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# Augmented Reality Media in Human Respiratory System Learning Materials: A Literature Review

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**Abstract**
*Augmented Reality (AR) is a promising learning medium that integrates virtual objects into real environments to support interactive and immersive learning, particularly for abstract topics such as the human respiratory system. This study aims to analyze the characteristics and effectiveness of AR-based learning media through a literature review. A total of 15 peer-reviewed articles published between 2020 and 2025 were systematically analyzed. The review focuses on types of AR media, research designs, educational levels, and their impacts on learning outcomes. The results show that AR media are predominantly developed using Research and Development (R&D) approaches, especially the ADDIE model, and are widely applied at elementary and junior high school levels. AR consistently improves conceptual understanding, learning motivation, critical thinking skills, and spatial visualization. Therefore, AR is recommended as an effective and scalable medium for enhancing science learning, particularly in teaching abstract biological concepts.*
***Keywords:*** *Augmented Reality, Learning Media, Human Respiratory System, Science Education, Literature Review*

**Abstrak**
Augmented Reality (AR) merupakan media pembelajaran yang menjanjikan dengan mengintegrasikan objek virtual ke dalam lingkungan nyata untuk mendukung pembelajaran yang interaktif dan imersif, khususnya pada topik abstrak seperti sistem pernapasan manusia. Penelitian ini bertujuan untuk menganalisis karakteristik dan efektivitas media pembelajaran berbasis AR melalui studi literatur. Sebanyak 15 artikel jurnal bereputasi yang dipublikasikan pada tahun 2020–2025 dianalisis secara sistematis. Kajian ini berfokus pada jenis media AR, desain penelitian, jenjang pendidikan, serta dampaknya terhadap hasil belajar. Hasil menunjukkan bahwa media AR didominasi oleh pendekatan Research and Development (R&D), khususnya model ADDIE, dan banyak diterapkan pada jenjang sekolah dasar dan menengah pertama. AR secara konsisten meningkatkan pemahaman konsep, motivasi belajar, kemampuan berpikir kritis, dan visualisasi spasial. Oleh karena itu, AR direkomendasikan sebagai media yang efektif dan skalabel untuk meningkatkan pembelajaran sains, khususnya pada konsep biologi yang abstrak.

**Kata kunci:** Augmented Reality, Media Pembelajaran, Sistem Pernapasan Manusia, Pendidikan Sains, Studi Literatur

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## INTRODUCTION

Education plays a crucial role in helping learners develop meaningful and sustainable understanding of learning concepts (Jang et al., 2021). In elementary science education, students are not only expected to memorize content but also to understand processes, causal relationships, and scientific phenomena occurring in their surrounding environment (Rini et al., 2022). A solid conceptual understanding serves as the foundation for developing higher-order thinking skills, such as analysis and problem-solving (Prananta et al., 2024). Therefore, science learning processes need to be carefully designed to support students in constructing comprehensive conceptual understanding rather than relying on verbalistic learning (Wardani et al., 2024; Prananta et al., 2024).

One science topic that requires a high level of visualization is the human respiratory system. This topic includes the structure of respiratory organs, the functions of each organ, and the mechanisms of inspiration and expiration, which cannot be directly observed by students. As a result, students often experience difficulties in visualizing how the respiratory system works when learning relies solely on verbal explanations or two-dimensional images. Learning that still depends on conventional media, such as textbooks, tends to limit students' deep conceptual understanding, which in turn affects learning outcomes (Sari et al., 2020).

The rapid development of information and communication technology has created significant opportunities for education to introduce more innovative and interactive learning media. One technology that has been increasingly developed in the educational field is Augmented Reality (AR). AR technology integrates virtual objects into the real environment in real time, allowing students to interact directly with learning objects. The use of AR in science learning is considered effective in helping students understand abstract concepts in a more concrete and engaging manner (Putri et al., 2021).

The application of augmented reality–based learning media in teaching the human respiratory system offers a different learning experience compared to conventional instruction. Through three-dimensional visualization, students can observe the structure of respiratory organs from various perspectives and gain a clearer understanding of the relationships among organs. This learning approach supports students in developing deeper and more meaningful conceptual understanding. Previous studies have shown that the use of AR-based media in learning the human respiratory system significantly improves students' conceptual understanding (Handayani et al., 2022).

