Al-Ishlah: Jurnal Pendidikan
Vol.16, 4 (December, 2024), pp. 4737-4747
ISSN: 2087-9490 EISSN: 2597-940X, DOI: 10.35445/alishlah.v16i4.4718

Virtual Reality-Based Learning Innovations in Early Childhood Education

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ARTICLE INFO

Keywords:

early childhood education;
learning innovation;
virtual reality

Article history:

Received 2023-10-13
Revised 2024-11-14
Accepted 2024-12-02

ABSTRACT

Early Childhood Education (PAUD) in Indonesia is designed for children under six to foster learning motivation and interest. However, young learners often focus more on play than education. Virtual reality (VR)-based learning offers innovative opportunities to enhance learning experiences and deepen material comprehension. This study utilizes a qualitative approach through a Systematic Literature Review (SLR) of articles published in Indonesian journals. Primary data are derived from literature on virtual reality-based educational innovations aimed at increasing early childhood interest in learning. The findings reveal that virtual reality significantly enhances learning interest among early childhood learners compared to traditional methods. VR-based learning also improves educational outcomes, memory retention, and student engagement. These outcomes demonstrate the effectiveness of VR as a tool for stimulating curiosity and motivation in early learners. The study highlights the potential of virtual reality in early childhood education and its role in transforming traditional learning methods. By integrating VR, educators can create immersive and engaging experiences that align with the developmental needs of young learners. The findings emphasize the need to develop VR infrastructure and encourage its adoption in PAUD schools across Indonesia. The study advocates for educators to embrace VR technology to enrich early childhood learning, ultimately fostering greater interest and engagement among young learners.

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1. INTRODUCTION

The sophistication of technology can facilitate activities carried out by some people in their daily lives. Technology can also be used in learning activities in early childhood education institutions (Asmawati, 2021). Learning in the 21st century equips the generation to understand information and

communication technology and acquire skills to meet future difficulties brought on by globalization (Zurweni et al., 2017). Specifically, the learning process in Early Childhood Education (PAUD, *Pendidikan Anak Usia Dini*), Early Childhood Education is education given to children before the age of six, intended so that stimulation related to education and interest in learning can develop. Early childhood education can also be called the golden age, where all forms of material delivery to students will be easy to remember for them (Mulyati, 2019). Students are taught various subjects, including introduction to plants, animals, daily prayers, etc. Early age is when they are still happy with activities by playing and interacting with the immediate environment; for that, an effort is needed to attract interest in learning from students so that they like learning, which is done from an early age (Mardliyah et al., 2020). An conclusion, the application of technology in early childhood education not only introduces children to technological tools but also equips them with essential skills to tackle future global challenges.

A child's first four years are golden, starting at birth. In particular, the brain's intelligence, currently at 80% but won't reach 100% until age 18, is developing quickly. This period is also critical for children because it will significantly influence the subsequent period till adulthood (Khasanah & Wibaw, 2019). An early childhood interest in learning is minimal, focusing only on play activities (Salis & Astuti, 2020). For a child to learn well, they take an interest in learning first. Interest is a tendency that can settle in a person to pay attention, remember certain activities or fields, and feel happy to be involved in the field (Ayuningtyas & Wijayaningsih, 2020). In some, it is noted that certain young children don't have a high desire to learn, which manifests itself in the pupils' lack of engagement, lack of focus, and general boredom with the teacher's lessons. Based on this, an effort is needed to foster interest in early childhood (Mulyati, 2019). Thus, the early years known as the 'golden age' are crucial for cultivating a love for learning, where engaging stimulation can strengthen children's involvement and focus in the learning process.

The process of fostering demand for learning from students requires attractive, effective, and efficient media that can attract learning interest from students (Nurfadillah et al., 2021). The exposure to media presented in one element will certainly reduce interest in learning. For example, teachers deliver material only by giving writing to students. Such an incident will undoubtedly cause a sense of boredom in students, so their interest in learning directly from students will decrease. By developing increasingly sophisticated technology at this time, the use of learning media can be facilitated using existing technology (Hapsari & Pamungkas, 2019). Accordingly, designing engaging and effective learning media is essential to boost early childhood interest in learning, ultimately creating a more positive and interactive educational environment.

