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The Influence of Augmented Reality on the Ability of Analytical Students in Science Learning

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Abstract

Education is not free from the development and progress of the world. Augmented Reality (AR) is one of them. Emerging technologies have quickly entered the field of education because of the diverse possibilities they offer. Besides that student expected to follow the progress of the times. Students sued for their ability to face the challenge of development of the times. Analytical ability is one of the most basic high-level thinking skills to hone 21st-century skills. The research design chosen is SLR (Systematic Literature Review) which uses the PRISMA method to collect data. The results of this study show that AR (Augmented Reality) can help science learning and improve students' analytical skills. Study this expectation can become a runway for development and more carry-on utilization of AR to support learning science.

Keywords: *Augmented Reality (AR); Ability Analytical; Science*

Introduction

At this time, life is progressing in all areas. Everything is advanced and made easier in all things. The development of information and communication technology in the 21st century has contributed to changes in various aspects of life (Bastian dkk., 2021). Humans must keep up with developments, and every nation, including Indonesia, needs to adapt to global demands. Technology helps society, especially in facing future challenges in society 5. 0. (Bastian dkk., 2021). Education plays a vital role in the world's development and helps prepare students for future challenges. It aims to enhance students' personality, attitude, intelligence, and morals. There is an increasing focus on 21st-century skills to equip students for complex future challenges. (Nisa, 2024). Challenges are getting more complex every day so quality students are needed.

Analytical thinking is one of the most basic high-level thinking skills to hone 21st-century skills such as critical thinking, problem-solving, creativity, and decision making so analytical thinking skills are very important for prospective teachers as basic skills (Yulina dkk., 2019). Ability analytics is one of the skills the main things that need to be done by students to face challenges in the digital era. Ability This covers the ability to think critically, analyze information, and complete problems in a way logical (Anggraini, 2018). Analytical thinking allows students to think logically, about the relationship between concepts and situations they face, because analytical thinking involves the ability to (1) categorize problems into their parts and understand those parts, (2) explain the function of a system, why something happens, or how to solve a problem, (3) compare and contrast two or more phenomena, or (4) evaluate and examine the characteristics of a phenomenon (Sari dkk., 2022). Think analytical is a tool for powerful thinking to understand parts of a defined situation as: (1) checking and separating facts and thoughts through strengths and weaknesses; (2) developing wise and intelligent problem-solving skills, analyzing data, remembering, and using information. However, various studies show that many students struggle to develop analytic ability. (Chonkaew dkk., 2016). This becomes a challenge big for educators for looking for more learning media effective.

To improve education, it's important to develop its components, especially learning media. One notable approach is augmented reality (AR) technology, which blends the real world with digital elements for interactive and immersive learning, enhancing understanding, motivation, and student engagement (Sahin & Yilmaz, 2020). AR provides an opportunity to create an environment that is more interesting and conducive, especially in helping students understand difficult material through more visualization real and contextual. Augmented Reality (AR) is becoming very important for various eye lesson learning Because capacity to contextualize knowledge, unite content with context, and delete abstraction (Christopoulos dkk., 2021).

Augmented Reality (AR) is one of the emerging technologies that have with fast entered to field of education Because of the diverse possibilities it offers. Between reasons other, this convenient access information offered by the tool, because usually accessed via a blessing device mobile, with source Power technology this is very present with students in the Ibero-American context (Cabero-Almenara dkk., 2019). AR offers the possibility of mixing and combining two environments: physical and digital, and all This in real-time, through the use of emerging and easy technology access, such as mobile phones or tablets. Augmented reality introduces knowledge that must be studied by students in a real-world environment, with the way it looks.

A number of studies previously have proven the effectiveness of AR in increasing results Study students. For example, research shows that AR can increase the motivation and interest of students in learning, connecting draft abstracts with real-world situations, as well as strengthening the skills of cognitive students (Sahin & Yilmaz, 2020). However, even though Lots of proof supports the benefits of AR, yet Lot of research is special to study the impact to ability analytic students. This has become a gap necessary for research to know how far AR can go to help the student develop skills in analytics, especially in solving a problem that needs analysis depth and retrieval of rational decisions.