In addition to enhancing conceptual understanding, augmented reality–based learning media also have a positive impact on students' motivation and engagement. Interactive and visually rich learning experiences increase students' interest and enthusiasm in learning activities. Students become more actively involved in asking questions, participating in discussions, and engaging directly in the learning process. These conditions indicate that AR-based learning media can create an enjoyable and non-monotonous learning environment (Kurniawan et al., 2023).

Based on these findings, augmented reality–based learning media have great potential to support science learning in elementary schools, particularly in the topic of the human respiratory system. AR media not only help students understand abstract concepts more concretely but also enhance motivation and active participation in learning. However, previous studies on the use of augmented reality in science education are still fragmented and tend to focus on specific aspects, such as media development, effectiveness testing, or particular learning outcomes, without providing a comprehensive synthesis of findings across studies (Prananta et al., 2024; Lahagu et al., 2024). In addition, research on AR in the context of the human respiratory system is often conducted separately with varying methodologies and educational settings,

making it difficult to obtain an integrated understanding of its overall effectiveness. Therefore, a comprehensive review is needed to analyze the use of augmented reality–based learning media in teaching the human respiratory system. This study aims to analyze the implementation of augmented reality–based learning media in human respiratory system instruction through a literature review approach, in order to provide an overview of the effectiveness of AR media in elementary science education.

## METHOD

This study employed a literature review research method. A literature review is a research approach aimed at systematically identifying, evaluating, and synthesizing findings from previous studies relevant to a particular research topic (Prananta et al., 2024). Through a literature review, researchers can obtain a comprehensive overview of research developments, key findings, and existing research gaps that require further investigation (Lahagu et al., 2024).

The data sources for this study consisted of national and international journal articles discussing the use of augmented reality (AR)–based learning media in teaching the human respiratory system. The articles were selected based on several criteria, including relevance to the research focus, recency of publication, and source credibility. The analyzed articles were scientific publications published between 2020 and 2025 and covered various educational levels, with a primary focus on elementary and secondary education.

Data collection was conducted by searching for relevant articles in scientific journal databases such as Google Scholar, DOAJ, and ResearchGate, using keywords including *augmented reality*, *learning media*, *human respiratory system*, and *science learning*. The exclusion criteria in this study included articles that were not published in peer-reviewed journals, studies not written in English or Indonesian, articles that did not focus on augmented reality in science learning, studies unrelated to the human respiratory system topic, and publications with incomplete or inaccessible full texts. The search process yielded a number of articles, which were then screened based on their relevance to the research topic and objectives. A total of 15 articles that met the inclusion criteria were selected for in-depth analysis.

The data analysis technique used in this study was content analysis. Content analysis involved examining the research objectives, methodologies, types of augmented reality media, educational levels, and the main results and findings reported in each article. The analysis results were then synthesized to identify patterns, trends, and the impacts of using augmented reality–based learning media in teaching the human respiratory system.

## RESULTS AND DISCUSSION

Based on the literature review method employed in this study, 16 scientific articles relevant to the use of augmented reality (AR)–based learning media in teaching the human respiratory system were analyzed. These articles were published in both national and international journals over the past ten years. The analysis focused on the research objectives, methodologies, and key findings in order to obtain a comprehensive understanding of the effectiveness of AR media in human respiratory system learning.

The initial stage of article collection involved searching various scientific journal sources based on the alignment of the research variables, namely augmented reality learning media and the human respiratory system topic. From the articles identified through this process, 16 studies met the relevance and recency criteria and were selected for further analysis. The results of the analysis are presented in the form of a synthesis table, as shown in Table 1, which summarizes the key characteristics and findings of the selected studies.

