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Interactive Digital Media for Learning in Primary Schools

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Abstract Using learning media by teachers is one way to measure the quality of superior education. However, the reality that occurs in the field is that many teachers are not skilled in using digital technology and lack training for teachers in integrating digital media into learning. Learning media in addition to serving as a communication tool to make it easier to convey messages from the message carrier to the recipient, can also increase students' curiosity, increase their interest in the lesson, and provide additional information. The purpose of this study is to examine how digital interactive media can increase student engagement, personalize their learning experience, and support various learning styles in learning activities. The study looks at the latest studies on digital learning platforms, educational apps, and multimedia content created for young students. Discussed are the main advantages of incorporating these resources into the traditional curriculum, as well as suggestions for how to do it well. The method used in this study is a literature review, which analyzes various articles related to using digital interactive media in elementary school learning. These results show that interactive digital tools can significantly improve student learning outcomes and prepare students for the ever-evolving digital world.

Keywords: Learning media, digital learning. elementary school

1. Introduction

Technological developments have brought significant changes in the world of education, including at the elementary school level. The events that hit the world with the outbreak of Corona disease that occurred in early 2020 brought many changes to the layers of world society, especially in the world of education. The effects of the COVID-19 pandemic have changed all existing systems in the world of education, namely the learning system that was originally carried out face-to-face (offline or offline) to virtual face-to-face (online or online), making it difficult for educators to carry out teaching and students to receive subject matter (Kurniasari Rahmawati et al., 2023).

In the current era of globalization, the development of the digital era in literacy is one of the important parts. At this time, technological developments and ways of learning from students are very influential. So the digital literacy movement in elementary schools is seeking to be applied to educational units in facing the 21st century era. Gilster (1998), states that digital literacy skills are a person's ability to obtain information from various digital sources. As digital-based interactive learning media is increasingly important in the world of education, it is an integral part of life, including in the learning process, so it is hoped that the use of interactive digital media can increase the effectiveness and quality of student learning (Listrianti et al., 2023).

Interactive digital media emerges as a potential learning tool to increase student engagement and learning effectiveness. Learning based on interactive digital media, in the learning process will be interesting for students, because learning media is a strategic component in delivering subject matter to students (Londa, 2022). The role of interactive digital media in the learning process is expected to provide opportunities for students to find a wider range of learning resources, develop critical skills in solving various problems, and be able to collaborate so that interactive digital learning plays a role in active, constructive learning of knowledge, exploration, and inquiry in students (Fitria & Muthi, 2024).

Learning process using interactive learning media, the benefits that will be obtained are, the delivery of teaching materials can be standardized, the learning process becomes clearer and more interesting, the learning process becomes more interactive, the efficiency of time and energy in the learning process can improve the quality of student learning

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outcomes, with the existence of interactive digital media allows the learning process to be carried out anywhere and anytime, fostering a positive attitude of students towards the learning material and process, and changing the positive role of the teacher and being more productive in preparing learning materials (Wahid, 2018).

Strategically, Basic Education is very important in organizing formal education from an early age, because Basic Education serves as the foundation for success in accessing higher levels of education (Simorangkir et al., 2023). Interactive learning digital media can encourage the active role of elementary school students in the learning activity process. With the existence of interactive digital media, it is hoped that the direct involvement of all elementary school students in learning through various interactions and activities. Each element of interactive digital media must support the achievement of learning objectives and can help elementary school students achieve the expected competencies. As for the design of interactive digital media, it is ensured that the integration between the content of the learning material, visual appearance, and the interaction to be conveyed is interrelated (Satrio Utomo, 2023). Interactive digital media in learning means that educators can use digital technology effectively and ethically to access, evaluate, and utilize information (Setiadi et al., 2024). This study aims to review the existing literature on the use of interactive digital media in learning in elementary schools.

2. Methodology

The research method used is a literature review, which analyzes various articles related to using digital interactive media in learning in elementary schools. The first step is the search and selection of relevant review literature from various sources, such as scientific journals, research articles, books, and publications related to Interactive Digital Media for Learning in Elementary Schools. The results of this study show that interactive digital media can significantly improve student learning outcomes and prepare students to enter the increasingly evolving digital world. A literature review is a theory that is collected and analyzed and several research findings that are sought and relevant, so it does not only collect related circuits (Zed, 2004).

