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The Potential of Artificial Intelligence for Autism Spectrum Disorder: Moderating Role of Government Initiatives

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Abstract

Rapid technological advancements have significantly transformed and enhanced several aspects of our everyday lives. However, it is important to acknowledge that these technological innovations mostly cater to the demands of the general population, inadvertently neglecting individuals with specific requirements, such as those diagnosed with autism spectrum disorder (ASD). The rapid development of artificial intelligence (AI) technology in the Fourth Industrial Revolution (4IR) period offers significant potential for integrating students with special needs, particularly those with ASD. Extensive research has demonstrated the manifold advantages that ASD youngsters derive from including robots in their educational experiences. This study aims to elucidate the potential of artificial intelligence in enhancing early intervention and special education for children diagnosed with ASD. The utilization of gamification has the potential to enhance the efficacy and benefits of educational content, thereby serving as an innovative instrument to foster increased involvement of children with the subject matter. Research has indicated that individuals diagnosed with ASD can have enhanced motor, behavioral, and communication skills by using gamification and gamified instructional materials. This study will further examine the moderating effect of government initiatives on the association between artificial intelligence and autism in Malaysia. This study is expected to benefit the policymaker by providing valuable insights into AI's potential benefits and challenges in autism diagnosis and treatment. Policymakers can use this information to make informed decisions about regulations and guidelines surrounding the use of AI in the field. Additionally, the study may highlight the need for increased funding and support for research and development in AI-based therapies for autism, which policymakers can address through appropriate policy initiatives.

Keywords: *Artificial Intelligence, Autism, Gamification, Special Needs Education, Communication Gap*

1.0 Introduction

Autism spectrum disorders (ASD) encompass a wide range of heterogeneous diseases. Individuals with this condition exhibit varying challenges in their ability to engage in social interactions and communicate effectively. Additional features encompass abnormal manifestations of activities and behaviors, including challenges in transitioning between different tasks, an inclination toward meticulous attention to detail, and idiosyncratic responses to sensory stimuli (FirespringInt, 2023). The capabilities and requirements of individuals with autism spectrum disorder exhibit considerable variability and may undergo developmental changes. While certain individuals diagnosed with ASD possess the ability to live autonomously, there are others who experience significant impairments and necessitate ongoing assistance and supervision throughout their lives. The presence of autism frequently exerts a significant influence on both educational attainment and employment prospects. Furthermore, the responsibilities placed on families to provide care and support might be substantial. The quality of life experienced by individuals with autism is significantly influenced by societal views and the extent of support offered by local and national authorities (Kapp, 2018).

The Comprehensive Mental Health Action Plan 2013-2030 by the World Health Organization (WHO) and the World Health Assembly Resolution WHA73.10, which focuses on global actions for epilepsy and other neurological disorders, emphasize the need for countries to address the existing deficiencies in the early identification, provision of care, treatment, and rehabilitation for mental and neurodevelopmental disorders, including autism. Furthermore, it is imperative for counties to effectively handle the social, economic, educational, and inclusionary requirements of individuals residing with mental and neurological diseases, as well as their families. Additionally, there is a need to enhance monitoring mechanisms and conduct pertinent research in this domain.

The utilization of artificial intelligence (AI) is currently being investigated as a means to diagnose autism and facilitate the enhancement of social, communication, and emotional abilities in individuals on the autistic spectrum (Rudy, 2023; Walker, 2017). AI-based therapeutic interventions are currently being developed and have demonstrated considerable potential. Scientists have successfully devised algorithms capable of forecasting autism by analyzing the brain structures of infants, as well as determining the presence of autism through the examination of brain scans. An innovative precision medicine strategy, augmented by AI, has established the foundation for potentially developing the initial biological screening and intervention tool for a specific subtype of autism (Rudy, 2023; Hadhazy, 2022; Burns, 2017). The majority of studies that have been conducted in the past about AI and autism have concentrated on the diagnosis or screening of autism disorder using AI (Shahamiri and Thabtah, 2022; Thabtah and Fadi, 2017; Towle and Patrick, 2016; Duda et al., 2016; Bone et al., 2016; Wall et al., 2012).

