Sosioedukasi
JURNAL ILMIAH ILMU PENDIDIKAN DAN SOSIAL
ISSN: 2086-6135 E-ISSN: 2541-612x
Volume 15 No. 2. Juni 2026 https://ejournal.unibabwi.ac.id/index.php/sosioedukasi/index

# SYMBOLIC INTERACTIONISM IN THE TRADITIONAL WEDDING CEREMONY OF THE PEOPLE OF TEMPIRAI VILLAGE, PALI DISTRICT

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**ARTICLE HISTORY**
**Received : 20-01-2026**
**Revised : 07-02-2026**
**Accepted : 15-04-2026**

**KEYWORDS**
Marriage Ceremony;
Tempirai Village;
and Symbolic Interaction;

**ABSTRACT**
This study aims to determine the role of symbolic interactionism in the marriage ceremony of the Tempirai village community. This research uses a qualitative approach through the use of case study methodology. Data collection methods were conducted through observation, in-depth interviews, and documentation. This research uses data reduction, data presentation, and conclusion making as its data analysis approach. The results of this study show that the traditional marriage ceremony procession of the Tempirai village community begins with the process of gathering the nuclear family, proposal, invitation notification, mipis bumbu, simbang ngambik, marriage contract, mapak, and tandang sujud. Secondly, the process of symbolic interactionism in the traditional marriage ceremony in Tempirai community includes the procession of making kanjang by prospective bride groom, process invitation notice with mokon, and honest sen or request of the bride-to-be to the groom-to-be.



## INTRODUCTION

Students' understanding of science materials in elementary schools is one of the main challenges in learning science science. Comprehension is defined as the cognitive ability to interpret, classify, summarize, deduce, compare, and explain a concept according to the second level of the Revised Bloom Taxonomy (Anderson & Krathwohl, 2001). Students' low understanding of abstract materials such as the Human Respiratory System has the potential to hinder the mastery of the IPAS competencies required in the Independent Curriculum.

Human Respiratory System material is one of the topics in the IPAS Class V subject which has a high level of abstraction. Respiratory organs such as the trachea, bronchi, bronchi, and alveolus cannot be observed directly by the sense of sight, so they require learning media that is able to visualize these anatomical structures in a concrete and interactive manner. The results of observations and interviews at SDN 2 Sokaraja Tengah, Banyumas Regency, show that the learning process of IPAS is still going on expositorily by relying on textbooks and whiteboards as the main media, so that students have difficulty visualizing the abstract respiratory organs. This condition has an impact on the low understanding and interest in learning of students in the material taught.

Elementary School Class V students are in the age range of 10–11 years in the concrete operational stage according to Piaget's theory of cognitive development (1952). The unique and diverse developmental characteristics of elementary school age students, including cognitive, emotional, social, and motor aspects, need to be deeply understood by educators so that the learning designed is truly tailored to their needs (Andriani & Muntohar, 2022). At the concrete operational stage, students still urgently need the help of concrete objects and direct experience to understand abstract concepts. *Augmented Reality* (AR)-based interactive learning media is specifically able to present a concrete learning experience through three-dimensional visualization, so that it is very in line with the characteristics of the cognitive development of elementary school students. A better understanding of the material of the Human Respiratory System is expected to improve the cognitive abilities of students at the C2 level which includes the ability to interpret, classify, summarize, conclude, compare, and explain (Anderson & Krathwohl, 2001).

Augmented *Reality* (AR) technology comes as an innovative solution that allows the incorporation of three-dimensional virtual objects into the real environment in real-time. Unlike Virtual Reality, which completely replaces the real world, AR only adds a layer of digital information on top of the real environment so that users remain aware of the surrounding environment (Hadi, 2023). Through AR technology, students can observe three-dimensional models of respiratory organs from various perspectives, read the information labels of each part of the organ interactively, and compare healthy and unhealthy lung conditions directly on their study desks using mobile devices.