**Table 1. Summary of Research Findings**

| No | Author & Year | Title | Research Objective | Method | Results |
|---|---|---|---|---|---|
| 1 | Alfiana & Purbawanto (2021) | Learning Media for the Human Respiratory System Using Android-Based Augmented Reality (AR | Developing Android-Based AR Media | R&D | The results indicate that augmented reality (AR)–based learning media effectively support students' understanding of the structure and functions of the human respiratory system by providing concrete three-dimensional visualizations. The developed media were considered user-friendly and capable of attracting students' attention during the learning process. Based on feasibility testing, the AR media were found to be valid and suitable for use as instructional media in elementary science education. |
| 2 | Rusli et al. (2023) | Augmented Reality for Studying Hands on the Human Body for Elementary School Students | Developing AR Media for Human Body Anatomy | Experiment | This study demonstrates that the use of augmented reality (AR) media provides a more interactive learning experience compared to conventional instruction. Students are able to directly observe the structure of the human body through three-dimensional objects, which enhances their conceptual understanding. Learning outcomes indicate increased student engagement and improved understanding following the implementation of AR-based media |

| No | Author & Year | Title | Research Objective | Method | Results |
|---|---|---|---|---|---|
| 3 | Nasher & Aditya (2022) | Application of Android-Based Augmented Reality (AR) Technology in the Human Respiratory System | Developing Marker-Based AR Tracking | R&D | Marker-based tracking augmented reality (AR) media are able to present human respiratory organs in a realistic and detailed manner. The use of this media increases students' interest in learning due to its interactive visual presentation. Trial results indicate that AR-based media support students in understanding respiratory system concepts more effectively than conventional learning media |
| 4 | Hayyuna et al. (2023) | 3D AR Learning Media on Human Respiratory Organs to Train Science Process Skills | Developing Science Process Skills | Experiment | The developed 3D augmented reality (AR) learning media were effective in fostering students' science process skills through activities involving observation, measurement, and analysis. Students demonstrated improved abilities to systematically observe and identify human respiratory organs. The findings revealed a media feasibility level of 92.6% and an improvement in science process skills with an N-gain value of 0.58, categorized as moderate. |
| 5 | Pamorti et al. (2024) | Effectiveness of AR Based Learning Media to Improve | Evaluating the Effectiveness of Augmented Reality (AR) in Enhancing | Experiment | The results indicate that the use of augmented reality (AR)–based media significantly enhances students' |

| No | Author & Year | Title | Research Objective | Method | Results |
|---|---|---|---|---|---|
| | | Critical Thinking Skills on IPAS Material | Critical Thinking | | critical thinking skills. AR-based instruction encourages students to analyze information and develop a deeper understanding of concepts. The average score of the experimental class reached 75.98, which was higher than that of the control class, which achieved an average score of 58.80. |
| 6 | Maimuna et al. (2024) | AR-Based Student Worksheet on Human Respiratory System | Developing Augmented Reality (AR)-Based Learning Worksheets | R&D (ADDIE) | The developed AR-based student worksheet (LKPD) was effective in improving students' conceptual understanding of the human respiratory system through interactive learning activities. This media helped students connect theoretical concepts with realistic visualizations. Validation results indicated a validity level of 92% and an improvement in learning outcomes with an N-gain value of 0.55, categorized as moderate. |
| 7 | Anggraeni et al. (2024) | Development of Augmented Reality (AR) Media for Mastery of the Respiratory System | Improving Science Learning Outcomes | R&D | The developed augmented reality (AR) media were effective in improving fifth-grade students' mastery of human respiratory system content. Students were able to understand the concepts more easily due to the visual and interactive presentation of the learning materials. Evaluation results demonstrated an |

| No | Author & Year | Title | Research Objective | Method | Results |
|---|---|---|---|---|---|
| | | | | | improvement in learning outcomes following the implementation of AR-based media in instruction. |
| 8 | Lahagu et al. (2024) | Application of Augmented Reality (AR) Technology in Learning the Human Respiratory System | Examining the Utilization of Augmented Reality (AR) | Literature Review | The literature review findings indicate that augmented reality (AR) technology has significant potential in teaching the human respiratory system. The three-dimensional visualizations provided by AR help students gain a deeper understanding of the structure and functions of respiratory organs. In addition, AR enhances students' interest and learning motivation by offering more engaging learning experiences |
| 9 | Ridho & Setyasto (2024) | Development of Android-Based AR Learning Media on Human Respiratory System | Developing Android-Based Augmented Reality Learning Media | R&D | Android-based augmented reality (AR) learning media were proven to be effective in improving students' learning outcomes. Students demonstrated enhanced conceptual understanding after using the developed learning media. The analysis results showed an increase in posttest scores of 33.37 points with an N-gain value of 0.73, categorized as high |
| 10 | Fauni & Isdaryanti (2025) | Development of Flipbook Assisted by AR Media on Human Respiratory System | Development of an Augmented Reality (AR)-Assisted Flipbook | R&D | The AR-assisted flipbook was able to present human respiratory system content in an engaging and easily understandable manner. This media integrates text, images, and three-dimensional |