This aims to explore the influence of AR on analytic students' development based on literature analysis. Compiling and analyzing various studies can show the effectiveness of AR in supporting.

Methods

This is SLR (Systematic Literature Review) research. In design study, this is the process of identifying, reviewing, evaluating, and interpreting all available research. SLR research is a design study to synthesize evidence based on previous studies in a systematic way to answer a question. According to M. Newman and D. Gough, SLR has nine stages. Namely 1) developing question research, 2) framework

conceptual design, 3) determining criteria, 4) developing research strategies, 5) selecting by criteria, 6) giving code, 7) assessing journal selected, 8) doing synthesis results research, 9) results findings.

At the stage First, researchers sort out the problem that will be researched. The researchers chose to discuss students' analytical abilities to educate in science learning. As well as research more about Augmented Reality. So, it is formulated question:

1) How Augmented Reality (AR) help science learning?

2) How influence Augmented Reality (AR) against the ability of analytical students in science learning?

Stage second is framework conceptual design, at this stage, this researcher chooses the SLR design to suit with research. Research This is by design research by M. Newman and D. Gough, with the PRISMA method for filter journal research. Stages third is determined criteria. Selected criteria namely 1) the selected journal There is a journal publication 2014-2024, 2) the selected journal is journal indexed Scopus quartile 1-4 and sinta 1-4, 3) related journals with augmented reality and capabilities analytical.

Stages four involve choosing a suitable research strategy. Researchers gathered related journals from Google Scholar and Scopus using Publish or Perish. They filtered the journals using Convidence to find duplicates and suitable ones. In stage five, they selected and analyzed journals based on criteria. Initially, there were 2,282 journals identified. After filtering, 137 were found to be duplicates. Filtering by title and abstract resulted in 206 appropriate journals. Finally, applying the set criteria led to 20 suitable journals for analysis. A PRISMA diagram of the study is provided for clarity.Stages *sixth* and *seventh*, researchers map results research on selected journals and grouping results and give code. Stages *eighth* and *ninth*, researchers start analyze and conclude results research. The analysis used is analysis descriptive.

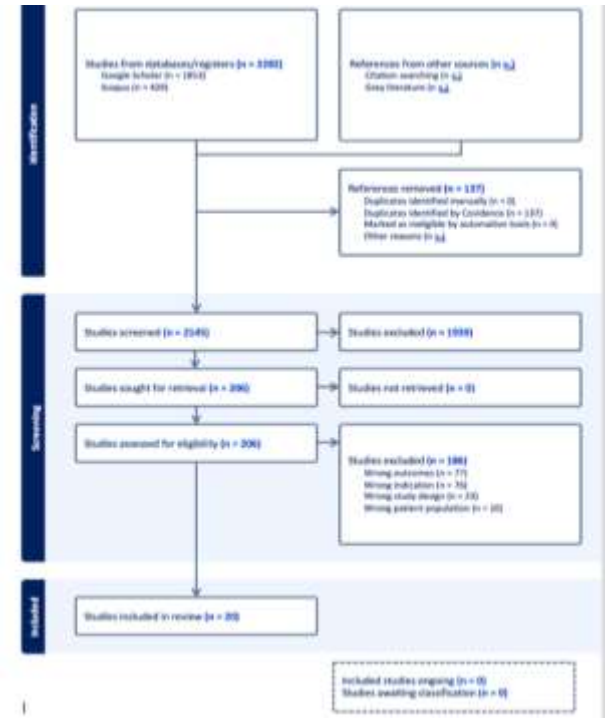

Figure 1. PRISMA Diagram

Result and Discussion

Results

From the filtering results, 20 journals were produced as follows:

Table 1. Selected Journals

Writer	Title	Research result	Code
Fatih 2024	Science learning game (SLG) based on augmented reality enhances students' science literacy and critical thinking skills	• AR based SLG is proven become effective tool in support modern science learning, providing experience interesting, relevant and in - depth learning for student.	AR can help science learning
Anggraini 2020	How to improve critical thinking skills and spatial reasoning with augmented reality in mathematics learning?	• learning AR based strengthens ability think critical and reasoning spatial with provide tool visualization interactive support understanding deep as well as involvement student.	AR can help science learning
Syawaluddin 2019	Development of Augmented Reality-Based Interactive Multimedia to Improve Critical Thinking Skills in Science Learning.	• Interactive multimedia AR based is tool learning innovative that supports improvement skills think critical with give experience dynamic, visual, and immersive learning.	AR can help science learning
Sunrise 2020	Augmented Reality for Integer Learning: Investigating its potential on students' critical thinking	• AR for learning number round effective in increase skills think critical student with provide experience visual, interactive and fun learning.	AR can help improve ability student AR can help learning
Herliandry 2021	Improve critical thinking abilities through augmented reality assisted worksheets	• Worksheet effective Augmented Reality based for increase ability think critical students. This is especially because AR provides experience learn more interactive and contextual.	AR can help learning
Zuniari 2022	The effectiveness of implementation learning media based on augmented reality in elementary school in improving critical thinking skills in solar system course	• AR based media is more effective compared to method conventional, especially For difficult concept understood through 2D image or text just . • Students who use AR more fast understand concept, and show better understanding deep about solar system material.	AR can help science learning
2019	Implementing multiple AR markers in learning science content with Junior High School students in Thailand	• Use *multiple AR markers* in proven science learning effective increase understanding concept, motivation learning, and interaction student. • AR media helps create atmosphere interactive and collaborative learning.	AR can help improve ability student AR can help science learning
2019	Design and Development of Constructivist Augmented Reality (AR) Book	• Use AR book shows improvement significant in ability think analytical student. • Student can analyze problem, identify	AR can help improve ability analytical student

Writer	Title	Research result	Code
	Enhancing Analytical Thinking in Computer Classroom	solutions, and understanding connection between elements draft computer in a way more deep.	
Thabvithorn 2022	Development of Web-Based Learning with Augmented Reality (AR) to Promote Analytical Thinking on Computational Thinking for High School	• AR helps student understand draft abstract in a way more visual and concrete. • Student more understand draft base *computational thinking*, such as decomposition and introduction pattern.	AR can help improve ability student
Oakkarawong 2016	Designing a framework of augmented reality learning environment to promote analytical thinking for grade 8 students	• The framework is designed succeed increase ability think analytical student. • Indicator ability think increased analytics includes: Ability identify pattern, Ability analyze connection between draft, Ability finish problem data- based	ability think analytical student can improved with learning media
2022 Samranchai	The Development of Augmented Reality Book to Promote Analytical Thinking on the Basic of Life Units for Secondary School	• The 3D visualizations and animations from AR help students grasp complex concepts like cell metabolism and organelle functions. • Students can better analyze connections in biology and recognize patterns in cellular structure and function, which was hard to understand with just text.	AR can help improve ability student AR can help science learning
Cabero Almenara 2019	Educational uses of augmented reality (AR): Experiences in educational science	• use of AR helps student understand difficult concepts with a better way interactive and visual. • Learning AR based allows student for interact with objects and simulations in time real, stimulating thinking critical and analytical.	AR can help improve ability analytical student AR can help science learning
Marine 2022	Mobile augmented reality learning media with Metaverse to improve student learning outcomes in science class.	• AR and Metaverse media help students deeply learn by visualizing scientific objects that can rotate, zoom, and be explored. • Students show improved abilities in remembering, analyzing, and applying science concepts after immersive virtual world experiences.	AR can help improve ability student AR can help science learning
Elbyaly 2023	The effectiveness of a program based on augmented reality on enhancing the skills of solving complex problems among students of the Optimal Investment	• Learning through AR allows student for see direct consequence from decision investment they, who help strengthen understanding they to concepts the.	AR can help improve ability student
Weng 2020	Enhancing students' biology learning by using augmented reality as a learning supplement	• Students using AR demonstrate improvement score posttest compared with those who only use method learning traditional • Most of the student feel AR makes things easier understanding draft complex and increasing interest they to biology.	AR can help improve ability student

