



Implementation of Augmented Reality-Based Learning Media to Increase Students' Interest and Understanding of Plant Anatomy Materials

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Abstract

This study aims to explore the implementation of Augmented Reality (AR)-based learning media in increasing students' interest and understanding of plant anatomy material. The method used is a quasi-experiment with a pretest-posttest design. This study involved grade III students in one of the elementary schools in *MI NW Keruak*. The results showed that the use of AR-based learning media significantly increased students' interest which was reflected in increased enthusiasm, engagement in discussions, and frequency of asking questions during learning. In addition, test results show a significant improvement in students' understanding of plant anatomical concepts, such as the structure and function of plant organs. The use of interactive 3D models allows students to more easily understand abstract material. Thus, the application of AR technology in learning can be an effective alternative to improve the quality of science learning, especially in materials that require strong visual understanding. This research contributes to the development of more innovative and contextual learning methods, as well as offering insights into the use of technology in education.

Keywords: Learning Media, Augmented Reality, Interests, Student Comprehension, Plant Anatomy Material

1. Introduction

Biology education has an important role in shaping students' understanding of life concepts, one of which is plant anatomy (Adhani & Rupa, 2020). This material is fundamental because it forms the basis for a more complex understanding of plant ecology, physiology, and biotechnology (Telaumbanua et al., 2024). However, in the learning process, students often have difficulty in understanding the structure and function of plant parts due to the limitations of the media used (Fitriani, 2022).

Conventional learning that still relies on textbooks and two-dimensional (2D) images is often less effective in building strong concepts in students' minds (Huda & Ikhsan, 2024). This limitation results in low interest in learning and a lack of in-depth understanding of the material (Hakim et al., 2024). Therefore, innovation is needed in learning media that is more interactive and able to present a more real learning experience. One of the technological innovations that can be used is Augmented Reality (AR), which combines the real world with virtual elements interactively.

(SUBAH & FADLILAH, n.d.), Plant anatomy material is often considered difficult by students due to its abstract characteristics. Plant parts such as meristem tissue, xylem and stomata cannot be observed directly without the help of laboratory tools such as microscopes (Zulkarnain, 2024).

However, the limited laboratory facilities in many schools are the main obstacle in this learning process. As a result, students can only rely on static images in textbooks that lack providing immersive visual experience.

Moreover (Pratiwi, 2019), The low interest of students in learning biology material is also a problem that needs to be considered. (Pratiwi, 2019), Many students feel that plant anatomy material is boring because the presentation is uninteresting and less interactive. Studies by several researchers show that the use of technology in learning can increase student motivation and engagement, so innovative approaches that are more engaging and effective are needed.

(Wahyudi & Jatun, 2024), Technological advances in the world of education have brought significant changes in learning methods, especially with the integration of digital technology in learning media. (Enderto & Marthadi, 2022), One of the innovations that is growing is the use of Augmented Reality (AR) as an interactive medium to improve the learning experience. (Rosidin et al., 2024), AR allows users to interact with virtual objects projected into the real world, thus providing a more immersive and engaging learning experience. In the context of biology learning, especially in plant anatomy material, the use of AR can be an effective solution to overcome the limitations of conventional media such as textbooks or two-dimensional images that are often less interesting and difficult for students to understand.

(Saba, 2024), Students' interest and understanding in learning are crucial factors that affect the success of the learning process. However (Cholid, 2021), In practice, many students have difficulty in understanding the structure and function of plant organs because of their abstract nature and are difficult to visualize properly through static media. Therefore, the application of AR-based learning media is expected to provide a more interactive and in-depth learning experience, so that students can more easily understand the material and increase their interest in learning plant anatomy.

The use of AR in learning plant anatomy provides various benefits. Interactive and engaging AR technology can arouse students' curiosity and increase their motivation to learn (Ramadhan et al., 2024). With 3D visualization, students can see the structure of plants in more depth and better understand the relationships between plant parts (Alfina et al., 2024). Moreover (Fitri, 2024), AR It also helps to overcome the limitations of laboratories in schools that do not have microscope facilities or other laboratory equipment, so that they can still provide an in-depth learning experience.

