its previous offline, face-to-face approach to an online format. This change necessitated psychologists to reformat the assessment tools used, as these tools were originally designed for in-person assessments. Interviews with students and parents were also conducted online, as was the process of observing behavior. However, despite its effectiveness, online assessments and observations had certain limitations. One notable drawback was the possibility of prospective students receiving assistance from their caregivers during the assessment, thereby potentially skewing the results and failing to provide an accurate reflection of the actual condition of autism spectrum disorders.

Retno Wulandari, a teaching assistant at LSBA, also highlighted the limitations of online assessments. She emphasized that online assessments were unable to capture the true character and behavior of students, stating,

"During the pandemic, our system was online, and if I am honest, sir, we faced significant challenges because we could not directly observe the children's behavior. Parents may help ASD children with their assignments, which could have influenced the results. After

conducting online observations, it became evident that the outcomes did not truly reflect the actual condition of autism disorders that the students had". (RW)

The role of assessment becomes pivotal, as the recommendations and suggestions generated by the assessment team serve as the foundation for creating Individualized Educational Programs (IEPs). The National Information Center for Children and Youth Disabilities explains that the assessment process aims to gather information about students' abilities and obstacles, determine suitable programs tailored to their needs, formulate individualized learning programs, and establish educational plans for children with autism (Roshinah, 2016).

After the assessment process, students receive an introduction to different majors in the first semester. During this initial semester, all courses remain the same, but students are grouped based on their academic test results or IQ abilities. Following the completion of the first semester, lecturers and teaching assistants assess the students' learning outcomes to determine their majors for the second semester. For instance, they assess whether a student is better suited for the Office Administration department or Textile Craft.

"After the first semester concludes, lecturers and teaching assistants evaluate students' learning outcomes to assign majors. Initially, students do not select their preferred majors. Instead, we assess their potential and whether their interests align with the chosen major. We are concerned that if parents impose a specific major choice on their children, it may result in learning difficulties". (RW)

Although the curriculum in the first semester is generally structured, it is tailored to each student's academic ability and IQ level, and it is divided into several tiers: A, B, and C. The variations in the learning systems among these levels (A, B, and C) can be illustrated as follows:

"For instance, in the graphic design field, students at levels B and C can search for images or photos on Google when assigned to create posters. However, students at level A cannot access Google for images, so the lecturer must provide the images, and these students only duplicate them". (RW)

One of the effective tools for teaching ASD students is the use of videos as a visual medium by educators. Videos serve as a medium to present learning materials and demonstrate positive behaviors. They are used to introduce teaching materials to students because videos can engagingly cover extensive content, incorporating audio, subtitles, or music. The use of videos as a visual medium for instructional purposes helps students grasp the meaning of language and enhances message clarity. Videos are also valuable for students as they exemplify how language conveys general meaning and mood through expressions, gestures, and other visual cues (Puspita et al., 2019).

To address these technological challenges, LSBA conducted outreach to the parents of students by creating a guide on how to use YouTube and Google Classroom, which was then distributed to parents. Another challenge arose when parents were unable to assist their

children with online learning due to work commitments. In one instance, a student was forced to take a leave of absence because their parents could not be present to support their online learning.

Cycle of Transformation

Online learning offers students with autism spectrum disorder (ASD) the flexibility of learning at their own pace and location, allowing for asynchronous participation in discussions with both peers and educators. The shift from offline to online learning has transformed how educators interact with ASD students. Despite students with disabilities having their unique means of communication, it is evident that they still require interaction to effectively communicate.

Virtual face-to-face interaction through online platforms like Zoom creates a comfortable space for students to ask questions or simply observe class discussions, especially for those who cannot communicate verbally. Students' eagerness to engage in class is reflected in their enthusiasm when posing questions, leading educators to implement a rule requiring them to use the "raise hand" feature before asking questions. In some cases, educators must act as hosts to manage the class and mute participants if multiple students speak simultaneously during online classes.'