The application of AR in education has been shown to increase learning motivation, facilitate the understanding of abstract concepts, and encourage active involvement of learners (Ibáñez & Delgado-Kloos, 2018; Koumpouros, 2024). Tekedere & Göke (2016) through meta-analysis found that AR applications have a significant positive impact on learning outcomes and student attitudes. Munir (2024) developed AR media for digestive system organ materials that succeeded in improving the motivation and learning outcomes of Class V SD/MI students. Gutama & Winanto (2025) developed water cycle AR media that was proven to help Class V elementary school students understand abstract concepts visually and interactively. Maziyah & Zumrotun (2025) developed AR-based magic card media in Grade 5 elementary school ecosystem materials that have been proven to be feasible, practical, and effective in improving learning outcomes, and Lestari & Setyasto (2025) developed AR-assisted e-learning teaching materials in science subjects that show very feasible and effective results. The development of technology-based media in elementary schools in general has proven to consistently produce decent products, as shown by Arwanda et al. (2020) in the development of Articulate Storyline media which obtained a student response of 4.6 (Very Good) and Dewi, Irianto, & Andriani (2020) in the development of mathematics teaching materials that obtained expert validation of 4.5 (Excellent).

The objectives of this research are: (1) to develop Augmented Reality (AR)-based IPAS learning media on human respiratory system materials; (2) analyzing the validity of AR-based learning media; (3) Testing the practicality of AR-based learning media; (4) testing the effectiveness of AR-based learning media in improving student learning outcomes; and (5) Analyze the difference in learning outcomes between the use of AR-based media and expository learning. The novelty of this research lies in the specific focus of the development of AR media for Human Respiratory System materials through the integration of three digital platforms, namely Assemblr Studio, ChatGPT, and Canva, which has never been done in previous studies.

## METHODS

This research is research and development or Research and Development (R&D), which is a type of research that aims to produce certain products as well as test the effectiveness of the product (Sugiyono, 2016). The R&D approach has been proven to produce quality and suitable learning products in elementary schools, as shown by

Arwanda, Irianto, & Andriani (2020) in the development of Articulate Storyline media and Dewi, Irianto, & Andriani (2020) in the development of mathematics teaching materials. The R&D approach was chosen because this research is product-oriented that can be directly utilized in the context of real learning. The development model used is ADDIE (Analysis, Design, Development, Implementation, Evaluation) which was chosen because it is systematic, structured, and each stage provides feedback that can be used to iteratively improve the previous stage (Lukman et al., 2021). The research was carried out at SDN 2 Sokaraja Tengah, Banyumas Regency, Central Java, in January-March 2026.

The research subjects consisted of two groups. Class VA (n = 26) acted as an experimental class that received learning using AR-based IPAS media, while Class VB (n = 28) acted as a control class that received learning by expository method. The group division was carried out without randomization because it used a Nonequivalent Control Group Design, which is a quasi-experimental design where both classes were given a pretest before implementation and a posttest after implementation (Sugiyono, 2016). The product validator consists of two experts from the University of Muhammadiyah Purwokerto, namely Dr. Beny Wijanarko K., M.Si. as a media expert validator and Dr. Gunawan as a material expert validator.

Data collection was carried out through four techniques. First, expert validation uses a media expert validation sheet (20 items) which covers aspects of display, material content, and use, and a material expert validation sheet (20 items) which includes aspects of material content, question items, language, and usefulness. Second, a teacher response questionnaire (20 items) and a student response questionnaire (20 items) to measure the practicality of the product. Third, the learning outcome test is in the form of 37 multiple-choice pretest and posttest questions that have been tested on 43 students outside the research subject. The test instrument test included a validity test using Product Moment correlation, a reliability test using the Kuder-Richardson formula 20 (KR-20), a difficulty level test, and a differentiating power test (Arikunto, 2012), resulting in 37 valid questions out of 40 questions tested. Fourth, observation and interviews at the stage of analysis need to dig up information about learning conditions in the field.

Data analysis is carried out in stages according to the type of data obtained. Expert validation data and response questionnaires were analyzed using descriptive statistics with a likert scale of 1–5. The product eligibility criteria refer to Riduwan (2013), namely Very Good (> 4.2), Good ($3.4 < x \leq 4.2$), Adequate ($2.6 < x \leq 3.4$), Not Good ($1.8 < x \leq 2.6$), and Very Bad (≤ 1.8). The learning outcome data was analyzed using prerequisite tests that included the Shapiro-Wilk normality test and the Levene's Test homogeneity test. Based on the results of the prerequisite test showing that the data were not normally distributed, the hypothesis test was carried out using the non-parametric Mann-Whitney U Test as an alternative to the independent t-test with the help of the SPSS version 25 program. In addition, the N-Gain Score analysis was carried out to measure the amount of improvement in students' understanding using the Hake (1999) formula: N-Gain = (Posttest Score − Pretest Score) / (Maximum Score − Pretest Score) × 100. N-Gain criteria: High (> 70), Medium (30 ≤ N-Gain ≤ 70), and Low (< 30) (Hake, 1999).