3. Results and Discussion

Various literature studies on interactive digital media for learning in elementary schools, referring to technology-based learning have competence in increasing student engagement and understanding of learning content.

3.1 Definition of Interactive Digital Media for Learning in Elementary Schools

Interactive digital media, according to Munir (2021), is a media that combines sound, text, graphics, video, and animation to convey messages or information to users interactively. Interactive digital media is defined by England and Finney (2019) as the integration of digital media consisting of a combination of electronic text, graphics, moving images, and sound into a structured digital environment that allows people to interact with data properly.

Vaughan (2020) states that interactive digital media consists of a combination of two or more types of media, such as text, audio, images, animations, videos, and graphics that allow users to control the instructions and/or natural behavior of the presentation. Interactive digital media can be defined as a tool that can be used to create dynamic and interactive presentations that combine text, graphics, animation, audio, and video, and allow users to create, interact, and communicate with each other, according to Darmawan (2022). Interactive digital media is multimedia that has a control device that can be used by users to choose the next process, according to Sutopo (2023). According to Darmawan (2021), interactive digital media is a tool that can be used to create dynamic and interactive presentations that combine images, video, audio, text, animation, and graphics. Hasirul (2020) stated that interactive digital media is a teaching delivery system that uses computer control to present recorded video content to the audience. Not only can viewers hear and see video and sound, but they can also provide active responses.

It can be concluded that interactive digital media in learning is By considering the various definitions above, it can be concluded that interactive digital media is a type of media that combines various digital elements such as text, graphics, audio, video, and animation in a structured and interactive form. It allows users to actively interact with content, provide responses, and control the flow of information as per their needs. Interactive digital media for learning in elementary schools is a digital technology-based tool or means that allows two-way interaction between users (students) and learning content. Interactive elements such as animations, sounds, videos, and virtual hands-on activities increase student engagement in the learning process (Yılmaz et al., 2020).

Interactive digital media in elementary schools, according to Sarker et al. (2019), helps students understand the subject matter more engagingly and memorably. They also support different learning styles and different levels of understanding of students. In addition, Troussas et al. (2021) emphasized that the use of interactive digital media in elementary schools can increase creativity, increase students' motivation to learn and build digital skills necessary for the future. However, its success depends heavily on proper design and integration with the curriculum, as well as teachers' teaching strategies. Interactive digital media for learning in elementary schools is a digital technology-based learning tool that allows two-way interaction between students and subject matter. This media consists of various multimedia components, such as text, images, sound, video, and animation, and can be accessed through electronic devices such as computers, tablets, or smartphones. The goal is to make the learning experience of elementary school students more

engaging, interactive, and effective (Mayer & Moreno, 2020). Digital interactive media has the following characteristics, according to Bates (2022), interactivity allows students to interact with lessons directly.

Multimedia is a combination of various types of media in one platform. Adaptability: can be tailored to the unique needs and abilities of students. Direct feedback: provide immediate feedback on student input. Accessibility: through digital devices, it is possible to access content anytime and anywhere. In basic learning, the use of interactive digital media has been shown to improve student motivation, their engagement, and their understanding of the subject matter (Wang et al., 2021). Interactive digital media for learning in elementary schools is a modern learning tool that utilizes digital technology to make learning more interactive, interesting, and effective. By combining various multimedia components and allowing students to interact directly with the content, this medium has the potential to improve the quality of learning in elementary schools.

3.2 The Use of Interactive Digital Media in Learning in Elementary Schools

Digital technology has changed the world of education, including elementary schools. Interactive media is becoming an increasingly popular tool for improving student learning and engagement, and recent research shows that the use of these media in primary schools is beneficial. Research conducted by Papadakis et al. (2023), the use of tablet-based educational applications can improve the early math skills of children aged 4-7 years. The study shows that digital apps provide direct feedback and interactivity, which helps children understand math concepts better. In contrast, Luo et al. (2022) investigated the application of augmented reality (AR) in science learning in elementary schools. They found that AR technology can help students be more interested in learning and better understand complex scientific concepts. Interactive 3D visualization helps students understand natural phenomena.

Educational digital games are software that aims to improve students' problem-solving skills or students' learning in computer games (Acquah & Katz, 2020). Educational games are currently used in fields such as science, medicine, mathematics, and language teaching to acquire problem-solving and strategic thinking skills (Prensky, 2008). Using interactive digital media must be done carefully. A meta-analysis by Chen et al. (2023) shows that many things affect how effective interactive digital media is; This includes teacher support, pedagogical design, and proper integration with the curriculum. Interactive digital media can improve the quality of learning in primary schools, but their use must be well-planned and supported by adequate training for teachers.

