

Virtual Reality-Based Assistive Technology as a Solution for Autistic Students to Know the School Environment During the COVID-19 Pandemic

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Abstract—The current study aims to analyze virtual reality-based assistive technology to help autistic students know the school environment during the COVID-19 pandemics. This research study goes through three stages: determining the research focus's scope, determining the urgency and novelty of the research, and determining the formulation and research objectives. A total of twelve journal articles from 2002-2020 with appropriate topics. This literature study was collected through the Google Scholar database. As a result, virtual reality-based assistive technology can help autistic students understand the actual school environment. Introduction through virtual media is beneficial for students during this pandemic. In addition, this media can help autistic students in improving cognitive, communication, and social skills with controlled, safe, and fun situations. Virtual reality-based media can adjust the characteristics and abilities of autistic students, such as using a user design approach, namely contextual design, participation, and ease of access. In addition, using structured commands, letting autistic children feel in control of the use of the media, can provide a sensory experience to students, make their eyes focus, and use their whole body to use it.

Keywords—assistive technology, virtual reality learning media, autism, COVID-19 pandemic

I. INTRODUCTION

The spread of the COVID-19 virus has forced the Indonesian government to make large-scale social

restrictions (PSBB) policies throughout Indonesia as a form of prevention (Wiresti, 2020). This policy urges all people to reduce activities outside the home, limit and even close various public places, such as shopping centers, educational institutions, tourist attractions, to places of worship. The consequences of this policy have a significant impact on various aspects of people's lives, one of which is education (Agustino, 2020). In an effort to prevent a decrease in performance and knowledge for students who attend school, the order to enforce an online learning policy is no exception for students with special needs.

One of the students with special needs who are also affected by online learning is autistic students (Primasari, & Supena, 2020). Autistic students have experience barriers to behavior, communication, and social interaction, so that in the implementation of online learning policies, they have difficulty accepting learning (Widianingsih & Damaianti, 2018). Autistic students have problems recognizing abstract information, making it easier to understand something real (Nuraeni & Mardiah, 2020). This pandemic period makes them unable to learn something directly. It is limited, such as getting to know the school environment, getting to know public places, getting to know road routes, and getting to know the environment around their home. Based on these problems, assistive technology is needed to help autistic students recognize or study the surrounding environment. The assistive

technology used is the use of virtual reality (VR) technology.

Virtual reality (VR) is becoming increasingly common as a medium for delivering interventions to students with autism spectrum disorders. VR is an interactive environment created by a computer that simulates the real world by presenting a three-dimensional image to the user. This system can provide a higher level of situational realism and a relatively inexpensive way to learn and practice skills in a personalized, controlled, and safe environment so that they can be used for the learning of autistic students (Malihi, Nguyen, Cardy, Eldon, Petta & Kushki, 2020).

Based on research that autistic students prefer learning in virtual reality compared to learning given on a monitor screen. It is because learning using virtual reality is more natural for autistic students. Other research that virtual reality (VR) can enable direct feelings for objects and events that are physically beyond the reach of children, support learning in a safe environment, and avoid potential direct hazards (Freina & Ott, 2015; Miller, 2015). Wiederhold, Miller & Wiederhold, 2020). In addition, learning using virtual reality can increase the motivation and understanding of autistic students towards learning (Ip, Wong, Chan, Byrne, Li, Yuan & Wong, 2018). The design of learning media that will be made must be simple, honest, and easy to understand for autistic students (Lorenzo, Lledó, Arráez-Vera, & Lorenzo-Lledó, 2019; Li, Ip & Ma, 2019; Bradley & Newbutt, 2018). The image design must also have attractive colors so that learning can be conveyed well (Parsons, 2016; Ghanouni, Jarus, Zwicker, Lucyshyn, Mow, & Ledingham, 2019).

Based on the existing problems above and previous research, this research aims to develop learning media that is useful for helping students with special needs with autism problems recognize the surrounding environment by using virtual reality technology.

II. METHOD

The method used in writing this article is a narrative review, which is a research conducted by summarizing several research results and comparing them to produce a holistic interpretation. This study critically reviews the knowledge, ideas, or findings contained in the body of academic-oriented literature (Cooper 2010).

The stages of narrative review research (Gasparyan et al., 2011) consist of three stages. The first stage is to determine the scope that focused on the research to be formulated into a research title, determine the urgency and novelty of the research, and determine the formulation and research objectives. The main intervention studied in this scientific search is virtual reality (VR)-based assistive technology to help autistic students get to know the school environment during a pandemic. The outcome generated in this scientific research is the development of assistive technology to

help autistic students get to know the school environment during a virtual reality-based pandemic.

Second, conduct a literature search with keywords that are relevant to the research topic. The search for publication articles was carried out on Google Scholar and Eric with the keywords: assistive technology for autistic children, virtual reality (VR) technology for autistic children, learning media for introducing school environments for autistic children. The articles used are literature published in 2002-2020. The criteria for the journals reviewed are research journal articles in Indonesian and English with assistive technology materials for autistic children based on virtual reality. Based on these criteria, 85 eligible articles were obtained with keyword criteria, of which 85 articles produced 12 eligible articles related to virtual reality (VR)-based assistive technology for the introduction of the school environment for autistic students during the pandemic for further analysis (Table 1).

