APPLICATION OF AUGMENTED REALITY IN LEARNING THE CIRCULATORY SYSTEM: SYSTEMATIC LITERATURE REVIEW

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Abstract

The circulatory system is one of the topics in Biology that is difficult to understand. The learning method of reading and explaining is one of the reasons it is difficult to learn Biology material and is no longer suitable to be applied in the current era. This method seems monotonous, less interesting and boring because it does not actively involve students. Student activities only read learning books and listen to teacher explanations. Augmented Reality can be used as a media to help learn the circulatory system. This research aims to analyze previous research regarding the application of Augmented Reality (AR) in learning the circulatory system. The research method used in the analysis is a systematic literature review. The literature used uses a qualitative approach and the type of literature research. The author conducted a literature review study by finding journals that matched keywords and then selected 15 relevant English or Indonesian journals. The data obtained will be analyzed descriptively and thematically. Based on the analysis, it can be concluded that the application of Augmented Reality (AR) has positive benefits in the application of circulatory system learning media, including making the learning process easier, increasing students' interest and motivation to learn, and making the learning process more fun and interesting.

Keywords: Augmented Reality, Learning, Circulatory System

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INTRODUCTION

There are many case studies of ineffective learning in the classroom because students feel bored only as listeners (Setiawan and Hasan, 2021). The circulatory system is one of the biological materials that are abstract and difficult to understand. Understanding abstract languages in the field of natural science that have various scientific terms requires special reasoning. The learning process of science material on the circulatory system is only done by lecturing and question and answer. Limited learning resources and conventional learning models also cause a boring learning process so that students pay less attention (Rahmadan, et al, 2022). In addition, human circulatory system material is abstract material. Therefore, there is a need for assistive media that helps students and teachers in the learning process of human blood circulation with Augmented Reality (AR).

Research that conducts studies related to learning media for the topic of the human circulatory system has been done before. The previous research used a marker in the form of a Liver image which when scanned will display a 3D image of the Liver organ. Markers are also used to display 3D animation of organs. The AR concept is also combined with other media such as in the research of Dehghani et al. (2023) which combines infographics with AR for circulatory learning media. While in Ningrum's research, et al (2022) made electronic comics integrated with AR. The research shows that AR can increase student motivation, interest, and learning outcomes for human circulatory material. Augmented Reality techniques help students understand science learning objects more realistically with flexible time and memorable experiences, and increase interest in learning (Sudarmayana, et al, 2021).

Augmented Reality (AR) technology is the integration of two-dimensional or three-dimensional virtual objects into the virtual world in real time. AR technology can do three things: combine the digital world and the real world, enable real-time interaction, and accurately identify virtual and real objects (Oktaviani and Agus, 2024). Augmented Reality has advantages and disadvantages. The advantages of Augmented Reality are as follows: interactive, effective, easy to use, simple objects displayed, low manufacturing costs, and easy to use. In addition to having advantages, Augmented Reality also has disadvantages, such as its shape can be changed from certain angles easily, its applications are still few and that installation requires a lot of memory (Setiawan and Hasan, 2021).

The application of Augmented Reality (AR) as a learning medium is expected to improve students' reasoning and imagination.

METHODS
Research Design

The method used in this study is Systematic Literature Review (SLR). The aim is to see how current theories compare to theories discussed in the research literature. The literature consists of study findings or research results presented in scientific articles. The literature used uses a qualitative approach and the type of literature research. Electronic data literacy search engines such as Google Scholar and are used. Qualitative research is conducted because it is exploratory. After that, it is discussed further with the help of a review of relevant literature or libraries. This is used as a basis for creating new hypotheses, which will be used to compare findings or results from previous studies.

Research Objectives

The subjects in this study are to review 15 journals from 2020 to 2024 related to augmented reality on the human circulatory system.

Planning

Designing the type of journal to be reviewed and the methods to be used.

Data Collection Technique

Conducted a literature review study by finding journals that matched keywords and then selected 15 relevant English or Indonesian journals using Electronic data literacy search engines such as Google Scholar.

Data Analysis

The data obtained will be analyzed descriptively and thematically. Data obtained from journals will be summarized and analyzed to provide a clear picture of the characteristics or patterns in the data. Data in journals are also sought for similarities in patterns or recurring themes in the data.

RESULT AND DISCUSSION

The circulatory system is one of the Biology materials that is difficult to understand and complex. Many foreign terms and circulation processes must be memorized. The reading and explaining learning method is one of the reasons why it is difficult to learn Biology material. This method seems monotonous, less interesting, and boring because it does not involve students actively. Student activities are only reading textbooks and listening to the teacher's explanations. The scientific literacy ability of circulatory system material in Junior High School students in Pemalang, Central Java is included in

the low category with a percentage below 50% (Hasasiyah, et al. 2020).

