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# DEVELOPMENT OF PHYSICS MAGAZINE LEARNING MEDIA BASED ON ETHNOSCIENCE TO IMPROVE SCIENCE LITERACY IN JUNIOR HIGH SCHOOL STUDENTS

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**Abstract:** The low scientific literacy of junior high school students is caused by the lack of interesting and contextual learning media. This study aims to develop an ethnoscience-based physics magazine as a learning media integrated with local culture. The method used is Research and Development (R&D) with the ADDIE model. Validation was carried out by media and material experts with very good and good results. The magazine was implemented in class VIII MTs At-Taqwa Beru. The results of the pretest and posttest showed a significant increase, from an average of 43.25 to 70, with a significance value of 0.000 and an effect size of 1.68. As many as 75% of students achieved the KKM. The output of this study is an ethnoscience-based physics magazine product that effectively improves students' scientific literacy through a local cultural approach.
***Keywords:*** Development; Learning media; Physics magazine; Ethnoscience; Science literacy

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## Introduction

Previous studies have highlighted the importance of strengthening the scientific knowledge of secondary school students, which is still relatively low (Wang & Zheng, 2021). Lack of interest in science is often associated with limited access to relevant and contextual learning media, especially those that link science materials to students' daily lives and local culture (Zidny et al., 2020). The ethnoscience approach is one of the solutions offered in various studies, because it is able to bridge the concept of modern science with local wisdom that has long developed in society. This approach not only makes learning materials easier to understand, but also fosters students' sense of belonging and pride in their own culture, thereby encouraging higher engagement and motivation to learn.

Ethnoscience integrates modern science with local cultural practices and values. In the context of education, this provides an opportunity to enrich science learning by making it closer to students' social realities. The application of ethnoscience in learning media has been

proven to improve students' cultural literacy and scientific understanding of scientific concepts that previously felt abstract (Chibuye & Singh, 2024). Especially in the era of the industrial revolution 4.0 to 5.0 which is marked by the rapid development of technology, students are required to have good scientific literacy in order to be able to keep up with the changing times. Unfortunately, data shows that scientific literacy in Indonesia is still relatively low (Mardiyanti et al., 2022), and one of the causes is the lack of interesting, relevant, and contextual learning media (Nurhanifah & Utami, 2023).

To address these challenges, this study develops an ethnoscience-based physics magazine that links force and motion concepts with local culture. The magazine combines text, illustrations, cultural photos, experiments, and quizzes to make learning engaging. The research aims to: (1) describe the development process of the magazine and (2) examine its effectiveness in improving junior high school students' scientific literacy. This media is expected to enhance understanding while preserving local culture.

## 1. Literature Review

### 1.1 Teaching Media

Scientific literacy requires not just accepting facts but actively thinking critically (Azrai et al., 2020). Education aims to equip students with skills to understand, analyze, and interpret scientific information (Narut & Supardi, 2019). This includes mastering concepts, developing critical thinking, solving problems, evaluating arguments, and making evidence-based decisions. Ultimately, scientific literacy prepares students to engage actively in a science- and technology-driven society (Kristyowati & Purwanto, 2019).

### 1.2 Physics Magazine

Physics magazines serve as engaging learning media, combining scientific articles, illustrations, and practical experiments to make physics concepts more enjoyable for students (Dinata & Yuliani, 2022). Unlike general magazines, educational book magazines focus on specific subjects, use formal but clear language, and include illustrations and exercises to support learning. The use of an ethnoscience approach makes physics magazines more meaningful by connecting scientific concepts with local culture and students' real-life context (Putri et al., 2023; Kusnadi & Devi, 2020).