*"When synchronous learning through Zoom, students actually ask a lot of questions. So the lecturer makes a rule so that students who want to ask questions must raise their hands and all other participants' microphones must be turned off. Because otherwise, the voices of Zoom participants are muttering to each other. Moreover, there is a time delay in the use of Zoom, so it is increasingly difficult to control the voices of the students. At this moment, the practitioner lecturers and teaching assistants who are the hosts have to work hard to organize the students, one of which is by mute participants".
(CR)*

Furthermore, educators have devised strategies to foster more intensive interactions during online learning via Zoom by individually engaging with each student to showcase their work. While this approach extends the time required for educators to interact with each student, it encourages meaningful engagement. Successful online learning for ASD students necessitates the development of self-regulation, discipline, time management, organizational, planning, and self-evaluation skills. These skills can be particularly challenging for many students on the autism spectrum, impacting their performance in online activities. The success of an online learning environment depends on various factors, including pedagogical approaches. Therefore, fostering positive interactions between learning methods, engagement, and online learning environment design is paramount (Adams et al., 2019).

Outcomes

The results or outputs of online learning have shown a decrease of approximately 20 percent when compared to traditional offline methods. To address this issue, LSBA introduced

a new department designed to accommodate students facing challenges in existing departments due to their autism spectrum disorder (ASD) conditions. For instance, some students may exhibit disruptive behaviors, such as frequent flapping, which can disrupt their peers during the learning process. This situation arises because the results of online assessments do not accurately reflect the actual condition of students with ASD. Despite these challenges, many prospective students are admitted, even though they may struggle with vocational learning from an autistic perspective.

The introduction of this new department aims to ensure that students do not face setbacks in their learning journey. Placing students in majors that they are unable to follow can lead to suboptimal results. In this newly established department, the difficulty level is lower, but students still receive guidance to foster their independence and prevent hindrances in their self-development.

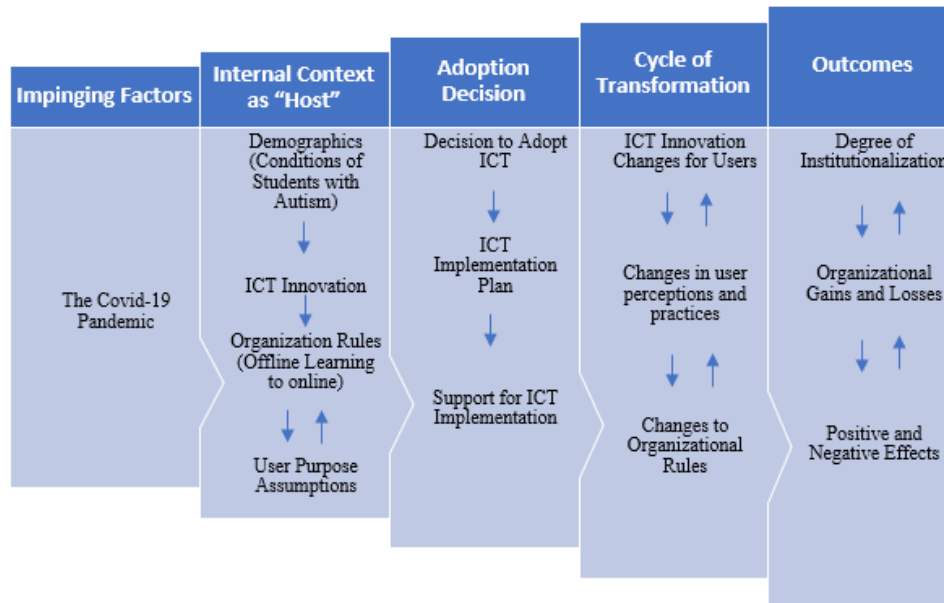
"Yes, it is true, the outcomes are very different. The difficulty level is much lower. For example, in a regular class, they may produce 10 different works, while here, they only create about 3 similar ones repeatedly". (CR)

Another educator informant explained that the new department was created to cater to students who encountered behavioral difficulties in other majors. Typically, the new department focuses more on teaching life skills to students.

"The special skills department is primarily for children with behavioral challenges. Students majoring in textile craft and those in the special skills department have some similarities, but the latter emphasizes life skills material. On the other hand, the textile craft department covers various technical aspects, such as batik, sewing, fabric arts, and dyeing techniques, which are more advanced in terms of difficulty. Placing students with special skills in the textile craft department could result in learning difficulties". (RW)

The positive outcome of implementing online learning is the innovation in marketing products created by students. To align with LSBA's goal of promoting economic independence among students, a learning process leading to the Vocational Training Center (Indonesian: *Balai Latihan Kerja* [BLK]) has been introduced. During the pandemic, the BLK system transitioned to an online format. Learning materials are delivered to students' homes, and they receive instruction via the ZOOM platform, which includes activities like crafting room fragrance candles. Educators also provide mentoring through ZOOM to guide students in producing the desired output within specific deadlines.