The validity of the data in this development research is guaranteed through several procedures. First, the validity of the test instrument is guaranteed through the validity test of the question item using the Product Moment correlation with the table r = 0.301 at a significance level of 5% (n = 43), so that only the question item that meets the valid criteria is used in the study. Second, the reliability of the test instrument is guaranteed through the KR-20 test which produces a reliability coefficient rb = 0.891, which is included in the very high category. Third, the validity of learning media products is guaranteed through a validation process by two experts who are competent in their respective fields. Fourth, the verifiability of the data is guaranteed through triangulation of sources, namely by comparing assessment data from media experts, material experts, teachers, and students to obtain a comprehensive picture of the quality of the products developed.

## RESULTS AND DISCUSSION

### *AR-Based IPAS Learning Media Development*

#### *Analysis Stage*

The analysis stage identifies three main components, namely needs analysis, student characteristics analysis, and curriculum analysis. Needs analysis through observation and interviews at SDN 2 Sokaraja Tengah shows that the learning process of IPAS material on the Human Respiratory System is still ongoing expositorily. The limited media available causes students to have difficulty visualizing the respiratory organs that are abstract and invisible, thus having an impact on the low understanding and interest in learning of students.

Analysis of the characteristics of students shows that Class V students are in the age range of 10–11 years in the concrete operational stage according to Piaget (1952), requiring real and concrete learning experiences. Interviews with classroom teachers revealed that students have a high interest in the use of technology, but have never had experience learning using AR. Curriculum analysis ensures the suitability of the product with the learning outcomes of the Independent Curriculum in the Class V Science subject, which includes the ability to explain the function of respiratory organs, identify respiratory mechanisms, and describe the differences in healthy and unhealthy lung conditions.

***Design Stage***

The design stage produces a design of the learning media structure which includes display design, material content, AR content, quiz questions, and research instruments. The design of the media display is designed using a child-style cartoon visual theme with a combination of bright and harmonious colors to create a fun learning atmosphere for elementary school students. The AR content is designed to cover four main topics: (1) parts of the nose, (2) the organs of the respiratory system as a whole, (3) the bronchi and bronchioles, and (4) the comparison of healthy lungs and unhealthy lungs. Each AR content is designed to display a three-dimensional model that can interact with the user through a QR Code scan using *the Assemblr app*. The research instruments designed at this stage include media expert validation sheets, material expert validation sheets, teacher response questionnaires, student response questionnaires, and *pretest* and *posttest questions* which include 32 learning objective indicators.

***Development Stage***

The development stage realizes the design into a real product through three platforms that work synergistically. The process of creating AR content through *Assemblr Studio* is carried out by importing and configuring a three-dimensional model of the respiratory organs which includes: (1) the parts of the nose including the nasal bones, mucous membranes, cilia/nasal hair, sense nerves, and sense nerves to the brain; (2) the organs of the respiratory system as a whole; (3) bronchi and bronchioles; (4) alveolus and capillary vessels; and (5) a comparative model of healthy lung and cancer lung. Each 3D model is equipped with an information label that can be accessed interactively by the user.

Image illustration creation uses *the image generation* feature in ChatGPT with detailed prompts so that the images produced are in accordance with the needs of the learning media content. The resulting images include cartoon-style learning media cover illustrations, supporting images of the respiratory system understanding material page, and other supporting illustrations. All the components are then combined and compiled using Canva into a complete learning medium, consisting of 25 pages, and ready for expert validation.

The Augmented Reality-based IPAS learning media product developed has a visual appearance in the form of an interactive book that is integrated with AR content. The product display can be seen in the following image.