Augmented Reality (AR) is the latest technology applied by realizing virtual objects such as images, videos, and audio into the real world and projecting them in real-time.

The application of Augmented Reality in learning has a positive impact on students and has the potential to attract and motivate students. Research on the role of Augmented Reality in learning the circulatory system is presented in Table 1.

Table 1. Research on the role of augmented reality in learning

The Researcher	The Results
Gnidovec, et al (2020)	The use of Augmented Reality of the human circulatory system in junior high school students shows that students are very enthusiastic and makes learning more interesting and enjoyable, improves learning, and makes it easy to use.
Sudarmilah & Asiyah (2020)	Augmented reality educational games on the human circulatory system can run well and can be an alternative learning media that is more varied, innovative, fun, and easier to use.
Kadaravut & Osman (2021)	Teaching with augmented reality applications shows positive responses from students. The use of AR also increases students' interest, and desire, and attracts attention. AR also has an impact on student achievement and attitudes.
Sontay & Karamustafaoğl (2021)	The application of augmented reality applications on body systems, one of which is the human circulatory system, has shown effectiveness in student understanding, increasing student motivation and making lessons fun.
Yusufa, et al. (2021)	The AR-based circulatory system learning media equipped with the IBL-Stem model was assessed by teachers and categorized as very feasible (96% percentage), so it can be implemented in classroom learning to improve junior high school students' scientific literacy in the human circulatory system material.
Limbong, et al. (2023)	The use of AR media in learning the human circulatory system shows great potential. Most students gave positive responses, considering AR media to be visually appealing, easy to understand, realistic and interactive visualizations, and can facilitate deeper understanding.
Sangi & Julius (2023)	The application of the ADDIE method in the development of AR-based learning media can be used as a learning medium for the circulatory system. There was an increase in the post-test value compared to the pre-test value with an N-Gain value of 0.5421 (categorized as moderate criteria).
Mukhoyyaroh, et al. (2023)	The learning module using Augmented Reality (AR) on the circulatory system material was declared very good (86.6%) by several experts including media experts (85.3%), material experts (90.2%) and language experts (84.3%).
Utomo,et al. (2023)	The implementation of Augmented Reality in science learning of the human circulatory system showed a score of 90%, indicating that it is easy to use, interactive, and interesting.
Apriliyani & Asep (2024)	Human circulatory system learning media using AR can display three-dimensional objects, and learning videos, log in and display student test features with 10 multiple-choice questions. The learning media has been tested on students with a percentage of 97.8% and can be very well received by students and teachers as learning materials in schools.
Agustin,et al.(2024)	The application of the use of augmented reality media shows an increase in concept understanding as evidenced by the calculation of the average n-gain of the experimental class of 0.45 categorized as moderate and the control class of 0.22 categorized as low.
Kerina, et al. (2024)	Augmented reality-based learning media for human circulatory system material shows that it can display 3-dimensional virtual shapes of heart, blood, and blood vessels. Augmented reality-based learning media can

	foster interest and ease in studying the circulatory systems.
Magfiroh,et al.(2024)	Augmented reality learning media can be used in learning. The average result of expert validation obtained a score of 90% with a very valid category. The practicality test obtained an average score of 93.8% with a very practical category based on practitioners and users in small group trials and field trials. The effectiveness test results were obtained at 94% (observer) with a very effective category. The N-Gain test obtained 2.77 with a very effective category. Thus, augmented reality learning media on human circulatory system material is feasible to use in reinforcing learning.
Sari, et al. (2024)	Augmented reality science learning media with Assemblr Edu obtained a valid feasibility of 0.84, practicality of 0.93, and effectiveness of 0.92. These results indicate that augmented reality-based science learning devices can be applied legally, realistically, and successfully.
Suhaida & Siti (2024)	The application of AR to blood circulation shows cognitive improvement results of 32.4% and psychomotor of 11.3%. In addition, it makes learning fun and gets positive responses from students.

CONCLUSIONS AND SUGGESTIONS
Conclusion

The application of Augmented Reality in learning the circulatory system has positive benefits in the application of circulatory system learning media, including facilitating the learning process, increasing students' interest and motivation to learn, and making the learning process more enjoyable and interesting. limitations in the use Augmented Reality in learning the circulatory system include

Augmented Reality is difficult for students to use, Augmented Reality is prone to the same problems that can affect any digital device, such as software glitches, hardware malfunctions and connectivity issues, and it is difficult to create and distribute Augmented Reality content.

Suggestions

The suggestion is better if the application of augmented reality to the material on the circulatory system is further developed with features related to the depth of the material concept so that the human circulatory process can be more realistic and easier for students to understand.

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