In numerous nations, government initiatives in the use of AI in education is a topic of interest. In Malaysia, the Ministry of Science, Technology, and Innovation (MOSTI) is collaborating with Universiti Teknologi Malaysia, government agency representatives, and industry stakeholders to develop a code of ethics and governance for artificial intelligence (AI). The Department of Education in the United States has shared insights and recommendations for artificial intelligence including emphasizing humans-in-the-loop, aligning AI models to a shared vision for education, designing AI using modern learning principles, prioritizing

strengthening trust, informing and involving educators, focusing R&D on addressing context and enhancing trust and safety, and developing education-specific guidelines and guardrails are among the recommendations. UNESCO is committed to assisting Member States in harnessing the potential of AI technologies to achieve the Education 2030 Agenda while ensuring that its application in educational contexts adheres to the core principles of inclusion and equity. This study intends to investigate the moderating effect of government initiatives on the relationship between artificial intelligence and autism in Malaysia.

2.0 Literature Review

Autism and Artificial Intelligence (AI) are a powerful combination that can assist individuals with autism spectrum disorder. AI can help diagnose autism spectrum disorders, help develop personalized learning and therapy, facilitate social skills development, and help individuals with language difficulties communicate via alternative means (McClure, 2023).

2.1 Underpinning Theory

The study used the Unified Theory of Technology Acceptance and Use Theory 2 (UTAUT2) to predict AI acceptance in the treatment of autism spectrum disorder-related disabilities. UTAUT2 is an extension or improvement of Venkatesh et al. (2003)'s UTAUT, which was designed to measure users' behavioral intentions to accept technology (Morton et al., 2016). The premise of the UTAUT is "that an individual's intention to use technology is influenced by four major constructs: performance expectancy (PE), effort expectancy (EE), social influences (SI), and facilitating conditions (FC)" (Yeou, 2016, p. 302). It is a model that explains 70% of the variance in the behavioral intentions of users to accept technology, which is a significant improvement over previous technology acceptability models, which explain between 27% and 40% of the variance (Yeou, 2016; Venkatesh et al., 2003). The primary criticism of UTAUT was that it was too cumbersome and failed to explain the technology usage behavior of users (Casey and Wilson-Everett, 2012). As a result, Venkatesh et al. (2012) introduced the UTAUT2 by adding three more constructs, namely hedonic motivation, price value, and habit (Abu-Gharaah and Aljaafreh, 2021). The conceptual and theoretical frameworks were used to develop a research model (Figure 1).

2.2 Gamification

The concept of gamification presents a viable alternative method for promoting and evaluating desired behaviors and cognitive processes within a context that is more authentic and spontaneous (Vallee, 2021). Gamification has shown promising results in helping individuals with autism improve their social skills, communication abilities, and overall engagement. Gamification can create a motivating and enjoyable environment for individuals with autism to learn and practice essential skills by incorporating game elements such as rewards, challenges, and interactive interfaces. Additionally, the use of technology in gamification allows for personalized experiences that can be tailored to meet the specific needs and preferences of each individual with autism. The ability to customize both analog (traditional board games) and digital (computer and video games) games allows for the development of interventions that primarily target specific skills while also providing entertainment (Atherton and Cross, 2021). This suggests that gamification has the potential to greatly enhance social skills development in this population. Furthermore, the interactive nature of gamification provides opportunities for individuals with autism to practice and generalize their social skills in a safe and controlled environment, leading to improved social interactions in real-life situations. Through the

integration of sensory activities into gamified tasks, children diagnosed with autism can actively participate in therapeutic exercises that facilitate the regulation of their sensory processing and enhance their overall sensory integration abilities. This not only improves their capacity to navigate and adjust to various sensory surroundings but also helps their overall well-being and quality of life.