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Volume 15 No. 2. Juni 2026 https://ejournal.unibabwi.ac.id/index.php/sosioedukasi/index


Figure 1. Augmented Reality-based IPAS learning media *cover*

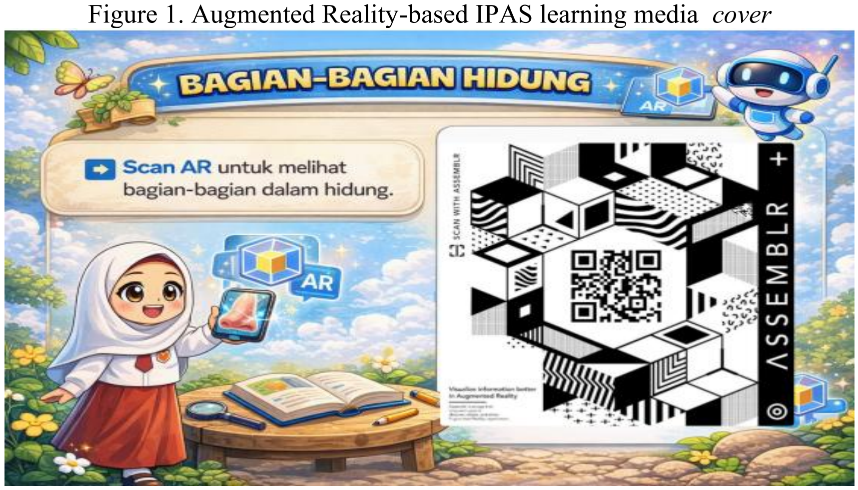


Figure 2. QR Code for AR access Nose Parts

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ISSN: 2086-6135 E-ISSN: 2541-612x
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Figure 3. QR Code for AR Access Parts of the Human Respiratory System

***Validity of Learning Media Products***

The validation of media experts was carried out by Dr. Beny Wijanarko K., M.Si. from the University of Muhammadiyah Purwokerto on March 5, 2026. The validation sheet consists of 20 statements that include aspects of display, aspects of material content, and aspects of use with an assessment scale of 1–5. The display aspect received an average score of 4.6, the content aspect of the material received an average perfect score of 5.0, and the use aspect received an average score of 5.0. The recapitulation of the results of the validation of media experts is presented in Table 1.

**Table 1. Recapitulation of Media Expert Validation Results**

| No. | Aspects Assessed | Score | Average |
|---|---|---|---|
| 1–11 | Aspect of Display | 51 | 4,6 |
| 12–16 | Aspects of Content Material | 25 | 5,0 |
| 17–20 | Aspects of Use | 20 | 5,0 |
| | **Total Average** | | **4,8** |
| | **Criteria** | | **Excellent** |

The media expert validator commented that the learning media was very interesting, noting that the selection of letter colors was more concerned with the contrast with the background color. The product is declared worthy of trial without fundamental revisions.

The validation of the material expert was carried out by Dr. Gunawan from the University of Muhammadiyah Purwokerto on the same date. The validation sheet consists of 20 statements that include aspects of material content, question item aspects, linguistic aspects, and usefulness aspects. The content aspect of the material got an average of 4.5, the question item aspect got an average of 4.5, the language aspect got an average of 4.8, and the usefulness aspect got an average of 4.7. The recapitulation of the results of the validation of the subject matter experts is presented in Table 2.

**Table 2. Recapitulation of Material Expert Validation Results**

| No. | Aspects Assessed | Score | Average |
|---|---|---|---|
| 1–6 | Aspects of Content Material | 27 | 4,5 |
| 7–12 | Question Item Aspect | 27 | 4,5 |
| 13–17 | Language Aspects | 24 | 4,8 |
| 18–20 | Aspects of Usefulness | 14 | 4,7 |
| | **Total Average** | | **4,6** |
| | **Criteria** | | **Excellent** |

The material expert validator provides three improvement notes, namely: (1) the material needs to be deepened and clarified; (2) the display needs to be more informative; and (3) need to meet the broader understanding aspect. The product remains declared worthy of testing and the improvement notes have been followed up prior to implementation.

***Product Practicality — Implementation Stage***

The implementation phase will be carried out in March 2026. The experimental class received learning using AR-based IPAS media, while the control class received learning by expository method. Both classes were first given

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a *pretest* to measure initial ability. The average *pretest score of the* control class was 71.32 and the experimental class was 69.88, indicating the initial ability of the two classes was relatively equal.