The third stage is writing. Research journals that are eligible to be analyzed, collected, and summarized include the researcher's name, the year the journal was published, the title of the research, and the results or findings in the table. The journal summary then analyzed the contents contained in the research objectives and research results/findings.

III. RESULT

The current study found that virtual reality (VR) based learning media can help autistic students in the learning process (Parsons & Cobb 2011; Wallace, Parsons, Westbury, White, White, & Bailey, 2010; Roper, Millen Dutka, Cobb, & Patel, 2019). Virtual reality learning media provides a more tangible experience for autistic students in receiving learning, and autistic children generally accept and are willing to use this form of VR technology and want to return to using it (Parsons & Cobb 2011; Newbutt, Sung, Kuo, Leahy, Lin & Tong 2016). Research related to the effectiveness of using virtual reality in learning for autistic students has been carried out. The results state that virtual reality-based media can improve the understanding, motivation, communication, and socialization of autistic students (Cai, Chia, Thalmann, Kee, Zheng, & Thalmann, 2013; Ramachandiran, Jomhari, Thiyagaraja, & Maria, 2015; Millen, Cobb, Patel & Glover, 2012; Wallace, Parsons, Westbury, White, White, & Bailey, 2010; Millen, Edlin-White, & Cobb, 2010).

This virtual reality-based learning media can be used to introduce students to the surrounding environment. Moreover, based on research from Konstantinidis, Luneski, Frantzidis, Costas, & Bamidis (2009) strengthens by stating that semi-virtual interactive media created to introduce the environment can improve the education of children with autism spectrum disorders.

TABLE I. VIRTUAL REALITY-BASED ASSISTIVE TECHNOLOGY FOR AUTISTIC STUDENTS

Author(s)	Findings
Konstantinidis, Luneski, Frantzidis, Costas, & Bamidis, (2009).	Semi-virtual interactive media created to introduce the environment can improve the education of children with autism spectrum disorders.
Cai, Chia, Thalmann, Kee, Zheng, & Thalmann (2013).	<ul style="list-style-type: none"> a. The recent development of virtual reality (VR) technology in autism therapy to promote positive learning and behavior among such children has yielded optimistic results in developing various skills and abilities in it. b. The virtual dolphin interaction program can improve communication (nonverbal) learning through hand movements in children with autism.
Parsons & Cobb (2011).	<ul style="list-style-type: none"> a. VR offers unique benefits for children on the autism spectrum, primarily because it can provide authentic simulations of real-world situations in a carefully controlled and safe environment. b. VR supports learning for children on the autism spectrum.
Newbutt, Sung, Kuo, Leahy, Lin & Tong (2016).	Autistic children generally accept and are willing to use this form of VR technology and return to using it.
Wallace, Parsons, Westbury, White, White, & Bailey (2010).	<ul style="list-style-type: none"> a. Children with ASD can make connections between images in an immersive virtual environment (Blue Room) and their everyday experiences b. The virtual environment created can simulate and assess social situations for children with ASD who have difficulty socializing in the real world. c. Virtual environment (Blue Room) has ecological solid validity and potential as a learning tool for the future.
Ramachandiran, Jomhari, Thiyagaraja, & Maria, (2015).	Virtual reality-based learning tools that include virtual environments and virtual agents are effective methods to support the social communication skills of children with autism.
Daud, Maria, Shahbodin, & Ahmad (2018).	<ul style="list-style-type: none"> a. Assistive technology plays an essential role in helping students with autism to improve their construction skills. b. Future assistive technology for students with autism focuses on mobile learning
Millen, Edlin-White, & Cobb (2010, March).	<ul style="list-style-type: none"> a. Virtual reality (VR) technology has great potential as an educational tool to teach and stimulate social and collaboration skills in autistic children and motivate them. b. User-centered design approaches include contextual design, participatory design, inclusive design, and accessible design.
Grandin (2002).	In teaching autistic students, several things need to be considered. Avoiding sudden loud voices and singing is better than explaining explanations using visuals such as pictures/videos and short and clear explanations.
Van Rijn, & Stappers, (2008).	In teaching autistic students, several things need to be considered, for example: giving commands in a structured manner, let them feel in control, reward them with sensory experiences, use their eyes for detail, let them use their whole body.
Millen, Cobb, Patel & Glover (2012, September).	The virtual environment can make autistic students communicate in a safe and fun environment.
Roper, Millen Dutka, Cobb, & Patel (2019).	The use of virtual tools to support children with autism have higher abilities and show their potential.

Another study stated that the development of applications based on virtual reality (VR) technology also showed optimistic results in developing various skills and abilities in autistic students (Cai, Chia, Thalmann, Kee, Zheng, & Thalmann, 2013). One of the developments of this technology is that it is used in intervention and therapy programs for autistic students.