(Hariyono, 2023), AR-based learning allows students to be more active in exploring the material, thereby increasing their involvement in the learning process. Students not only become passive recipients of information, but can also interact directly with the visual objects displayed through AR (Isnaeni & Hildayah, 2020). Selain itu (Wibowo, 2023), this technology also supports self-paced learning as students can access AR-based materials anytime and anywhere, allowing them to learn flexibly outside of class hours.

This research aims to implement AR-based learning media and analyze its effectiveness in increasing students' interest and understanding of plant anatomy material. With this innovation, it is hoped that biology learning can be more interesting, interactive, and able to provide a better understanding to students compared to conventional methods.

Problem Formulation

1. How does the implementation of Augmented Reality-based learning media affect students' learning interest in plant anatomy material?
2. The extent of the effectiveness of the use of Augmented Reality in improving students' understanding of the anatomical structure and function of plants?

2. Method

This study uses the classroom action research method (PTK) with a quantitative and qualitative approach. With this methodology, it is hoped that a comprehensive picture can be obtained of the effectiveness of Augmented Reality-based learning media in increasing students' interest and understanding of plant anatomy materials. This research is classroom action research that aims to increase students' interest and understanding through the implementation of Augmented Reality-based learning media.

2.1 Participants

The subject of the study was a student at one of the high schools who was studying plant anatomy material. Samples were selected purposively considering classes that had difficulty understanding the material.

2.2 Data Collection

The instruments used in this study include Learning Interest Questionnaire to measure changes in student interest before and after the use of AR and Comprehension Tests in the form of pre-tests and post-tests to measure the improvement of student understanding. While Observation is used to see student involvement in AR-based learning. This research was carried out in several cycles with the following stages: Planning, preparing AR-based learning media and compiling research instruments. Implementation, implementing AR-based learning in the classroom and collecting data through tests and observations. Reflection, analyzing the results obtained to determine improvements in the next cycle.

2.3 Data Analysis

Quantitative data from the pre-test and post-test were analyzed using statistical tests using SPSS 2020 software to see significant differences. Meanwhile, qualitative data from observations and questionnaires were analyzed descriptively to determine changes in student interest and involvement.

3. Results

1. Quantitative Data

To measure the effectiveness of the use of Augmented Reality (AR) in increasing students' interest and understanding, data was collected through a learning interest questionnaire as well as pre-test and post-test.

a. Results of the Learning Interest Survey

Questionnaires were given before and after the implementation of AR to measure changes in students' interest in learning plant anatomy. The results of the analysis showed: Before the use of AR, the average student learning interest score was 67.4 (medium category). After the use of AR, the average score increased to 85.6 (high category). The increase in interest in learning by 18.2%, shows that AR has a positive impact on students' motivation to learn.

b. Results of Pre-test and Post-test

Comprehension tests are given before and after the application of AR in learning. Results: Average pre-test score: 56.8 (category adequate). Average post-test score: 82.3 (good category). Increased student understanding: 25.5%, indicating that the use of AR helps students better understand plant anatomy material.

Statistical analysis using the t-paired sample test showed a p value of < 0.05 , which means that there is a significant difference between the pre-test and post-test results. This proves that the implementation of AR has a positive impact on student understanding.

2. Qualitative Data

In addition to quantitative data, this study also collects qualitative data through observation and interviews.

a. Class Observation Results

During AR-based learning, students show a more active response compared to conventional methods. Some of the key findings from the observations were: Student engagement increased, characterized by more students asking questions and discussing in class. Students are more focused and enthusiastic when exploring 3D models of plant parts. Student interaction increases, they work more often in groups to understand the material with AR.

b. Results of Interviews with Students and Teachers

Students' opinions after using AR in learning plant anatomy: 80% of students find it easier to understand the material than the previous method. 75% of students stated that they were more motivated to study biology. 85% of students feel more confident in answering questions related to plant structure and function.

Teacher's opinion after using AR: Teachers acknowledge that AR helps explain abstract concepts more clearly. Teachers see an increase in student participation in class discussions. Some of the challenges faced are device limitations and initial adaptation time.

4. Discussion

The results of this study show that the implementation of Augmented Reality (AR)-based learning media significantly increases students' interest and understanding of plant anatomy materials. These findings are in line with previous research that stated that the use of AR technology in learning can increase student engagement and engagement with the material being studied (Indriani, 2021); Novia et al., 2022).