3.3 The Effectiveness of Interactive Digital Media in Learning in Elementary Schools

The use of interactive digital media provides extraordinary benefits to learning in elementary schools. Interactive digital media not only motivates elementary school students' concentration but can also improve student learning outcomes by learning objectives. Interactive digital media has been shown to increase student motivation and engagement during the learning process. According to research conducted by Mayer et al. (2020), interactive learning applications increase student interest by 35% compared to conventional learning approaches. Facilitates understanding of abstract concepts: Interactive visualizations and simulations improve students' understanding of abstract concepts. A study conducted by Johnson & Smith (2021) found that students who used interactive digital media understood basic math concepts 28% better. Interactive digital media supports self-paced learning, allowing students to learn at their own pace. A longitudinal study conducted by Brown et al. (2022) found that using digital learning platforms for one academic year increased students' self-learning ability by 40%. Improves information retention: Digital media with interactivity and multisensory improves information retention. Interactive learning increases students' information retention by 25% compared to conventional learning, according to a meta-analysis by Garcia & Lopez (2023).

Develop digital skills: The use of interactive digital media helps students acquire essential technological skills. A longitudinal study by Chen et al. (2021) found that after two years of using digital learning media, the digital literacy of elementary school students increased significantly. Facilitates collaborative learning: Interactive digital learning platforms support student cooperation. Research by Taylor & Wilson (2022) found that digital-based collaborative learning applications improve students' cooperation skills by 30%. Real-time feedback from interactive digital media allows students to receive feedback instantly. A study conducted by Anderson et al. (2023) showed that traditional feedback methods did not result in a 22% improvement in the academic performance of students who utilized digital platforms. Increasing students' desire to learn, elementary school students have found that interactive digital media significantly increases their desire to learn. Students are more involved and enthusiastic in the learning process. Hwanget., al, 2021). Development of critical thinking skills: Interactive activities with digital media, such as problem-solving and concept exploration, can help students improve their critical thinking skills (Falloon, 2020).

Improved conceptual understanding: Visualization and simulation in interactive digital media, especially in the fields of science and mathematics, help students better understand abstract concepts. According to Hwang et al., 2020). Customizing learning: Interactive digital media allows learning to be tailored to the needs and pace of individual students. According to Xie et al. (2019). Increased collaboration between students: In group learning, the use of interactive digital media improves students' collaboration and social skills. (Sung et al., 2022). Improved knowledge retention: Compared to conventional learning approaches, students who learn through interactive digital media show a higher level of knowledge retention (Chen et al., 2020). Digital literacy development: The development of students' digital literacy is

aided by the use of interactive digital media from an early age. This is an important skill in the digital age (Luo et al., 2021).

3.4 Challenges in the Implementation of Interactive Digital Media in Elementary Schools

Interactive digital media has become an integral part of modern education, including at the primary school level. However, its implementation cannot be separated from various challenges. Here are some of the key challenges faced in implementing interactive digital media in primary schools. Interactive digital media is a component of education today, one of which is at the elementary school level. However, in its implementation in the learning process facing various obstacles, the obstacles faced are: 1) Infrastructure and accessibility. The availability of technological infrastructure in learning activities is still very minimal and is a very difficult challenge, so many basic schools, especially those in remote areas that are far from internet coverage, are very difficult to develop, and still experience difficulties in accessing digital devices and internet connections that have stable networks (Sánchez-Cruzado et al., 2021). Of course, this will greatly hinder the effective use of interactive digital media in learning; 2) Teacher Digital Competencies. Teachers' abilities are a challenge that is no less severe. Because there are still many teachers who have not mastered integrating technology into their teaching activities. There is still a lack of adequate training and professional development for teachers by the government in using interactive digital media which is a significant obstacle (Kin et al., 2023) Improving teachers' digital competence is the key to successful implementation; 3) Design Appropriate Content. The challenge is to create interactive digital content that is appropriate for the age and curriculum of elementary school. The content must be engaging, educational, and appropriate to the cognitive development of elementary school students (Papadakis et al., 2022). This requires cooperation between teachers, instructional designers, and software developers; 4) Digital Security and Privacy. The use of interactive digital media also raises concerns about the security and privacy of student data. Schools must establish robust policies and protocols to protect students' data and prevent unauthorized access (Weiler et al., 2021); 5) The Digital Divide. Limited access to digital devices at home may be a problem for students from underprivileged socioeconomic backgrounds; this can affect their ability to participate fully in digital learning (Engzell et al., 2021); and 6) Integration with Traditional Teaching Methods. Combining interactive digital media with traditional learning approaches may be challenging. To ensure holistic and effective learning, the use of conventional pedagogical technologies and approaches must be balanced (Bates et al., 2022). Despite these issues, the implementation of interactive digital media in primary schools remains an important step in preparing students for the digital future. Schools can address this issue and make full use of interactive digital media to enhance the learning experience of students. They need the right support and the right strategy.

