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Obstacles to Learning Using Augmented Reality Technology in the Independent Curriculum and Middle School Students' Perceptions of Critical Thinking Ability

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Abstract

This study aims to identify the obstacles to learning using augmented reality (AR) technology in the independent curriculum and examine students' perceptions regarding their critical thinking abilities. This research employs a descriptive approach. Data were collected through interviews with teachers and students, as well as questionnaires distributed to 35 seventh-grade middle school students. The findings indicate that the main challenges in implementing AR technology include limited technological infrastructure and insufficient training for teachers. Most students reported that the use of AR helped them better understand the subject matter and enhanced their critical thinking skills. Student perception data revealed that on the indicator of drawing conclusions, students scored 45.70%; for generating assumptions, 42.90%; for deduction, 42.90%; for interpreting information, 45.70%; and for analyzing arguments, 40.00%. However, 57.1% of students indicated that printed books were still the primary learning medium. Furthermore, 97.1% of students expressed enthusiasm for learning science through technology-based interactive media. These findings highlight the need to develop AR-based e-modules for science learning to improve students' critical thinking skills.

Keywords: Augmented Reality, Independent Curriculum, Critical Thinking Skills, Student Perceptions, Technology Learning

INTRODUCTION

The rapid advancement of educational technology has created new opportunities to enrich students' learning experiences (Atwood-Blaine, & Huffman, 2017). One of the most promising developments is the integration of augmented reality (AR) into educational curricula. This technology enables interactive and immersive learning environments that actively engage students. In Indonesia, the introduction of the independent curriculum has given schools greater flexibility to adopt innovative teaching approaches (Bressler, & Bodzin, 2013). AR, in particular, is being explored as a tool to enhance student learning outcomes by fostering critical thinking skills. Critical thinking, which includes the ability to evaluate information, generate reasoned assumptions, and make informed decisions, has become an essential skill in modern education.

Despite its potential, the adoption of AR in education is not without challenges. One of the primary hurdles is the lack of adequate infrastructure, which includes both the technological resources necessary for AR implementation and the internet connectivity required to support these systems (Chen, & Liu, 2020). Schools, especially in rural or underfunded areas, often struggle to provide the necessary devices and technological infrastructure. Additionally, there is a significant gap in teacher

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training. Many educators are not yet familiar with AR tools and require professional development to effectively integrate this technology into their teaching practices.

The independent curriculum in Indonesia emphasizes the development of critical thinking, making AR an attractive tool for schools. AR allows students to engage with complex concepts through visualizations and simulations, which can aid in deeper understanding and knowledge retention. By interacting with AR content, students can analyze, interpret, and apply information more effectively, which strengthens their critical thinking abilities. However, without the proper infrastructure and teacher support, the potential of AR to enhance education remains underutilized.

This study seeks to address two main issues: the barriers to implementing AR technology in Indonesian schools and students' perceptions of how AR influences their critical thinking skills. By identifying the obstacles—such as inadequate infrastructure and insufficient teacher training—the research aims to provide recommendations for overcoming these challenges. Furthermore, understanding students' perceptions will help educators and policymakers gauge the effectiveness of AR in promoting critical thinking within the framework of the independent curriculum.

Preliminary findings suggest that students generally have a positive view of AR technology in education. Many believe that it makes learning more engaging and helps them grasp difficult concepts more easily. In particular, students reported that AR experiences enhanced their ability to draw conclusions, generate hypotheses, and analyze information—all key components of critical thinking. However, these benefits were most evident in schools where teachers had received adequate training and the necessary technological infrastructure was in place.

Ultimately, this study underscores the need for greater investment in educational technology infrastructure and teacher training programs. If these barriers can be addressed, AR has the potential to significantly improve student learning outcomes in Indonesia, particularly in terms of developing critical thinking skills. By integrating AR into the independent curriculum, schools can provide students with a dynamic and interactive learning experience that prepares them for the challenges of the modern world.

METHODS

This study utilized a descriptive research approach to explore the challenges and perceptions surrounding the use of augmented reality (AR) technology in educational settings. Both qualitative and quantitative methods were employed to collect comprehensive data (Dias, 2009). Specifically, interviews were conducted with teachers and students to obtain in-depth insights into the barriers faced during the integration of AR technology in the classroom. To complement the qualitative data, a structured questionnaire was administered to 35 seventh-grade students. This questionnaire was designed to assess the students' perceptions of how AR-based learning influences the development of their critical thinking skills.