2.3 Special Needs Education

Special needs education and artificial intelligence are becoming increasingly intertwined. AI has the potential to revolutionize the way special needs students learn by providing personalized and adaptive learning experiences. By analyzing individual strengths and weaknesses, AI can tailor educational content to meet the specific needs of each student, ultimately enhancing their overall learning outcomes. Adapting teaching styles for students with learning disabilities can be challenging, especially in modern classrooms. AI can help provide tailored instruction, as researchers develop cognitive systems that support students with disabilities in unique ways, presenting material in a fresh way, independent of teacher instruction (Lynch, 2018). Students with special needs will have varying levels of engagement and learning capacity with various instructional strategies. The utilization of AI is now being investigated as a means to enhance and develop educational resources that cater to the unique requirements of students with special needs, hence fostering more inclusive learning settings. AI offers a pedagogical approach that is highly individualized, and capable of adjusting to the specific requirements of each student. This adaptability has the potential to enhance a child's ability to sustain focus and engage in the learning process. Furthermore, AI facilitates the provision of simulations and real-time examples, which serve to effectively illustrate the educational content being taught (Lynch, 2020). ECAR Study of the Technology Needs of Students with Disabilities, 2020 presents findings on the technology needs of students with disabilities. This report highlights key findings regarding the technological needs and experiences of students with disabilities. Many encounter obstacles to their learning, and they view certain technologies as a means to overcome these obstacles. Students with disabilities are a vulnerable population in higher education because their rates of dropping out are significantly higher, and their graduation rates are significantly lower, compared to the rates of students who do not have disabilities (Derrick, 2013).

2.4 Communication Gap

People who are nonverbal have motor disabilities and rely on computers to communicate with others can benefit from the use of AI, which can help bridge the communication gap. Researchers from the University of Cambridge and the University of Dundee have developed a novel context-aware method that narrows this communication gap by reducing the number of keystrokes a person needs to type to communicate by between fifty percent and ninety-six percent. The software was designed with nonverbal people in mind and makes use of a wide variety of context 'clues,' such as the user's location, the time of day, or the identity of the user's speaking partner, in order to assist in suggesting sentences that are the most pertinent for the user. Children who have difficulties speaking, hearing, or understanding language can benefit from the use of AI to improve their communication skills. Artificial intelligence systems provide effective support for online learning and teaching, including the personalization of learning for students, the automation of routine tasks for instructors, and the powering of adaptive assessments. Microsoft has developed a variety of AI-related resources, such as accessibility tools, games, screening tools, and more, in order to improve children's speech, hearing, and language communication. According to Professor Per Ola Kristensson, who was

the lead author of the study and works in the Department of Engineering at Cambridge, "this difference in communication rates is referred to as the communication gap." People who rely on computers as their primary means of communication experience a decline in the quality of their day-to-day interactions as a result of the gap, which is typically between 80 and 135 words per minute. Kristensson and his team have developed a method using artificial intelligence to quickly retrieve past sentences. This system uses information retrieval algorithms to retrieve relevant previous sentences based on the text typed and the context of the conversation. The system uses computer vision algorithms to identify the other speaker. The researchers simulated a nonverbal person typing a large set of sentences to understand the best method for retrieving sentences and the impact of parameters on performance. They found that only two reasonably accurate context tags are needed for most of the gain. The sentences are retrieved using information retrieval algorithms (Kristensson et al., 2020).

2.5 Moderating Effect of Government-driven Technology Initiatives

The rapidly accelerating progress of AI in fields such as autonomous vehicles and robotics presents significant challenges for governments. AI may improve economic efficiency and quality of life, but it also introduces new dangers. For these risks to be mitigated, governments all over the world need to gain an understanding of the risks and develop regulatory and governance systems (Taeihagh, 2021). National governments and international organizations are currently competing to be the first to implement AI-focused policies in order to reap the maximum possible benefits from this technology. Prior to 2021, the United States of America had committed to invest approximately $6 million in artificial intelligence research and development projects. Between 2020 and 2023, it is anticipated that Europe will increase its spending on artificial intelligence by 33 percent. The Indian government has already begun this revolution, with organizations such as MeitY, NASSCOM, and DRDO creating a road map for artificial intelligence in India. Under India's National Education Policy (NEP) 2020, artificial intelligence will be incorporated into the school curriculum.

The Malaysian government recognizes the significance of artificial intelligence and has taken several measures to promote it. The Malaysian government has established AI integration frameworks, such as the Malaysia Artificial Intelligence Roadmap 2021–2025 and the Malaysia Digital Economy Blueprint. AI plays a significant role in the National Industrial Revolution 4.0 policy, which aims to increase output by 30 percent by 2030. On the other hand, the Malaysian government acknowledges the significance of autism spectrum disorder welfare. For instance, the Ministry of Health (MoH) has announced that a National Autism Council will be established in 2022 to standardize the provision of education, treatment, and post-diagnosis care for those with neurological and developmental disorders. The National Autistic Society of Malaysia (NASOM) is a nationwide organization that offers numerous intervention programs, educational support centers, and vocational educational facilities.