| No | Author & Year | Title | Research Objective | Method | Results |
|---|---|---|---|---|---|
| | | | | | visualizations, thereby enhancing student engagement. The study results indicated expert feasibility ratings exceeding 90% and an improvement in learning outcomes with an N-gain value of 0.71, categorized as high. |
| 11 | Fajrin et al. (2025) | The Effect of Augmented Reality (AR) on Science Learning Outcomes of Fifth-Grade Students | Evaluating the Effectiveness of Augmented Reality (AR) | Experiment | The results indicate that the use of augmented reality (AR) media has a positive impact on elementary students' science learning outcomes. Students were more active and enthusiastic during the learning process. The analysis revealed a significant improvement in students' learning outcomes following the implementation of AR-based media |
| 12 | Safa & Hardiyantari (2025) | Development of Augmented Reality (AR)-Based Learning Media for the Human Respiratory System | Developing Augmented Reality (AR) Learning Media | R&D | The developed augmented reality (AR)–based learning media effectively support the science learning process. These media assist students in understanding human respiratory system content through interactive visualizations. Feasibility testing results indicated that the AR media were valid and appropriate for use in instructional settings. |
| 13 | Alifah et al. (2025) | AR-Based Science Learning Design on Human Respiratory System | Designing Augmented Reality (AR)-Based IPAS Learning | R&D | AR-based learning design is able to improve the quality of science learning on the topic of the human respiratory system. AR visualization helps students |

| No | Author & Year | Title | Research Objective | Method | Results |
|---|---|---|---|---|---|
| | | | | | understand abstract concepts by making them more concrete. The research results indicate that AR learning design is effective in enhancing students' conceptual understanding. |
| 14 | Dilviana et al. (2025) | PBL Assisted by AR on the Respiratory System Topic | Examining Problem-Based Learning (PBL) Assisted by Augmented Reality (AR) | Quasi-Experimental Design | AR-based instructional design was effective in improving the quality of science learning on the human respiratory system topic. AR visualizations helped transform abstract concepts into more concrete representations, thereby facilitating students' conceptual understanding. The findings indicate that AR-based instructional design effectively enhances students' conceptual comprehension. |
| 15 | Hayyuna et al. (2023) | 3D AR Learning Media on Human Respiratory Organs | Enhancing Science Skills | Experiment | AR-based media help students understand respiratory system concepts through direct observation of three-dimensional objects. Learning becomes more meaningful as students are actively involved in the learning process. The results indicate that AR media are effective in enhancing students' science process skills. |
| 16 | Rusli et al. (2023) | AR for Studying Hands-on the Human Body | Visualization of Human Anatomy | Experiment | The use of augmented reality (AR) in teaching human body anatomy provides a more realistic learning experience. |

| No | Author & Year | Title | Research Objective | Method | Results |
|---|---|---|---|---|---|
| | | | | | Students are able to observe organ structures in detail through three-dimensional visualizations. The findings indicate improvements in students' conceptual understanding and active participation during the learning process. |

Based on the analysis of the 16 selected articles examining the use of augmented reality (AR)–based learning media in teaching the human respiratory system, several key findings were identified. Overall, the reviewed studies indicate that the integration of AR contributes positively to elementary science (IPAS) learning. The findings can be categorized into three main themes: enhancement of conceptual understanding, increased student motivation and engagement, and effectiveness of AR media on learning outcomes.