This virtual reality technology can also help students get to know the school environment, because the virtual environment created can simulate social situations for autistic children who have difficulty socializing in the real world, and this is very helpful for autistic students in getting to know the school environment without having to go to school. schools during a pandemic (Daud, Maria, Shahbodin, & Ahmad, 2018; Wallace, Parsons, Westbury, White, White, & Bailey, 2010). With the virtual environment created by autistic children, they can connect the learning provided with the everyday experiences they experience. Virtual reality (VR)-based learning also offers special benefits for children with the autism spectrum, namely providing authentic simulations of

real-world situations in a safe and carefully controlled environment for autistic students (Parsons & Cobb 2011; Millen, Edlin, -White, & Cobb, 2010).

IV. DISCUSSION

The use of virtual reality (VR) in the research of children with autism spectrum disorder (ASD) has received many results as a method with great potential in improving learning for autistic children (Wing, Gould, & Gillberg, 2011; Parsons, 2016; Golestan, Soleiman, 2011). & Moradi, 2018). The same results were also obtained in Blascovich's research (2002), which states that an interactive environment using virtual reality will be able to change interactions and evaluations with the opportunity to study human behavior in a standard, controlled, and replicable environment to produce individual responses that are close to those obtained. In real context. Interactive media technologies, such as immersive virtual reality environments, can provide a safe and authentic environment for experiential learning (Kalyuga, 2007). In addition, other studies have also shown that

experiential learning in an immersive virtual reality environment can improve the social competence of children with autism spectrum disorders (Ip, Wong, Chan, Byrne, Li, Yuan, & Wong, 2016).

Several interactive environments as a means of learning and teaching to rehabilitate autistic children have been developed. Most of these environments are created through software or educational platforms. Educational platforms in software use entertaining content to present knowledge in an engaging way (Luneski, A., Konstantinidis, E. I., Hitoglou-Antoniadou, M., & Bamidis, 2008; Marnik & Szela, 2008). One of the replicated environment goals for ASD and VR users is to improve their ability to work in everyday life. In another study, virtual environment development was used to learn various skills in children with ASD, such as cognitive learning, interaction, and emotional training (Kandalaft, Didehbani, Krawczyk, Allen, & Chapman, 2013; Bernardini, Porayska-Pomsta, & Smith, 2014; Bekele, Crittendon, Zheng, Swanson, Weitlauf, Warren & Sarkar, 2014).

During the COVID-19 pandemic, research results also showed that the use of virtual reality (VR) had increased significantly during the lockdown period. The study also stated that virtual reality had a positive impact on their mental and physical health (Siani & Marley, 2021). Virtual environments can be created according to the desired conditions, so virtual reality can be used to introduce the school environment to autistic students during the COVID-19 pandemic without making students come to school. The students were chosen because it pays attention to the characteristics of autistic students who, in learning something, must be in a concrete situation, and VR can provide this visually.

Developing virtual reality-based learning media (VT) is based on three basic principles: contextual, interaction, and user engagement with the environment and narrative. It will provide a very high potential in education by making learning more motivating and exciting (Freina & Ott, 2015). The primary motivation for using virtual reality is to provide an opportunity to live and experiment in situations that are not physically accessible. It is very suitable for use during this pandemic. There are several benefits of virtual reality in teaching-learning to autistic students, namely allowing students to experiment with different historical periods more realistically (Roussou, 2004); in addition, there is physical accessibility: for example, during a pandemic like this, students can still study their surroundings without having to leave their home (Detlefsen, 2014); safer because students do not interact directly but still get real experiences (Williams-Bell, Kapralos, Hogue, Murphy & Weckman, 2015); and students can learn things in detail (Liu, 2014).

In addition, research from Parsons and Mitchell (2002) states that virtual environments are conducive for people with the autism spectrum because: (1) users

have active control over their participation; (2) interactions can take many forms and do not require face-to-face communication; (3) the degree and number of non-verbal and verbal communication features can be directly controlled and manipulated; (4) behaviors and responses can be practiced and constructed in contexts that have similarities to the real world, thus offering tremendous potential for generalization; and (5) a more realistic representation of the situation can help mental stimulation, thereby improving social problem-solving.

V. CONCLUSION

Assistive technology based on virtual reality can help autistic students understand the actual school environment during the COVID-19 pandemic without students having to come to school. In addition, virtual reality can help autistic students improve their cognitive, communication, and social skills with controlled, safe, and fun situations. In developing virtual reality for autistic students, they must pay attention to and adapt to the characteristics and abilities of autistic students, such as using a user design approach, namely contextual design, participation, and ease of access. In addition, using structured commands, letting autistic children feel in control of the use of the media, can provide a sensory experience to students, make their eyes focus, and use their whole body to use it.

The results of this study explain quite clearly the benefits and effectiveness of virtual reality-based learning media for autistic students. However, in its application, it is necessary to assist autistic students. Controlling the duration of use is also recommended to prevent dependence on students and maintain children with autism. In addition, there is a need for further research to develop virtual reality media to help autistic students get to know their surrounding environment.

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