The implementation of learning in the experimental class went smoothly and received very high enthusiasm. Students actively scan the QR Code on print media to access three-dimensional content through *the Assemblr application*. Students can observe models of respiratory organs from various perspectives, read information labels interactively, and compare the appearance of healthy lungs and cancerous lungs. Students' active participation and curiosity about AR content is very high, creating lively and fun learning dynamics. The practicality of the product was measured through the teacher's response questionnaire and the student response questionnaire given after the learning was completed. The recapitulation of the results of the teacher response questionnaire is presented in Table 3.

**Table 3. Recapitulation of Teacher Response Questionnaire Results**

| No. | Aspects Assessed | Score | Average |
|---|---|---|---|
| 1–4 | Aspect of Display | 19 | 4,8 |
| 5–11 | Aspects of Content Material | 31 | 4,4 |
| 12–17 | Aspects of Usefulness | 29 | 4,8 |
| 18–20 | Aspects of Use | 13 | 4,3 |
| | **Total Average** | | **4,6** |
| | **Criteria** | | **Excellent** |

The teacher gave a written comment that the learning media used was very appropriate to the material and easy to understand by students. The results of the analysis of the student response questionnaire showed individual scores ranging from 54 to 80 out of a maximum score of 80. A total of 16 students (61.5%) received the Very Good category and 10 students (38.5%) received the Good category. None of the students gave a negative assessment. The average total response score of students is 3.45 with the criterion of Excellent. The aspect that received the highest assessment was the usefulness aspect, especially in the indicators of ease of understanding the material, the ability of the media to motivate learning, and the ability of the media to inspire students to like science lessons.

***Effectiveness and Differences in Learning Outcomes — Evaluation Stage***

After all learning sessions are completed, both classes are given *a posttest* to measure student learning outcomes. The average *posttest score of the* experimental class reached 90.65, while the control class reached 87.93. The increase in scores from *pretest* to *posttest* in the experimental class was 20.77 points greater than that of the control class of 16.61 points. A comparison of the scores of the two classes is presented in Table 4.

**Table 4. Comparison of Pretest and Posttest Scores of Both Classes**

| Groups | Rata-rata Pretest | Posttest rate-rate | Improvement |
|---|---|---|---|
| Control Class (n=28) | 71,32 | 87,93 | 16,61 |
| Experimental Class (n=26) | 69,88 | 90,65 | 20,77 |

The normality test using *Shapiro-Wilk* showed that *the pretest data of the* control class had a significance of 0.002 (< 0.05) so that it was not normally distributed, while the experimental class had a significance of 0.076 (> 0.05) so that it was normally distributed. *The posttest* data of both classes had significance below 0.05 (control: 0.002; experiment: 0.000), so they were not normally distributed. The homogeneity test using *Levene's Test* yielded a significance value of 0.005 (< 0.05), meaning that the variance of the two groups was not homogeneous. The *One Way ANOVA* test produced a significance of 0.700 (> 0.05), ensuring that there was no significant difference between the initial abilities of the two groups so that *the posttest* comparison could be conducted properly.

Based on the results of the prerequisite test showing that the data were not normally distributed and the variance was not homogeneous, the hypothesis test was carried out using the non-parametric *Mann-Whitney U Test*. The results of the test on *the posttest data* resulted in a value of U = 284,000, Z = −1,399, and a significance value (*Asymp. Sig.* 2-tailed) by 0.162. A summary of the results of the hypothesis test is presented in Table 5.

**Table 5. Summary of Mann-Whitney U Test Results**

| Statistics | U Grade | Z Value | Sig. (2-tailed) |
|---|---|---|---|
| Mann-Whitney U Test | 284,000 | -1,399 | 0,162 |

The significance value of 0.162 is greater than 0.05, so $H_0$ is accepted and $H_a$ is rejected. Statistically, there was no significant difference between the learning outcomes of students in the experimental class and the control class. However, the higher average increase in learning outcomes in the experimental class (20.77 points) compared to the control class (16.61 points) indicates a marked quantitative advantage of the use of AR-based media. Statistical insignificance is likely due to the relatively small sample size, considerable pretest value variability in the experimental class, and the short duration of the intervention.