One example of the application of technology-based media is VR or Virtual Reality (Riyadi et al., 2017). The application of virtual reality-based learning is expected to provide new experiences for early childhood, making the learning process more meaningful. Virtual reality is one of the media developed with technology, and there is an interaction between students and the simulated environment using hardware, such as computers, laptops, and so on (Pradiftha, 2020). The use of VR-based media will be able to increase early childhood interest in learning (Pradnyana et al., 2017). Media must be designed following the level of thinking of the target audience or study topic to improve early childhood interest through the media development (Heswari & Patri, 2022). Therefore, the development of technologies such as virtual reality as a learning medium is expected to offer meaningful new experiences for young children, enhancing their interest in the learning proces.

Early childhood has a level of concrete thinking and cannot think about abstract things. The development of these media should present concrete things in advance that students can encounter in their daily lives. Based on this, the development of VR media must go through validity tests from material and media experts so that researchers can use VR media in any educational institution (Liyana & Kurniawan, 2019). In other words, when presenting VR-based learning media, it is crucial for developers to ensure that the content aligns with the children's comprehension level and is concrete, making it more accessible to young learners.

From the explanation above, it can be concluded that the urgency of using virtual reality in early childhood learning is necessary to increase student learning interest in the current era of digitalization of learning. The availability of VR applications to support learning has been widely developed and easy to use, such as only with smartphones and Google Cardboard or Oculus Glasses (Rahmawati, 2022). However, many educators in Indonesia, especially in early education schools, still do not know this. Internet and intranet facilities are lacking, so schools must work with the government to improve and revitalize learning facilities that support virtual reality and socialize virtual reality (Ariatama et al., 2021). Hence, the effective use of VR technology in early childhood education requires support from various stakeholders, particularly in enhancing supportive facilities in schools and familiarizing educators with this technology.

In previous research by Simamora et al. (Simamora et al., 2021), the development of VR products goes through the evaluation and revision stages, which aim to produce good VR media. Various topics can be developed using VR media, and one example is the material "Types of Work," which is starting to be given at the early childhood level. Several learning topics can be displayed through the development of VR media, such as job support tools, where they work, types of work, and so on. Media development must include validity and practicality tests so that small group tests can provide an overview of the effectiveness of students' use of learning media. VR media must be as enjoyable as possible to attract students' interest in learning. It is well known that children prefer presenting material using interesting cartoons at an early age, so the development of VR media can be done with cartoon exposure. In summary, developing VR media as a learning tool must undergo multiple evaluation stages to ensure its effectiveness, especially with engaging approaches like cartoons that are appealing to young children.

Based on the explanation above, the author took the title "Virtual Reality-based Learning Innovation to Increase Early Childhood Learning Interest." This journal aims to analyze virtual reality-based learning innovations to increase interest in early childhood learning. The limitations used in this study are that it is only based on a literature review and a *systematic literature review* based on relevant titles. Therefore, this study aims to analyze VR-based learning innovations to increase early childhood learning interest, with the results expected to contribute to the development of more interactive and effective learning methods. The focus of this research is to examine the effectiveness of VR-based learning media in enhancing early childhood interest in learning compared to traditional methods, investigate the cognitive and engagement-related benefits provided by immersive virtual environments, and identify the potential challenges and necessary guidelines for implementing VR technology in early childhood education, with an emphasis on the importance of supervision by teachers and parents, particularly in fully online VR applications.

2. METHODS

This article's writing style leans toward the qualitative. Primary data and secondary data are the types of data used. Studying qualitative data is the main emphasis of this research. Although this research focuses on qualitative studies, the existence is undoubtedly involved if researchers find quantitative data studies. Figure 1 below shows the flow diagram of this study (Rumetna, 2018).

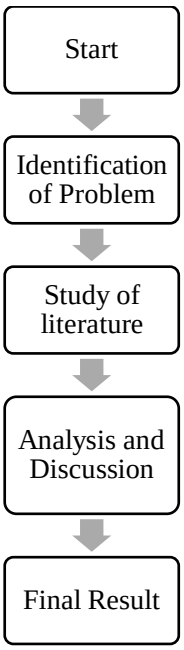

Figure 1. Research Flow

Qualitative research is carried out using the SLR approach, which includes history, pedagogy, and sociology (MacDonald, 2014; Patton, 2015). As for developing research instruments, this is the keyword. Researchers develop related keywords, including observations/observations, literature reviews, and documentation.. This study's primary keyword, or inclusion criterion, is *'virtual reality in early childhood learning in Indonesia,' supplemented by additional keywords such as 'Elementary School,*' *'Taman Kanak-Kanak,'* and *'High School*.' These keywords were systematically selected to capture a comprehensive range of studies, ensuring that the data gathered is both rich and methodological. In contrast, virtual reality in primary and secondary school learning is the keyword that becomes the inclusion criterion.