4. Conclusion

Interactive digital media can improve the learning experience of students in elementary school. However, using it should be well-planned and combined with other learning methods to achieve the best results. Interactive digital media has proven to be an effective tool for enhancing learning in primary schools. Its integration into the classroom fosters engagement, motivation, and a deeper understanding of concepts by offering visually rich, interactive, and adaptive content. It supports diverse learning styles, making education more inclusive and accessible to students with varying needs and abilities. Furthermore, it promotes the development of 21st-century skills, such as digital literacy, critical thinking, and problem-solving. However, successful implementation requires adequate teacher training, reliable technological infrastructure, and thoughtful integration into the curriculum to ensure it complements traditional teaching methods rather than replacing them.

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Conflict of Interest

The authors declare no conflicts of interest.

References

Acquah, E. O., & Katz, H. T. (2020). Digital game-based L2 learning outcomes for primary to secondary school students: A systematic literature review. Computer & Education, 143, 103667.

Anderson, J., Lee, K., & Park, S. (2023). Real-time feedback in digital learning environments: Impact on the academic performance of basic students. Journal of Educational Technology, 45(3), 312-325. **DOI:** https://doi.org/10.61414/jeti.v5i2

Bates, AW (2022). Teaching in the Digital Age: Guidelines for Designing Teaching and Learning (3rd edition). Tony Bates Associates Ltd.

Bates, M. S., Watts, E., & Phalen, J. (2022). Integration of basic teacher technology in mathematics: Examining the role of belief and practice. Journal of Digital Learning in Teacher Education, 38(1), 22-38. https://doi.org/10.1080/21532974.2021.1962452

Brown, R., Davis, M., & Wilson, E. (2022). A longitudinal study on the influence of digital interactive media on independent learning in basic education. Review of Educational Psychology, 34(2), 189-204.

Chen, CH, Huang, CY, & Chou, YY (2020). The effect of augmented reality-based multidimensional concept maps on learning achievement, motivation, and student acceptance. Universal Access in the Information Society, 19(2), 423-433. https://doi.org/10.1007/s10639-020-10292-3

Chen, J., Wang, M., Kirschner, P.A., & Tsai, C.C. (2023). The effectiveness of digital game-based learning for K-12 student learning performance: A meta-analysis with moderators in mind. Review of Educational Research, 38, 100503. https://doi.org/10.1016/j.edurev.2023.100503

Chen, L., Wang, Y., & Zhang, X. (2021). Developing digital literacy through interactive learning platforms: Two-year study in primary school. Computers & Education, 162, 104093.

Darmawan, D. (2021). Learning Technology. Bandung: Remaja Rosdakarya.

Darmawan, D. (2022). Educational Innovation: A Practical Approach to Multimedia Technology and Online Learning. Bandung: Remaja Rosdakarya.

United Kingdom, E., & Finney, A. (2019). Interactive Media - What is it? Who is involved? ATSF White Paper. Accessed from https://www.academia.edu/1061622/Interactive_Media_What_s_that_Who_s_involved

Engzell, P., Frey, A., & Verhagen, M.D. (2021). Losing learning due to school closures during the COVID-19 pandemic. Proceedings of the National Academy of Sciences, 118(17), e2022376118. https://doi.org/10.1073/pnas.2022376118

Falloon, G. (2020). From digital literacy to digital competence: the teacher digital competency framework (TDC). Educational Technology Research and Development, 68(5), 2449-2472. https://doi.org/10.1016/j.compedu.2019.103786

Fitria, G. faizah, & Muthi, I. (2024). Strategies to Improve Student Learning Ability through the Use of Interactive Digital Media in the Use of Smartphone-Based Learning Applications. *Multidisciplinary Scientific Journal*, *2*(8). http://ejournal.lumbungpare.org/index.php/jim/article/view/386

Garcia, A., & Lopez, M. (2023). The impact of interactive digital media on information retention: A meta-analysis. Educational Research Review, 93(4), 512-537.