The students' practical work results are now marketed on e-commerce platforms like Shopee. Previously, many of these products were ordered directly by consumers. However, due to the pandemic, the number of direct orders decreased, leading to the adoption of e-commerce platforms for marketing: *" We have a Shopee e-commerce platform. Students' work during online learning is now sold through this platform"* (CR).



Source: (Adapted from the research results, based on Huberman, A. M., & Miles, M. B., 1984)

Figure 1 The Process of Adopting ICT Innovations for ASD Vocational Students during the COVID-19 Pandemic

Figure 1 explain the process of implementing ICT innovation in vocational learning for ASD students at LSBA was analyzed using the "School Improvement" concept developed by Huberman and Miles (1984). In the Impinging Factors stage, the COVID-19 pandemic compelled educational institutions in Indonesia to shift from offline to online learning. In the Internal-Context-as-"Host" stage, LSBA considered the unique characteristics of students with autism spectrum disorders to develop ICT innovations tailored to their needs. In the Adoption Decision stage, LSBA's leadership tasked lecturers with creating instructional videos by adapting their offline course materials. Time constraints posed several challenges, especially in aligning video teaching materials with offline content. Teaching assistants, primarily tech-savvy youngsters, provided crucial support in video production. The role of teaching assistants is particularly significant for lecturers with limited technological literacy. ICT literacy was also promoted among students' parents, who act as companions in the learning process.

The Cycle of Transformation stage, learning is facilitated by uploading instructional videos on YouTube, allowing students to engage in asynchronous learning. A commonly used audio-visual technology in interventions for ASD children is video modeling (VM) (Thirumanickam *et al.*, 2018). Video modeling is a type of video-based instruction (VBI) rooted in Albert Bandura's Social Learning Theory, and it has been recognized as an evidence-based practice for individuals with ASD. Various forms of VBI include video modeling and video self-modeling (VSM), both presented from a third-person perspective, as well as point-of-view modeling (PoVM), presented from the learner's viewpoint. In video-based interventions, learners watch video clips demonstrating target behaviors, with the hope that they will learn and replicate these behaviors. The model showcasing the target behavior in a video clip can be an adult, a peer, an animated character, or the learner, as in VSM (Thirumanickam *et al.*,

2018). Conversely, synchronous learning is conducted using the ZOOM platform. In synchronous learning, technological innovation is also facilitated through the use of the AnyDesk application, enabling lecturers to remotely access students' computers at home to provide guidance and instruction on using learning applications or software.

Synchronous communication is typically less effective for individuals with ASD, especially those experiencing persistent deficits in social communication. Despite its limitations, most interventions and programs continue to rely on synchronous communication because it necessitates real-time expert guidance and management. In contrast, recent research studies have discovered that online asynchronous communication channels, such as weblogs, online dating sites, online video games, and online forums, can be highly beneficial for people with ASD. However, these studies have not specifically focused on learning contexts, which could potentially equip individuals with ASD with the skills needed to address their challenges (Seng et al., 2022). Synchronous discussions demand rapid, round-the-clock processing of conversations, which can be especially challenging for students with learning disabilities, particularly when dealing with unfamiliar topics and specialized terminology. Synchronous discussions also place greater demands on social dynamics, an area that poses particular challenges for some individuals with social pragmatic difficulties, such as autistic students (Dahlstrom-Hakki et al., 2020).

The outcomes of LSBA's ICT innovation efforts reveal both positive and negative aspects. ICT transformation is implemented across three stages of learning: assessment, instruction, and evaluation. During the assessment stage, the adoption of online ICT has made it challenging for psychologists to conduct observations. Moreover, there is the possibility of students receiving assistance from parents or caregivers in answering assessment questions, potentially leading to inaccuracies in assessing their abilities. This situation poses challenges for LSBA in preparing Individualized Educational Programs (IEPs) based on assessment results. On the other hand, the evaluation of learning outcomes also indicates a decline in student performance by approximately 20 percent compared to offline learning. This drop can be attributed to the inability of online assessments to accurately reflect the conditions of autism spectrum disorders in prospective students. Consequently, LSBA has introduced a new department to accommodate students who face challenges in participating in learning within the existing departments due to the severity of their autism condition. On a positive note, ICT innovation has facilitated the creation of learning materials in the form of videos that can be utilized in post-pandemic hybrid learning scenarios. Additionally, LSBA has leveraged e-commerce platforms to assist students in marketing their work.