The data collection stage is related to virtual reality-based learning innovations that increase interest in early childhood learning. Through a search of various articles on Google Scholar, only those that closely aligned with the predefined inclusion criteria were selected for analysis. This study remains limited to specific criteria focusing on virtual reality in early childhood learning in Indonesia. Future research could adopt broader and more detailed criteria, potentially including additional educational levels and diverse geographical contexts. Additionally, subsequent studies could explore this topic through alternative research methodologies, whether qualitative, quantitative, or systematic literature review approaches with refined criteria to yield even more comprehensive insights. After the data collection stage, the articulation stage referred to some supporting facts of this study. A piece of new knowledge will be generated by presenting the facts of the research results that have been carried out through critical and careful data analysis. The data analysis stage is carried out deductively or inductively, which can explain conclusions. The data analysis carried out can be described in Figure 2 below.

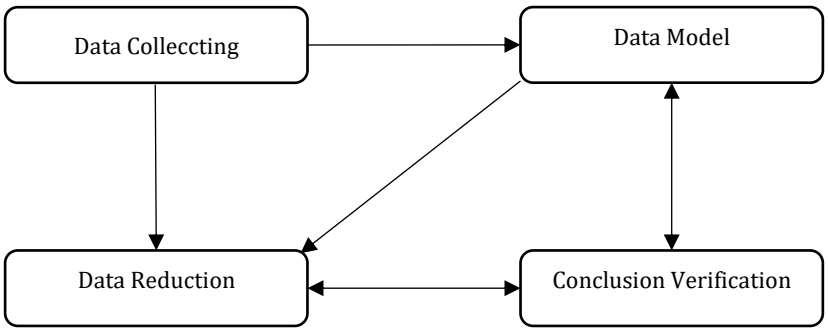

Figure 2. Data Analysis Phase, Model Analysis Miles & Huberman (Sugiyono, 2016)

3. FINDINGS AND DISCUSSION

The study results were presented using a systematic literature review based on the following title.

Table 1. Research Results

No.	Researchers and Years	Heading	Purpose	Analysis Results
1.	Arpiansah et al, (2021) (Arpiansah et al., 2021)	"VR Educational Game for Covid-19 Virus Introduction and Prevention Using MLDC Method for Early Childhood."	It attempts to give a general overview of VR utilization in PAUD (Early Childhood Education) settings.	Development related to educational games for early childhood is one effective way to provide learning. VR can be implemented in several kinds of media, including motion-sensitive gloves, headphones, HMDs, PCs, etc. Applications utilizing Virtual Reality can provide an overview of the imaginary area that exposes the actual place in digital form. The extent to be simulated is connected to PC (*Computer-Simulated Environment*) media. Games that will be developed by utilizing the concept of VR must be made as attractive as possible and able to attract students' attention, especially PAUD, so that VR-based educational games developed can be tested for effectiveness.
2.	Pranata et al. (2017) (Pranata et al., 2017)	"Balinese Fruit Shooter Game Was Categorized As a Virtual Reality-Based Which Was Appropriate As Instructional Media in Kindergarten."	It aims to analyze virtual reality-based learning media use at the pre-elementary school level.	Learning media developed based on virtual reality can provide stimulation or initial stimulus to students' learning interests, especially at the ECCE level. Virtual reality is an interaction created by combining simulations on computers to provide interaction between the environment and students. The exposure of the environment presented in virtual reality is the actual state of the environment, and only it is presented in a virtual or imaginary form. The positive impact of using virtual reality in learning is that students can know the real world, which can only be accessed through cyberspace. Virtual reality can provide images where the