The questionnaire focused on five critical thinking indicators: the ability to draw conclusions, generate assumptions, engage in deductive reasoning, interpret information, and analyze arguments. These indicators were selected to measure various dimensions of critical thinking that are essential in the learning process. Each student's response was quantified and analyzed using percentage scores, providing a clear overview of how AR technology impacted their critical thinking abilities. The combination of qualitative insights from interviews and quantitative data from the questionnaire allowed for a well-rounded analysis of both the obstacles to AR integration and its perceived benefits in enhancing critical thinking.

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RESULTS

The findings of this study reveal notable difficulties in the implementation of augmented reality (AR) technology within the independent curriculum. Two major obstacles were identified as the primary hindrances to successful AR integration. The first obstacle is the limited technological infrastructure in schools. Many institutions do not possess sufficient resources, such as high-quality AR devices and reliable internet connections, which are essential for the effective use of AR in education. Without access to the necessary hardware and stable connectivity, it becomes challenging to deliver AR-based learning experiences that can significantly enhance student engagement and understanding.

The second major challenge is the lack of teacher training. Many teachers expressed that they require more extensive professional development to learn how to effectively use AR technology in their classrooms. The absence of adequate training programs has resulted in a gap between the availability of AR tools and the ability of educators to harness their full potential for improving learning outcomes. Teachers need specific guidance on integrating AR into lesson plans in a way that promotes student interaction and critical thinking.

Despite these challenges, students had an overall positive perception of AR technology. Most students felt that AR helped them better understand complex topics and encouraged the development of critical thinking skills. When analyzing specific indicators of critical thinking, students scored 45.70% on drawing conclusions, 42.90% on generating assumptions, 42.90% on deduction, 45.70% on interpreting information, and 40.00% on analyzing arguments. Furthermore, while 57.1% of students noted that traditional learning tools, like printed books, were still predominantly used, a striking 97.1% expressed a preference for interactive, technology-based learning media, such as AR, particularly in science education. This demonstrates a strong demand for modern, interactive learning solutions among students.

DISCUSSION

The findings of this study indicate that augmented reality (AR) technology holds significant promise in enhancing students' critical thinking skills. However, its successful implementation in education hinges on addressing critical infrastructural and training challenges. Currently, the data reveals a moderate level of skill development in key areas of critical thinking, such as deduction and argument analysis. While students are demonstrating progress in these areas, there is ample opportunity for growth and further enhancement of these essential skills. The challenges related to infrastructure, including the need for AR-compatible devices and stable internet connectivity, and the necessity for comprehensive teacher training, need to be prioritized to fully unlock AR's educational potential.

In terms of skill development, the critical thinking indicators show that while students are making strides, improvement is particularly needed in deduction and the ability to analyze arguments. These are vital components of critical thinking that require more focused development. The current percentages suggest that while AR is helping students to engage with and understand material more effectively, a more targeted approach could further enhance their critical thinking abilities in these specific areas. By addressing these shortcomings, educators can ensure that students are better equipped with the necessary reasoning and analytical skills.

Additionally, the high level of student interest in AR-based learning tools reflects a growing demand for more interactive and technology-driven educational resources. This enthusiasm for AR suggests that students are seeking learning experiences that go beyond traditional methods,

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gravitating toward tools that engage them on a deeper level. This interest provides a strong incentive for schools to consider adopting more AR technologies, not only to meet students' preferences but also to improve educational outcomes. The feedback from students underscores the need for educational systems to adapt and evolve with technological advancements.

The study further emphasizes the importance of developing augmented reality-based e-modules, particularly for science education (Faridi, Ilyas, & Syawaludin, 2020). These modules could provide students with immersive, hands-on learning experiences that foster critical thinking by allowing them to visualize complex concepts and experiment in virtual environments. This would likely lead to higher engagement levels and a deeper understanding of the material, making the learning process more dynamic and effective. By incorporating AR-based e-modules, educators could better stimulate students' cognitive processes and encourage critical inquiry.

Moreover, AR-based learning modules would not only enhance engagement but also help in overcoming traditional learning limitations. For example, abstract scientific concepts that are difficult to grasp through textbooks or lectures could be better understood through AR's interactive features. This technology allows students to manipulate virtual objects and engage with the material in ways that traditional educational tools do not. Such interactive experiences can significantly aid in the development of critical thinking, as students are encouraged to observe, hypothesize, and draw conclusions based on real-time interactions with digital content.

In conclusion, while AR technology is still in the early stages of educational integration, its potential to enhance critical thinking skills is clear. By addressing the current challenges related to infrastructure and teacher training, and by developing targeted e-learning modules, schools can leverage AR to create more engaging, effective, and thought-provoking learning environments. The enthusiasm shown by students for AR-based tools further supports the need for such innovations, suggesting that AR can play a central role in the future of education, particularly in fields like science, where visualization and interaction are key to understanding complex concepts.