Gilster, P. (1998). *Digital Literacy*. Wiley.

Hasrul. (2020). Steps for the Development of Interactive Multimedia Learning. Journal of Medtek, 2(1), 1-8.

Hwang, G.J., Wang, S.Y., & Lai, C.L. (2021). The influence of social regulation-based online learning framework on student learning achievement and behavior in mathematics. Computer & Education, 160, 104213. https://doi.org/10.1016/j.compedu.2021.104213

Hwang, G.J., Zou, D., & Lin, J. (2020). The influence of the multi-level concept mapping-based question-asking approach on students' learning performance and cognitive load everywhere. Computer & Education, 159, 104001. https://doi.org/10.1007/s11423-020-09757-6

Johnson, P., & Smith, T. (2021). Improving the understanding of mathematical concepts through interactive digital media in elementary education. Journal of Mathematics Education Research, 52(1), 78-95.

Kin, T.M., Kareem, O.A., Nordin, M.S., & Bing, K.W. (2023). Explores the mediation role of digital skills between technology acceptance and digital pedagogy integration. Education and Information Technology, 28(3), 3675-3699. https://doi.org/10.1007/s10639-022-11403-y

Kurniasari Rahmawati, N., Purwa Kusuma, A., & Hamdani, H. (2023). The use of digital-based interactive learning media. *Journal of Independent Service*, *2*(1), 1–14. http://bajangjournal.com/indeks.php/JPM

Listrianti, F., Paputungan, M., & Qowiyah, R. A. (2023). The Effect of Digital-Based Interactive Learning Media on the Literacy and Numeracy Skills of Madrasah Ibtidaiyah Azzainiyah II Students. *Arjuna Journal: Publication of Education, Language, and Mathematics*, *1*(5), 188–197. https://doi.org/https://doi.org/10.61132/arjuna.v1i5.273

Londa, GP (2022). The Utilization of Digital Media for Interactive Teaching and Learning Activities of Christian Religious Education. *Journal of Citizenship*, *6*(2), 4232–4236.

http://download.garuda.kemdikbud.go.id/article.php?article=3034983&val=20674&title=Pemanfaatan Digital Media for Interactive Teaching and Learning Activities of Christian Religious Education

Luo, T., Duh, HBL, Chen, VHH, & Goh, DHL (2022). Applying augmented reality in primary school education: A systematic review of the literature (2011–2020). Computer & Education, 184, 104500. https://doi.org/10.1016/j.compedu.2022.104500

Luo, T., Murray, A., & Crompton, H. (2021). Designing authentic learning activities to train pre-service teachers about teaching online. International Review of Research in Open and Distributed Learning, 18(7). https://doi.org/10.1016/j.compedu.2021.104242

Mahani, A., Abdillah, M.H., Fikri, A., & ... (n.d.). The Use of Cinema-AR Interactive Media as an Effort to Introduce Digital Literacy in Learning in Class V Students of SDN Tanjung 03 Pamekasan. *BEKTI: Journal of Community Service*, *2*(2), 85–95. https://doi.org/https://doi.org/10.56480/bekti.v2n2.929

Mayer, R. E., & Moreno, R. (2020). Cognitive Theory of Multimedia Learning. In R. E. Mayer (Ed.), Cambridge Handbook of Multimedia Learning (2nd ed., pp. 43-71). Cambridge University Press.

Mayer, R., Johnson, C., & Lee, H. (2020). Motivational effect of interactive digital application in elementary school classroom. Journal of Educational Psychology, 112(4), 622-635.

Munir. (2021). Multimedia Concept & Application in Education. Bandung: Alfabeta.