The findings of this study underscore the presence of ICT innovation in the vocational learning process for ASD students. LSBA's ICT innovation strategy is tailored to the unique needs of students with autism spectrum disorders and the demands of mass learning. The novelty of this research lies in highlighting the ICT innovations implemented by educational institutions like LSBA as an adaptation to the challenges posed by the COVID-19 pandemic. These findings complement the results of previous studies on various aspects related to ASD students, including distance education strategies (Kessel et al., 2020), the inclusiveness of

online learning (Hameed, 2020), and factors influencing the level of inclusion in the education of students with disabilities both before and during the COVID-19 pandemic (Daruka & Nagavci, 2020). It also relates to the phenomenon where many parents or caregivers of children with autism spectrum disorder (ASD) have expressed frustration with the services offered in public school settings (Mendoza et al., 2019) and the necessity for training programs for parents of ASD children during the COVID-19 pandemic (Ardiyani *et al.*, 2020).

CONCLUSION

The COVID-19 pandemic necessitated a shift in the learning approach for ASD students at LSBA, transitioning from traditional face-to-face (offline) to online methods. LSBA's leadership, in collaboration with lecturers and teaching assistants, initiated the adoption of information and communication technology (ICT) innovations. This involved formulating policies and producing learning videos tailored for ASD students. LSBA also undertook efforts to familiarize and educate parents of ASD students in assisting with online learning. Several challenges emerged during the implementation of online learning, spanning from the assessment of prospective students to curriculum development and the adaptation of ASD students to this new mode of learning. The outcomes of online learning showed a decline in student performance in vocational education. This decline could be attributed, in part, to the limitations of online assessments in capturing the nuances of autism spectrum disorders among prospective students. In response, LSBA introduced a dedicated department to accommodate students who faced difficulties in existing departments due to the nature of their autism spectrum condition. On a positive note, LSBA successfully leveraged technology to sell students' work through e-commerce platforms during the pandemic.

Future research should delve into a comprehensive analysis of ICT utilization in the education of ASD students, with a focus on the concept of pedagogical content knowledge and technology. Pedagogical Content Knowledge, encompassing an understanding of concept representation using technology, constructive pedagogical techniques employing technology for effective content delivery, identification of challenging and facilitating aspects of learning, and the application of technology to build on existing knowledge and foster new epistemologies, is integral to effective technology-enabled teaching (Mishra & Koehler, 2006).

Acknowledgments: The authors extend gratitude to all those who contributed to this research endeavor, particularly the management, lecturers, and members of the LSBA community who supported and facilitated the research. Special thanks are also due to LPDP for funding this research project through the Indonesian Lecturer Excellence Scholarship (BUDI) and Doctoral Dissertation Research funding.

REFERENCES

- Adams, D., Simpson, K., Davies, L., Campbell, C., & Macdonald, L. (2019). Online learning for university students on the autism spectrum: A systematic review and questionnaire study. *Australasian Journal of Educational Technology*, 35(6), 111–131. <https://doi.org/10.14742/ajet.5483>
- Ardiyani, I. D., Febriyana, N., Setiawati, Y., & Kalalo, R. T. (2020). Parent Training Program for