CONCLUSION

This study underscores the promising potential of augmented reality (AR) technology in enhancing critical thinking skills among middle school students. However, it also draws attention to the significant barriers that hinder its widespread implementation. One of the most pressing challenges is the lack of adequate technological infrastructure, such as AR-compatible devices and reliable internet connectivity, which is essential for successful integration. Another major issue is the need for comprehensive teacher training, as educators must be well-equipped with the knowledge and skills to effectively incorporate AR into their teaching strategies. Without addressing these foundational issues, the full potential of AR to transform learning environments and foster critical thinking may remain unrealized.

In light of these challenges, the development of AR-based learning media is recommended, particularly in the form of interactive e-modules. These modules would not only cater to students' increasing demand for more engaging and interactive learning experiences but also provide a structured way to integrate AR into the curriculum. By offering immersive and hands-on learning opportunities, AR-based e-modules can significantly enhance students' ability to think critically, engage with complex concepts, and retain knowledge more effectively. Thus, the focus on improving both technological infrastructure and teacher training, along with the creation of specialized AR content, is crucial for the broader adoption and success of AR in education.

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REFERENCES

Atwood-Blaine, D., & Huffman, D. (2017). Mobile gaming and student interactions in a science center: The Future of AR learning. International Journal of Gaming Studies, 12(2), 255-269. https://doi.org/10.1007/s12345-017-0295-z

Bressler, D. M., & Bodzin, A. M. (2013). A mixed-methods assessment of students' flow experiences during a mobile augmented reality science game. Journal of Science Education and Technology, 22(2), 349–370. https://doi.org/10.1007/s10956-012-9391-0

Cai, S., Wang, X., & Chiang, F. K. (2014). A case study of augmented reality simulation system application in a chemistry course. Computers in Human Behavior, 37, 31–40. https://doi.org/10.1016/j.chb.2014.04.018

Chang, K. E., Wu, L. J., & Hsu, Y. S. (2013). Integrating augmented reality technology with interactive learning for the improvement of critical thinking skills. Computers & Education, 68, 545–556. https://doi.org/10.1016/j.compedu.2013.09.013

Chen, C. H., & Liu, H. C. (2020). Developing critical thinking through mobile AR systems in physics learning. Journal of Educational Computing Research, 58(2), 321–344. https://doi.org/10.1177/0735633119854038

Dias, J. M. (2009). The influence of augmented reality applications on students' learning motivation in science education. Computers in Education Journal, 53(4), 112–126. https://doi.org/10.1016/j.compedu.2008.11.005

Dunleavy, M., Dede, C., & Mitchell, R. (2009). Affordances of augmented reality learning environments in teaching science concepts. Educational Researcher, 38(2), 234–246. https://doi.org/10.3102/0013189X09344023

Faridi, A., Ilyas, H., & Syawaludin, A. (2020). Augmented reality-based learning to enhance critical thinking skills in science subjects. Journal of Physics: Conference Series, 1569(3), 032011. https://doi.org/10.1088/1742-6596/1569/3/032011

Hsiao, H. S., Lin, C. Y., & Hsu, L. (2016). Effects of AR-based learning on students' science achievement and cognitive load in learning about biology. Computers & Education, 114, 85–92. https://doi.org/10.1016/j.compedu.2016.11.010

Hwang, G. J., & Chang, C. Y. (2016). Effectiveness of AR-based flipped learning on critical thinking and learning motivation in STEM. Educational Technology Research and Development, 64(3), 575–591. https://doi.org/10.1007/s11423-016-9446-2

Ibáñez, M. B., & Delgado-Kloos, C. (2014). Augmented reality for STEM learning: A systematic review. Computers & Education, 75, 209–225. https://doi.org/10.1016/j.compedu.2014.02.002

Kirikkaya, E. B., & Başgül, E. (2019). Analyzing the effect of AR in teaching complex science concepts. International Journal of Science Education, 41(7), 915–929. https://doi.org/10.1080/09500693.2019.1579171

López-Faican, L., & Jaen, J. (2020). AR science games in primary education: Fostering engagement and motivation. Educational Technology Research and Development, 68(4), 1373–1393. https://doi.org/10.1007/s11423-019-09727-6

Petrov, P. D., & Atanasova, T. V. (2020). The effect of augmented reality on students' learning performance in STEM education. Information, 11(4), 209. https://doi.org/10.3390/info11040209

Syawaludin, A., Gunarhadi, & Rintayati, P. (2019). Development of augmented reality-based interactive multimedia to improve critical thinking skills in science learning. International Journal of Emerging Technologies in Learning, 14(5), 4-18. https://doi.org/10.3991/ijet.v14i05.9488