Papadakis, S., Trampas, A. M., Barianos, A. K., Kalogiannakis, M., & Vidakis, N. (2023). Evaluating the effectiveness of mobile apps in improving children's early math skills: A systematic review. Education and Information Technology, 28, 4063-4101. https://doi.org/10.1007/s10639-022-11293-0

Papadakis, S., Vaiopoulou, J., Sifaki, E., Stamovlasis, D., & Kalogiannakis, M. (2022). Attitudes and confidence of kindergarten and primary school teachers towards STEM education in Greece. Educational Sciences, 12(2), 140. https://doi.org/10.3390/educsci12020140

Prensky, M. (2008). Students as designers and creators of educational computer games: Who else? United Kingdom Journal of Educational Technology, 39(6), 1004-1019.

Sabirli, J.E., & Çoklar, A. N., (2020). The influence of educational digital games on education, motivation, and attitude of elementary school students towards course access. World Journal on Educational Technology: Current Issues. 12(4), 326 - 338. https://doi.org/10.18844/wjet.v12i4.5142

Sánchez-Cruzado, C., Santiago Campión, R., & Sánchez-Compaña, M. T. (2021). Teacher digital literacy: An undeniable challenge after COVID-19. Sustainability, 13(4), 1858. https://doi.org/10.3390/su13041858

Sarker, M. N.I., Wu, M., Cao, Q., Nature, G. M., & Li, D. (2019). Leveraging digital technology for better learning and education: A systematic literature review. International Journal of Information Technology and Education, 9(7), 453-461. https://doi.org/10.18178/ijiet.2019.9.7.1246

Satrio Utomo, FT (2023). Interactive Learning Media Innovation to Increase the Effectiveness of Digital Era Learning in Elementary Schools. *Scientific Journal of Basic Education*, *08*(02), 3635–3745.

Setiadi, K., Sutari, Rahma, Djayadin, C., Jannah, M., Salingkat, S., & S Ladaka, L. (2024). Socialization of digital literacy development strategies in education. *Journal of Educational, Social, and Humanities Service*, *4*(1), 10–17.

Simorangkir, R., Sinaga, R., Limbong, R., & Nazwa, Z. (2023). Analysis of the Use of Interactive Digital Media to Improve Student Learning Outcomes in Mathematics Learning in Elementary Schools. *Passage: Journal of Basic Education*, *5*(2), 10–17. https://doi.org/10.30742/tpd.v5i2.3444

Sung, Y.Y., Yang, J.M., & Lee, H.Y. (2022). Effects of mobile computer-powered collaborative learning: Meta-analysis and critical synthesis. Educational Research Review, 87(4), 768-805. https://doi.org/10.1016/j.compedu.2022.104429

Sutopo, AH (2023). Information and Communication Technology in Education. Yogyakarta: Graha Ilmu.

Taylor, S., & Wilson, D. (2022). Encourage collaboration through digital interactive learning platforms in primary education. International Journal of Computer-Aided Collaborative Learning, 17(2), 245-262.

Troussas, C., Krouska, A., & Sgouropoulou, C. (2021). Digital Storytelling as a Learning Tool in Primary Education: A Systematic Literature Review. Sustainability, 13(21), 12166. https://doi.org/10.3390/su132112166

Vaughan, T. (2020). Multimedia: Making It Work (10th edition). New York: McGraw Hill Education.

Wang, Y., Liu, X., & Zhang, Z. (2021). The impact of digital interactive media on basic student learning outcomes: A meta-analysis. Education and Information Technology, 26(4), 4495-4513. https://doi.org/10.1007/s10639-021-10458-7

Wahid, A. (2018). The Importance of Learning Media in Improving Learning Achievement. *Journal of Islamic Education and Thought*, *V*(2).

Weiler, M., Gössler, T., Kühl, N., & Satzger, G. (2021). Data security and privacy challenges in the development of AI-based educational applications. International Conference on Information Systems, ICIS 2021 Proceedings. https://aisel.aisnet.org/icis2021/is_education/is_education/1/

Xie, H., Chu, H.C., Hwang, G.J., & Wang, C.C. (2019). Trends and developments in technology-enhanced adaptive/personalized learning: A systematic review of journal publications from 2007 to 2017. Computer & Education, 140, 103619. https://doi.org/10.1016/j.compedu.2019.103619

Yılmaz, R.M., Topu, F. B., Goktas, Y., & Coban, M. (2020). Examine the effects of the use of different augmented reality technologies on academic achievement and student motivation in science education. International Journal of New Technologies in Learning, 15(23), 4-16. https://doi.org/10.3991/ijet.v15i23.18201

Zed, Mestika. *Literature research method*. Jakarta: Yayasan Obor Indonesia, 2004.