				ears (sense of hearing) and eyes (sense of sight) can feel the sensation of the real world. The development of media presented using virtual reality given to students should use engaging media with contrasting images, colors, and proportions.
3.	Sukaryawan et al. (2019) (Sukaryawan et al., 2019)	"The Effect of Using Virtual Reality Media on the Learning Outcomes of Group B Children on the Theme of Wild Animal Introduction."	It aims to provide an overview of the effectiveness of using virtual reality-based media as one of the learning media to develop student interest in learning.	Early childhood education is one of the education taken when children enter the age of four to six years. The interest in learning students can be viewed from acquiring learning outcomes. If students' learning results produce high scores/grades, the interest possessed by students in learning is also high, and vice versa. According to the research findings, pupils who used VR media had better learning outcomes than those who did not. The typical grade in classes that don't incorporate VR materials is 6.74. The average score for VR media kinds is 9.50, which differs from this. Particularly in early childhood education, using virtual reality media effectively enhances children's enthusiasm for learning.
4.	Firdiarahma (2020) (Firdiarahma, 2020)	"The Use of Virtual Reality Media as a Substitute for Field Trips for Low-Grade Students in the Period of Learning from Home."	It aims to provide VR media that is presented as one of the activities of students on field trips. This method is implemented during a pandemic when the government restricts all activities.	For a respectable amount of time—nearly two years—teaching and learning activities have been conducted in their homes, according to history. This reduces the COVID-19 virus's ability to spread. Children enjoy taking field trips as an activity. However, the realities of life prevent students from entering the public spaces. Based on this, teachers can create learning that combines with exposure to the imaginary environment, so a tool known as VR (Virtual Reality) media is needed. The implementation of field trips can be done using VR media. VR media can facilitate student learning, especially at the PAUD level, to the kindergarten level, in tourist visits or field trips so that even though students study at their respective homes, they can still feel related to tourist works.
5.	Simamora et al (2021) (Simamora et al., 2021)	"Development of Learning Media Introduction to Types of Virtual Reality-Based Work."	It aims to provide an overview related to various types of work as one of the learning materials using virtual reality developed based on	The development of VR products goes through the evaluation and revision stages that aim to produce good VR media. Various topics can be developed using VR media, and one example is the material "Types of Work," which is starting to be given at the early childhood level. Several learning topics can be displayed through the development of VR media, such as job support tools, where they work, types of work, and so on. For small group testing to give an overview

			learning media for students.	of the effectiveness of using learning media among students, the media development must incorporate validity and practicality tests. VR material must be as entertaining as feasible to pique students' interest in studying. Since it is commonly established that children prefer material presented with engaging cartoons at a young age, exposure to comics can be used to produce VR media.
6.	Dharma (2018) (Dharma et al., 2018)	"The Effect of Using Virtual Reality Media with a Classical Learning Model on Student Learning Outcomes in Tk Negeri Pembina Singaraja"	It aims to analyze students' learning outcomes at the early childhood school level by using VR learning media to facilitate students' learning.	Teachers use different forms of educational media to support learning activities. Examining the use of VR media is the primary goal of this study. The learning process will be relevant if learning media helps it. Students will interact interactively with the representation of the made-up world while using VR media as a learning medium, which has a beneficial effect. The VR media's delivered images have a dynamic quality. Therefore, students will feel that they are in the real world. The learning outcomes of students using conventional media were lower than those using VR media. The statement above has been proven, with the PTK test in the control class getting a total score of 22.03 while the experimental class got a total score of 25.9.
7.	Syafiah (2021) (Syafiah, 2021)	"Virtual Reality (VR) Analysis as a Media for Animal Recognition in Early Childhood"	It intends to examine VR material, which can be applied to early childhood education as a learning tool.	The findings of this study demonstrate that three-dimensional object representation can be achieved through VR media. One example of educational resources used to create VR media is livestock. The output of VR media can be used with many Android models. Contrarily, it is well known that various groups already utilize Android, allowing for the effective usage of VR media. Creating these learning resources seeks to lessen students' resistance to learning new topics due to boredom.

History records that teaching and learning activities have been carried out in their residences for a reasonably long period, almost two years, to minimize the spread of the COVID-19 virus. Study tour activities are one of the activities that children like. However, world conditions do not allow students to enter the tourism sector. Based on this, teachers can create learning that combines with exposure to the imaginary environment, so a tool known as VR (Virtual Reality) media is needed. Field trips can be implemented using VR media. The use of VR media can facilitate student learning, especially at the PAUD level, to the kindergarten level in tourist visits or tourist works, so that even though students study at their respective homes, students can still feel related to tourist works (Firdiarahma, 2020).

Development related to educational games for early childhood is one effective way to provide learning. VR can be implemented in several kinds of media, including motion-sensitive gloves, headphones, HMDs, PCs, etc. Applications that utilize Virtual Reality can provide an overview of the

imaginary area that exposes the actual location in digital form. The place to be simulated is connected to PC (*Computer-Simulated Environment*) media. Games that will be developed by utilizing the VR concept must be made as attractive as possible and able to attract the attention of students, especially PAUD, so that VR-based educational games developed can be tested for effectiveness (Arpiansah et al., 2021)