***N-Gain Score Analysis***

The *N-Gain Score analysis* was carried out to measure the amount of improvement in students' understanding after participating in learning in both groups. *N-Gain* is calculated using the formula of Hake (1999) with the following criteria: High (> 70), Medium (30 ≤ *N-Gain* ≤ 70), and Low (< 30). The recapitulation of the results of the *N-Gain Score analysis* of the two classes is presented in Table 6.

**Table 6. Recapitulation of N-Gain Score Analysis Results**

| Groups | Rata-rata Pretest | Posttest rate-rate | Average N-Gain (%) | Category |
|---|---|---|---|---|
| Control Class (n=28) | 71,32 | 87,93 | 57,12 | Medium |
| Experimental Class (n=26) | 69,88 | 90,65 | 75,53 | Height |
| **N-Gain Difference** | | | **18,41** | |

The results of the N-Gain calculation in the control class showed an average N-Gain of 57.12 which was included in the Medium category. The distribution of categories in the control class consisted of 14 students (50.0%) in the High category, 7 students (25.0%) in the Medium category, and 7 students (25.0%) in the Low category. These results show that expository learning is able to improve students' understanding, but the improvement is not optimal.

The results of the N-Gain calculation in the experimental class showed an average N-Gain of 75.53 which was included in the High category. The distribution of categories in the experimental class consisted of 16 students (61.5%) in the High category, 8 students (30.8%) in the Medium category, and 2 students (7.7%) in the Low category. These results show that the use of AR-based IPAS interactive learning media is able to improve students' understanding more optimally than expository learning.

The average *N-Gain* comparison between the control class (57.12, Medium category) and the experimental class (75.53, High category) showed a difference of 18.41 points. The experimental class obtained the High category while the control class only obtained the Medium category. These findings confirm that the use of AR-based IPAS interactive learning media is more effective in improving students' understanding than expository learning, although based on *the Mann-Whitney U Test* the difference between the two classes is not statistically significant. *N-Gain* analysis provides a more comprehensive picture of the effectiveness of learning media that cannot be fully revealed through statistical tests with limited sample sizes.

**Discussion**

***Validity of AR-Based IPAS Learning Media Products***

The results of validation by media experts and material experts show that the AR-based IPAS learning media products developed have an excellent level of validity. The average validation score of media experts is 4.8 and the average validation score of material experts is 4.6, both of which are in the Very Good criteria (> score of 4.2). This high validity achievement shows that the product has met quality standards from the technical aspects of the media and the substance of the learning content. A perfect score (5.0) on the content aspect of the material and the use aspect of the media expert indicates that the content is very relevant to the material and the media is very easy to operate. This finding is in line with the results of Munir's (2024) research which obtained a very valid category validation score from media experts and material experts on similar AR products.

The assessment of material experts who reached an average of 4.6 with the Very Good criterion showed that the substance of the content was in accordance with the learning outcomes of the Independent Curriculum, systematic, up-to-date, and easy for students to understand. The linguistic aspect received the highest score (4.8), indicating that language and sentences are very appropriate to the level of cognitive development of Class V students.

***Practicality of AR-Based IPAS Learning Media Products***

The practicality of the product measured through the teacher response questionnaire (average 4.6, Very Good) and the student response questionnaire (average 3.45, Very Good) showed that the learning media was received very positively by users. None of the learners gave a negative assessment, which is a strong indication that the product has high practicality in the context of learning in elementary schools. High practicality is inseparable from the selection of *Assemblr* 's free-to-download platform, intuitive interface design, and clear instructions for use. These findings are in line with the research of Maziyah & Zumrotun (2025) and Lestari & Setyasto (2025) which also found a high level of practicality in AR-based media.

Visual design that carries the theme of children's style cartoons with a combination of bright colors has proven to receive a very positive response from students, in line with the principle of display suitability with the characteristics of the target user stated by Arsyad (2007) as an essential aspect of effective learning media design. Understanding the characteristics of learners, including their diversity of interests, learning styles, and cognitive development, is a key prerequisite for designing targeted learning media (Andriani & Muntohar, 2022). The high enthusiasm of students during learning using AR media creates an active and fun classroom dynamic. Hidayah & Andriani (2025) in a related study also found that the use of visually appealing learning media had a positive effect on the interest and motivation of elementary school students. Arwanda, Irianto, & Andriani (2020) in a research on the development of Articulate Storyline media which also received a very good response from students (4,6) proves that the high practicality of a learning media in elementary school is always correlated with the suitability between media design and student characteristics.