- Autism Spectrum Disorder During The Covid-19 Pandemic Period in Indonesia. *Jurnal Psikiatri Surabaya*, 9(2), 60. <https://doi.org/10.20473/jps.v9i2.19123>
- Ayuningtyas, F., Intyaswati, D., Supratman, S., Setiawan, H., & Lusia, A. (2022). Studi Fenomenologi: Pengalaman Guru Insan Berkemampuan Khusus Dalam Menjalani Profesinya Di Rumah Autis Cabang Depok. In *Ekspresi Dan Persepsi: Jurnal Ilmu Komunikasi* (Vol. 5, Issue 1, pp. 16–27). <https://doi.org/10.33822/jep.v5i1.3377>
- Buchnat, M., & Wojciechowska, A. (2020). Online education of students with mild intellectual disability and autism spectrum disorder during the COVID-19 pandemic. *Interdyscyplinarne Konteksty Pedagogiki Specjalnej*, 29, 149–171. <https://doi.org/10.14746/ikps.2020.29.07>
- Creswell, J. W. (2021). *Research Design: Pendekatan Metode Kualitatif, Kuantitatif dan Campuran*. Penerbit Pustaka Pelajar.
- Dahlstrom-Hakki, I., Alstad, Z., & Banerjee, M. (2020). Comparing synchronous and asynchronous online discussions for students with disabilities: The impact of social presence. *Computers and Education*, 150, 103842. <https://doi.org/10.1016/j.compedu.2020.103842>
- Daruka, Z. H., & Nagavci, N. (2020). The impact of the COVID-19 pandemic on the Education of Children with Disabilities. *StatCan COVID-19: Data to Insights for a Better Canada*, 45280001. <https://doi.org/10.13140/RG.2.2.17807.41125>
- Hameed, N. (2020). Home schooling challenges for C hildren with Autism during Covid 19 pandemic. *Interventional Pediatrics & Research*, 3(1), 29–30.
- Huberman, A. M., & Miles, M. B. (1984). *Innovation up close: How School Improvement Works*. Plenum.
- Jhurree, V. (2005). Technology integration in education in developing countries : Guidelines to policy makers 1. *International Education Journal*, 6(4), 467–483.
- Kessel, R. van, Steinhoff, P., Varga, O., & ... (2020). Autism and education—Teacher policy in Europe: Policy mapping of Austria, Hungary, Slovakia and Czech Republic. In *Research in ... Elsevier*. <https://www.sciencedirect.com/science/article/pii/S0891422220301645>
- Marty, Meghan & Segal, D. (2017). Diagnostic and statistical manual of mental disorders (DSM). *Knowledge Organization*, 44(8), 668–676. <https://doi.org/10.5771/0943-7444-2017-8-668>
- Mendoza, A. L., Mckeithan, G. K., & Griswold, D. E. (2019). Effective Home School Programming for Students with Autism Spectrum Disorder. *Home School Researcher*, 34(3), 1–5. https://www.researchgate.net/publication/334416856_Effective_Home_School_Programming_for_Students_with_Autism_Spectrum_Disorder
- Mishra, P., & Koehler, M. J. (2006). Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge. *Teachers College Record: The Voice of Scholarship in Education*, 108(6), 1017–1054. <https://doi.org/10.1177/016146810610800610>
- Pacheco, J. A. (2020). *The "new normal" in education*. 0123456789.
- Puspita, L. P. A. S., Padmadewi, N. N., & Wahyuni, L. G. E. (2019). Instructional Teaching Media to Promote Autistic Student's Learning Engagement. *Journal of Education Research and Evaluation*, 3(2), 58. <https://doi.org/10.23887/jere.v3i2.20975>
- Rahmawati, A., & Sujono, F. K. (2021). Digital Communication through Online Learning in Indonesia: Challenges and Opportunities. *Jurnal ASPIKOM*, 6(1), 61. <https://doi.org/10.24329/aspikom.v6i1.815>
- Roshinah, F. (2016). Pelaksanaan Asesmen Untuk Layanan Pendidikan Anak Autis. *Widia Ortodidaktika*, 5, 1156–1168.

- Seng, A. K. K., Jain, J. A., Ponniah, L. S., & Jegathesan, A. J. (2022). Learning through Online Synchronous and Asynchronous Communication among Adolescents with Autism Spectrum Disorder: A Conceptual Discourse. *International Journal of Information and Education Technology*, 12(12), 1407–1416. <https://doi.org/10.18178/ijiet.2022.12.12.1765>
- Stenhoff, D. M., Pennington, R. C., & ... (2020). Distance education support for students with autism spectrum disorder and complex needs during covid-19 and school closures. *Rural Special Education* <https://doi.org/10.1177/8756870520959658>
- Thirumanickam, A., Raghavendra, P., McMillan, J. M., & van Steenbrugge, W. (2018). Effectiveness of video-based modelling to facilitate conversational turn taking of adolescents with autism spectrum disorder who use AAC. *AAC: Augmentative and Alternative Communication*, 34(4), 311–322. <https://doi.org/10.1080/07434618.2018.1523948>
- Tse-kian, K. N. (2003). Using multimedia in a constructivist learning environment in the Malaysian classroom The constructivist learning paradigm. *Australian Journal of Educational Technology*, 19(3), 293–310.
- Wiradharma, G., Ruliana, P., & Prisanto, G. F. (2021). Pemanfaatan Media Pembelajaran Daring Dalam Proses Belajar Mengajar. In *Ekspresi Dan Persepsi: Jurnal Ilmu Komunikasi* (Vol. 4, Issue 2, pp. 157–172). <https://doi.org/10.33822/jep.v4i2.2589>