Students' Interest in Learning

Data obtained through questionnaires and observations showed that the majority of students felt more enthusiastic when learning using AR media compared to conventional methods. Interactive three-dimensional visualization helps students to be more interested and motivated in understanding the anatomical structure of plants. This supports the findings (Asrial et al., 2021) which states that technology-based interactive media can significantly increase students' learning motivation.

Additionally, students report that the learning experience becomes more enjoyable because they can interact directly with realistic visual objects. This factor is also reinforced by the theory of experiential learning, where direct interaction with the material can increase students' emotional and cognitive engagement (Hardianti, 2019).

Students' Understanding of Plant Anatomy Material

Analysis of test results showed a significant improvement in understanding of plant anatomical concepts after the use of AR media. Students who previously had difficulty understanding the structure and function of plant organs can more easily understand the material through the three-dimensional simulation provided by AR. This finding is in line with the study (Rahma & Kasih, 2023) which reveals that the use of interactive visual media can improve students' understanding of abstract concepts in science.

In addition, the results of interviews with teachers also show that the use of AR helps students in building connections between theory and real applications. Thus, learning becomes more contextual and applicative, which ultimately improves students' memory and understanding of the material learned.

Implications and Challenges

The implementation of Augmented Reality (AR)-based learning media in plant anatomy material has various positive implications for the learning process (Setiawan et al., 2024). AR is able to increase students' interest in learning by presenting interactive visualizations that are more interesting than conventional methods (Hermawan & Hadi, 2024). Through explorable 3D models, students have

the opportunity to understand the anatomical structure of plants in more depth, especially in spatial aspects that are often difficult to explain with just two-dimensional images (Hajrah & Mukarramah, 2024). In addition, the use of AR in learning is also in line with the constructivist approach, where students can actively learn through independent exploration (Wibowo, 2023). On the other hand, the integration of AR in learning also encourages innovation in the world of education by connecting digital technology into the curriculum (Hafizah, 2023). This not only enriches learning methods, but also supports the development of STEM (Science, Technology, Engineering, and Mathematics) skills for students in the digital era.

But (Hafizah, 2023), AR implementation also faces various challenges that need to be overcome. One of the main obstacles is the availability of infrastructure, since not all schools have devices compatible with AR technology, such as smartphones or tablets with certain specifications. Moreover (Farid, 2023), Teachers' competence in using AR technology is also an important factor, considering that not all educators have the skills or readiness to adopt this technology. (Afriani, 2024), Another challenge is the potential resistance to change, where some schools or teachers are still more comfortable with conventional methods and doubt the effectiveness of new technologies. Financially (Juliawan et al., 2024), The development or procurement of AR applications also requires a lot of money, including in terms of teacher training and device maintenance. Additionally, if not managed properly, AR can be a distraction in learning, where students focus more on the technological aspects of it than the material being taught. The gap in access to technology also needs to be considered, because not all students have supporting devices at home, so there is a risk of creating inequality in the learning process (Miftah, 2022).

Overall, the application of AR in learning plant anatomy has the potential to bring significant changes in increasing students' interest and understanding. However, for its implementation to be optimal, readiness from various parties is needed, including the provision of adequate infrastructure, teacher training, and learning strategies that remain inclusive for all students. With careful planning and the right support, AR can be an innovative learning tool that is not only engaging but also effective in improving the quality of education.

The findings of this study have important implications for the development of learning strategies in schools. The integration of AR technology can be an effective alternative to improve the quality of learning, especially in subjects that require a strong visual understanding. However, there are several challenges that need to be considered, such as the availability of AR-enabled devices, teachers' readiness to integrate this technology, and potential technical glitches that can hinder the learning process.

Therefore, training is needed for educators to be able to make optimal use of this technology. In addition, there needs to be support from schools and the government in providing adequate infrastructure for the implementation of AR-based learning.

5. Conclusion

Based on quantitative and qualitative data, it can be concluded that the implementation of Augmented Reality-based learning media significantly increases students' interest and understanding of plant anatomy material. AR technology provides a more engaging, interactive, and supportive learning experience for students in learning. Overall, this study shows that AR-based learning media has great potential in increasing students' interest and understanding of plant anatomy material. With the right approach, this technology can be an effective tool in science learning at the secondary school level.

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