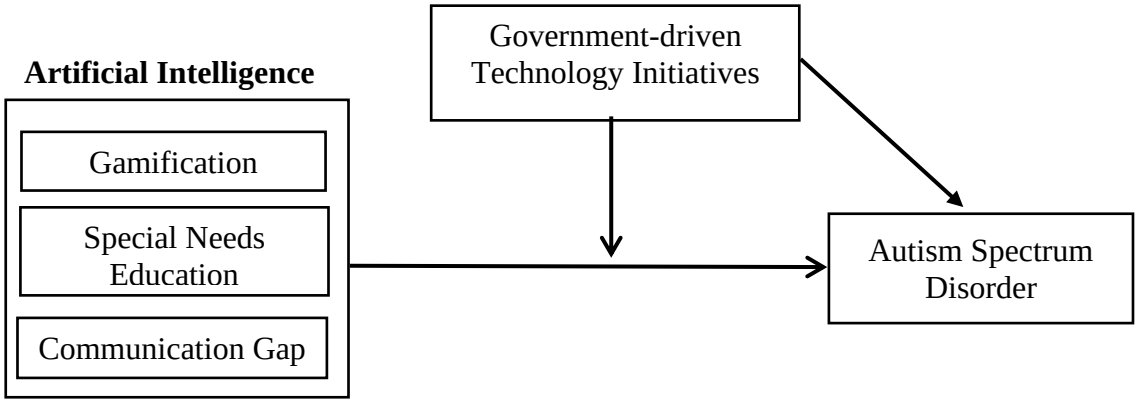
2.6 Hypothesis

Based on the previous literature and current issues about AI and autism spectrum disorder, the following study's hypotheses are developed:

H1: Artificial Intelligence has a significant impact on autism spectrum disorder in Malaysia.
H2: Government-driven technology initiatives have a significant impact on autism spectrum disorder in Malaysia.
H3: Government-driven technology initiatives moderate the relationship between artificial intelligence and autism spectrum disorder in Malaysia.

Conceptual Model

Figure 1 – Conceptual Model



3.0 Proposed Methodology

The primary purpose of this research is to investigate whether or not autistic people in Malaysia can benefit from the use of artificial intelligence (AI). This study also intends to determine the extent to which initiatives taken by the government can reduce the severity of this effect. To ensure validity and dependability, the research will adhere to Creswell's (2014) advice and employ meticulous sampling techniques. Specifically, stratified and simple random sampling methods will be employed to select the study's sample. The study will employ the structural equation model for data analysis (SEM). This model is an extension of the general linear model (GLM) and allows researchers to simultaneously test multiple regression equations. The analysis will employ two types of structural equation modeling (SEM) techniques: Variance-Based Structural Equation Modeling (VB-SEM) and Covariance-Based Structural Equation Modeling (CB-SEM).

4.0 Conclusion

The use of artificial intelligence (AI) to diagnose and treat autism is being investigated. Researchers are investigating the possibility that AI could be used not only to diagnose autism, but also to assist autistic individuals in enhancing their social, communication, and emotional skills. Autism diagnosis using AI is now a reality, and AI-based therapies in development are promising. As with any emerging technology, however, there are risks associated with the use of AI in diagnosing and treating autism. Researchers and policymakers must establish robust regulatory and governance frameworks to ensure the use of AI in this context is safe and ethical. In addition, collaboration between AI and autism experts will be essential for the development of AI-based therapies that truly benefit autistic individuals. It is anticipated that the policymaker will benefit from this study by gaining useful insights into the potential benefits and challenges of using AI in autism diagnosis and treatment. This information can be used by policymakers to help them make informed decisions about the regulations and guidelines surrounding the use of artificial intelligence in the field. Additionally, the study may bring to light the requirement for increased funding and support for research and development in AI-based therapies for autism, which policymakers can address by implementing appropriate policy initiatives.

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