Writer	Title	Research result	Code
Spicy 2020	What is the effect of using mobile augmented reality in K12 inquiry-based learning?	• AR helps students understand drafts better, boosts motivation to learn, and fosters interactive, collaborative environments. Success depends on infrastructure readiness, teacher training, and curriculum integration.	AR can help improve ability student
Chen 2020	Impacts of augmented reality and a digital game on students' science learning with reflection prompts in multimedia learning	• Students who use AR or digital games with *reflection prompts* show significant improvement in posttest compared group without *reflection prompts.* • AR more effective in help student visualize a complex concept, while more digital games Good in push exploration and extraction decision	AR can help improve ability student
Sahin 2020	The effect of Augmented Reality Technology on middle school students' achievements and attitudes towards science education	• Students using AR demonstrate a more positive attitude positive to science learning, including improvement interest and motivation For Study. • AR creates experience fun learning and reducing fear to eye lessons that are considered difficult.	AR can help improve ability student AR can help science learning
Purba 2022	The Effectiveness of Problem Based Learning Model on the Ability to Solve Mathematical Problems in terms of Students' Analytical Thinking Ability	• Student with ability think analytical tall get benefit more big from the PBL model compared with students who have ability analytical low. • Student with ability analytical low still show improvement, but with more speed slow.	ability think analytical student can improved with learning models

Discussion

How Augmented Reality (AR) helps science learning?

In the results, there are 20 journals with various discussions. This study focuses more on the results of the journals that have been collected. In the study, two codes were found that indicate that Augmented Reality (AR) can help learning. This is Because Augmented Reality (AR) gives experience learning more interactive and contextual (Herliandry dkk., 2021). In addition, water can help participants educate themselves for can feel more active with can feel or see virtually something is learned.

Augmented Reality (AR) Media helps create an atmosphere of interactive and collaborative learning (Nasongkhla dkk., 2019). Meanwhile, the code "AR can help science learning" has seven statements that state that water can help science learning. This code is the most apparent than the code others. This is because AR can used for show object or small and insignificant things can seen in a way visible eye like as it is cells, small organs in the body and still many others. AR also provides experience dynamic, visual, and immersive learning (Syawaludin dkk., 2019). Against the backdrop of science learning that requires observation things small and complex, then can concluded that water can help learning especially in science learning.

How influence Augmented Reality (AR) Against the Ability of Analytical Students in Science Learning?

Code found furthermore is Augmented Reality (AR) can increase the ability of students. This code is obtained from as many as 10 codes. The abilities described in the research found can increase the ability to understand draft critical reasoning special and analytical. Augmented Reality (AR) presents learning in detail so that can increase the ability of students in need of more details. While code that shows an ability to analyze can improve the use of Augmented Reality (AR) There are two journals. Journals show that Augmented Reality (AR) media provides visual images with details that can spur the student to increase ability analytic (Marini dkk., 2022) . There are two journals that state that ability analytical can increase the use of appropriate learning models/ media with objective learning. This strengthens that AR can also help increase the ability of the analytical student.

Need to know that indicator ability analytical that is the ability to differentiate (differentiating), organize (organizing), and connect (attributing) (Ware & Rohaeti, 2018). In the journal entitled Designing Framework of Augmented Reality Learning Environment to Promote Analytical Thinking for Grade 8 students, these three indicators can be met using AR. AR also provides learning that requires students to observe objects or small things, in the same form as the original so that students can analyze easily. This proves that AR can also improve students' analytical abilities.

In addition, it turns out that Augmented Reality (AR) can also increase student motivation and interest. Augmented Reality (AR) can create environment interactive learning as well as collaborative so that can interesting student for participate in learning. So from description the can seen that Augmented Reality (AR) can increase ability analytical student at the same time also can add motivation and interest student in learning.

Conclusion

Augmented Reality (AR) helps science learning, especially with complex materials that are not easily visible. AR provides interactive, visual learning environments and improves students' analytical abilities. This study suggests that AR can significantly enhance science learning. With proper technology integration into the curriculum, AR could transform science teaching and better prepare students for complex global challenges. Further studies should explore diverse geographical and cultural contexts to understand AR's global role.

Conflict Of Interest

The author declare no conflict of interest.

Author Contributions

Yuninda designed the research concept, developed the study design and methodology, and drafted the initial manuscript. Pujianto contributed to the literature review and interpretation of the research findings. Yuni conducted data collection and statistical analysis. Real performed editing, substantive revisions, and final validation of the manuscript. All authors have read and approved the final version of the article for publication.

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