***Effectiveness and Differences in Learning Outcomes***

The effectiveness of the product was analyzed from the comparison of *pretest* and *posttest results* between the experimental class and the control class. The average *posttest score of the* experimental class (90.65) was higher than that of the control class (87.93), and the increase from *pretest* to *posttest* in the experimental class (20.77 points) was greater than that of the control class (16.61 points), although the initial ability of the experimental class was slightly lower. This data shows that there is a real advantage in learning outcomes in the group that uses AR-based media compared to the group that gets expository learning.

The results of *the Mann-Whitney U Test* produced a significance value of 0.162 (> 0.05), so that statistically there was no significant difference between the learning outcomes of the two classes. This insignificance needs to be interpreted by considering the limitations of the study, namely the relatively small sample size (less than 30 students each) which limits the *statistical power*, the very large variability *of pretest scores* in the experimental class (range 24–97), and the short duration of the intervention. The control class, which also showed a considerable increase (16.61 points), indicated that the intrinsic motivation of the students towards the final assessment also played a role.

The distribution of *the N-Gain* category in the experimental class, which showed that 61.5% of students were in the High category and only 7.7% were in the Low category, compared to the control class with a more even distribution (50.0% High and 25.0% Low), confirming that AR-based media is more consistent in raising students' understanding to a higher level. The higher average increase in learning outcomes in the experimental class, combined with the High category *N-Gain* value and the very high positive response from learners and teachers, provides a

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ISSN: 2086-6135 E-ISSN: 2541-612x
Volume 15 No. 2. Juni 2026 https://ejournal.unibabwi.ac.id/index.php/sosioedukasi/index

comprehensive picture of the effectiveness of AR-based media. AR content that allows learners to observe three-dimensional models of respiratory organs, read interactive information labels, and compare healthy and unhealthy organ conditions creates a meaningful learning experience. These findings support the *experiential learning* theory which states that learners learn more effectively through direct involvement with learning objects that can be actively observed and explored (Slavin, 2021). The research of Azhar et al. (2021) also concluded that AR-based three-dimensional learning media is effective in improving understanding of science concepts. Follow-up studies with larger samples and longer intervention durations are strongly recommended to obtain stronger evidence about the effectiveness of these media.

The AR-based IPAS learning media product developed in this study is a learning innovation that combines expository print media with the latest digital technology. The integration between print media and AR technology results in a hybrid learning medium that leverages the advantages of both approaches at once: print media provides easy access without the need for electronic devices to read material in general, while AR content delivers immersive and interactive three-dimensional visualizations that print media alone cannot provide (Mursidi, 2025). The development process, which involves three digital platforms synergistically – *Assemblr Studio* for AR content, ChatGPT for image illustration, and Canva – is an innovative and cost-efficient approach to learning media development.

The findings of this study make a theoretical contribution to the development of knowledge about the integration of AR technology in science learning in elementary schools. Practically, this research produces a model for the development of AR-based learning media that can be used as a reference for media developers and educators in designing interactive learning media on abstract science and science materials, such as the digestive system, circulatory system, or water cycle. The success of this media was received very positively by teachers and students, strengthening the argument that the integration of AR technology in learning media in elementary schools is a strategic step that needs serious attention in the development policy of learning media in the digital era

## CONCLUSION

The Augmented Reality-based IPAS interactive learning media product on the Human Respiratory System material for Class V students of SDN 2 Sokaraja Tengah was successfully developed through an R&D approach with the ADDIE model using the integration of three platforms: Assemblr Studio, ChatGPT, and Canva, resulting in a 25-page learning media book that is integrated with three-dimensional AR content.

The product was declared very valid (media experts: 4.8; material experts: 4.6, both Very Good) and very practical (teacher response: 4.6; student response: 3.45, both Very Good) with all students giving positive ratings. The average increase in scores from pretest to posttest in the experimental class (20.77 points) was greater than that of the control class (16.61 points). The Mann-Whitney U Test produced a statistically insignificant value of 0.162, possibly due to the limitations of the sample size and the short duration of the intervention, so it needs to be interpreted together with qualitative data showing the real advantages of the experimental class. Follow-up research with a larger sample, longer duration, and development of AR content on other abstract IPAS materials is highly recommended.

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