1. Conceptual Understanding of the Human Respiratory System
   Most of the analyzed studies emphasize that AR-based learning media effectively support students in understanding the abstract concepts of the human respiratory system. The presentation of learning content through three-dimensional visualization allows students to observe the structure and functions of respiratory organs more concretely than through two-dimensional images or verbal explanations alone. As a result, students do not merely memorize concepts but develop deeper and more meaningful conceptual understanding.
   These findings are supported by Ridho and Setyasto (2024), who reported a significant improvement in students' learning outcomes after the implementation of Android-based AR media, with a posttest score increase of 33.37 points and an N-gain value of 0.73, categorized as high. Similarly, Alifah et al. (2025) found that AR-based science learning designs strengthened students' understanding of the human respiratory system by providing interactive visualizations that were contextualized to students' everyday experiences.
2. Motivation and Engagement in Learning
   The literature review also reveals that AR-based learning media positively affect students' affective aspects, particularly learning motivation and engagement. AR creates a more engaging learning environment through dynamic and interactive visual displays, encouraging students to actively participate in learning activities.
   Dilviana et al. (2025) demonstrated that the integration of Problem-Based Learning (PBL) with AR significantly increased students' learning motivation, reaching 76.36%, which falls into the high category. Furthermore, students exhibited higher levels of engagement in discussions, observations, and problem-solving activities related to the human respiratory system. These findings suggest that AR plays an important role in fostering student-centered learning in elementary science education.
3. Effectiveness of AR Media on Learning Outcomes
   Most experimental and quasi-experimental studies reviewed conclude that AR-based learning media are more effective than conventional instructional methods in improving students' learning outcomes. AR enables students to explore learning

materials independently and actively, making the learning process more meaningful and effective.

Hayyuna et al. (2023) reported that the 3D AR learning media for human respiratory system topics achieved a feasibility rate of 92.6% and improved students' science process skills, with an N-gain value of 0.58 (moderate category). These findings are reinforced by Pamorti et al. (2024), who found that the average score of students taught using AR media (75.98) was significantly higher than that of students taught using conventional methods (58.80). These results confirm that the use of AR media has a substantial impact on improving elementary students' science learning outcomes.

Despite the positive findings, this study has several limitations. First, the review included only 16 articles related to the human respiratory system and AR-based learning media, which may not fully represent all existing national and international research. Second, as a literature review, this study did not involve direct empirical data collection in classroom settings. Additionally, contextual factors such as technological infrastructure availability, teachers' digital competencies, and students' readiness across different elementary schools could not be examined in depth

Based on the discussion, it can be concluded that the implementation of augmented reality (AR) technology in elementary science learning, particularly in teaching the human respiratory system, has a positive impact on both the learning process and outcomes (Ridho & Setyasto, 2024; Fajrin et al., 2025). AR-based learning media have been shown to enhance conceptual understanding, increase student motivation, and significantly improve learning outcomes (Pamorti et al., 2024; Hayyuna et al., 2023; Alifah et al., 2025).

Therefore, the integration of AR can be considered a promising innovative instructional approach aligned with the demands of 21st-century learning. Future research is recommended to involve broader datasets, empirical classroom investigations, and contextual analyses to further explore the effectiveness and scalability of AR-based learning media in elementary science education.

## CONCLUSION.

Based on the findings of this literature review, it can be concluded that augmented reality (AR)–based learning media have significant potential in improving the quality of science education, particularly in teaching the human respiratory system. The reviewed studies indicate that AR-based media are predominantly developed using Research and Development (R&D) approaches, especially the ADDIE model, and are widely implemented at elementary and junior high school levels.

Furthermore, the use of AR consistently demonstrates positive effects on students' conceptual understanding, learning motivation, critical thinking skills, and spatial visualization abilities. Through interactive and three-dimensional visualization, AR is able to transform abstract biological concepts into more concrete and meaningful learning experiences.

This study provides a focused synthesis of recent empirical findings on the integration of AR in human respiratory system learning, highlighting both its pedagogical potential and current research trends. Therefore, augmented reality can be recommended as an effective and scalable learning medium to support science learning, particularly in addressing abstract concepts in biology.

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