Learning media developed based on virtual reality can provide stimulation or initial stimulus to students' learning interests, especially at the PAUD level. Virtual reality is an interaction created by combining simulations on computers to provide interaction between the environment and students. The exposure of the environment presented in virtual reality is the actual state of the environment, and only it is presented in a virtual or imaginary form. The positive impact of using virtual reality in learning is that students can know the real world, which can only be accessed through cyberspace. Virtual reality can provide images where the ears (sense of hearing) and eyes (sense of sight) can feel the sensation of the real world. The development of media presented using virtual reality given to students should use engaging media with a combination of contrasting images, colors, and proportions (Pranata et al., 2017)

Early childhood education is one of the educations taken when children enter the age of four to six years. The interest in learning students can be viewed from acquiring learning outcomes. If students' learning results produce high scores/grades, the interest possessed by students in learning is also high, and vice versa. In the results of the study, it was explained that the learning outcomes of students using VR media were more elevated than those not using VR media. The average score obtained in classes that do not use VR media is 6.74. This differs from VR media types, which get an average score of 9.50. The use of virtual reality media in learning is effective in increasing students' interest in learning, especially at the early childhood education level (Sukaryawan et al., 2019)

Teachers implement various kinds of learning media to support learning activities. The focus of this research is to examine the use of VR media. The learning process will be meaningful if it is supported using learning media to deliver knowledge quickly and minimize student misconceptions. The use of VR media chosen as a learning medium has a positive impact, where students will engage interactively with the depiction of the imaginary world. The nature of the images presented in VR media is dynamic. Therefore, students will feel that they are in the real world. The learning outcomes of students using conventional media were lower than those using VR media. This is evidenced by the PTK test in the control class getting a total score of 22.03 while in the experimental class getting a total score of 25.9 (Dharma et al., 2018)

The development of VR products goes through the evaluation and revision stages that aim to produce good VR media. Various topics can be developed using VR media, and one example is the material "Types of Work," which is starting to be given at the early childhood level. Several learning topics can be displayed through the development of VR media, such as job support tools, where they work, types of work, and so on. Media development must include validity and practicality tests so that small group tests can provide an overview of the effectiveness of students' use of learning media. VR media must be as enjoyable as possible to attract students' interest in learning. It is well known that at an early age, children prefer the presentation of material using interesting cartoons, so the development of VR media can be done with cartoon exposure (Simamora et al., 2021)

Through the results of research by Syafiah (2021), it can be seen that the use of VR media can provide results in depicting three-dimensional objects. Livestock is an example of using learning materials used as material in preparing VR media. The output produced by VR media can be applied to various kinds of Android. In contrast, it is known that Android is currently used by multiple groups, so the target of VR media can effectively be used together. The development of these learning media aims to minimize the level of boredom students experience when learning new things.

From the discussion of the seven articles above, it can be said that Virtual reality (VR) technology in early childhood education is a novel approach that can potentially revolutionize children's learning. VR can be used to create immersive and interactive virtual environments that stimulate students'

interests and enhance their learning experiences. Students can explore and interact with the environment by replicating real-world scenarios, fostering more profound understanding and engagement. Studies have shown that incorporating VR media in early childhood education can lead to better learning outcomes, increased enthusiasm for learning, and reduced misconceptions among students. The immersive nature of VR media, combined with captivating visuals and interactive elements, enhances student engagement and promotes active learning. As a result, VR has the potential to improve the quality of early childhood education significantly. It can provide children with a more engaging and practical learning experience while helping them develop the cognitive skills and knowledge they need to succeed in school and life.

4. CONCLUSION

The research concludes that virtual reality (VR)-based educational media is an effective tool for enhancing interest and engagement in early childhood learning. VR-based educational games provide engaging and effective learning experiences, fostering cognitive development and knowledge acquisition. Immersive virtual environments created by VR technology simulate real-world scenarios, enabling students to explore interactively, which enhances understanding and engagement. The use of VR has been shown to improve learning outcomes, increase enthusiasm for learning, and reduce misconceptions due to its immersive nature, captivating visuals, and interactive elements. The study highlights that VR-based learning significantly improves test scores compared to traditional methods, making it a promising approach to elevate the quality of early childhood education.

However, effective implementation requires careful monitoring by teachers and parents, particularly when VR is used entirely online, to ensure appropriate usage. Future research is encouraged to conduct effective tests to provide stronger evidence and accountability for the findings. Educators and prospective educators are recommended to integrate VR into their teaching methods to boost learning interest, particularly for young children. Additionally, parents are encouraged to instill in their children an early appreciation for the value of education to build a foundation for lifelong learning.

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