### 1.3 Science Literacy

Scientific literacy involves active critical thinking, not just accepting facts, and aims to equip students with the ability to understand, analyze, and interpret scientific information for decision-making based on evidence (Kristyowati & Purwanto, 2019; Pertiwi et al., 2023; Parisu et al., 2025). It includes appreciating science, applying it in daily life, solving problems scientifically, and understanding its nature and relation to other fields (Holbrook & Rannikmae, 2009). Key indicators of scientific literacy include understanding research design, presenting and interpreting data, applying quantitative skills and basic statistics, and using data to infer, predict, and conclude (Gormally et.al, 2012)

In another research, the TOSLS (Test of Scientific Literacy Skills) Test Tool developed by Gormally et al. (2012) explained that scientific literacy indicators include an understanding of inquiry methods that produce scientific knowledge, the ability to organize, analyze, and integrate quantitative data and scientific information. These indicators include understanding and organizing data as shown in Table 1.

**Table 1.** Science literacy indicators by Gormally et al (2012)

| Indicator | Sub indicators |
|---|---|
| **Understand inquiry methods that lead to scientific knowledge, organize, analyze and integrate quantitative data and scientific information.** | 1. Identifying appropriate scientific arguments (11)<br>2. Using effective literature searches (12)<br>3. Evaluating the use of scientific information (13)<br>4. Understanding research design elements and how they impact scientific findings (14)<br>5. Creating graphs that can represent data (15)<br>6. Reading and interpreting data (16)<br>7. Problem solving using quantitative skills including probability statistics (17)<br>8. Understanding and being able to interpret basic statistics (18)<br>9. Presenting conclusions and predictions based on quantitative data (19) |

Furthermore, research conducted by Diana revealed that the indicators of scientific literacy consist of four things, namely the role of science, thinking and working scientifically, science and society, and mathematics and science (Diana et al, 2015). The following is a table of scientific literacy indicators according to Diana in Table 2.

**Table 2.** Indicators of literacy

| Aspects of scientific literacy | Indicator |
|---|---|
| The role of science | Identify questions that can be answered through scientific investigations |
| | Understand the nature of scientific endeavors/activities |
| | Understand the concept of genetic science |
| Think and work scientifically | Applying natural phenomena |
| | Recognizing patterns |
| | Identifying research variables |
| | Asking critical questions about research design |
| | Obtaining/evaluating conclusions based on evidence |
| Science and society | Applying scientific conclusions in everyday life |
| | Identifying scientific issues that underlie policy decisions |
| | Understanding the role of science in decision making |
| | Developing questions to assess the validity of scientific reports |
| | Questioning sources of scientific reports |
| Mathematics and science | Using mathematics in science |
| | Understanding applications of mathematics in science |

Holbrook, J., & Miia, R. (2009). The Meaning of Scientific Literacy. *International Journal of Environmental and Science Education, 4*(3).

Mamat, A. (2016). Kemampuan Literasi Sains Siswa pada Pembelajaran Ekosistem. *Proceeding Biology Education Conference*, 90–92.

To observe the novelty in this research, an analysis of previous research was conducted. Relevant previous research includes several studies. Research by Hasan (2024) entitled Development of Physics Magazine Learning Media Based on Traditional Games to Improve Science Literacy in Junior High School Students used junior high school students as subjects

and produced traditional game-based learning media that can improve science literacy. Research by Junita & Yuliani (2022) entitled Development of Ethnoscience-Based e-LKPD to Train Science Literacy Skills on Membrane Transport Material used grade XI high school students as subjects and produced valid, practical, and effective ethnoscience-based e-LKPD to train science literacy skills. Furthermore, research by Kriswanti et.al, (2020) entitled Development of Ethnoscience-Based Learning Tools to Train Science Literacy of Elementary School Students used elementary school students as subjects and produced valid, practical, and effective rawon-processed ethnoscience-based learning tools. The following are the conclusions from the results of the previous research presentation which can be observed in table 3 below.

## Method

The research method that will be used is quantitative descriptive using the Research and Development (R&D) approach by applying the ADDIE learning model (Analysis, Design, Development, Implementation, Evaluation). The following is a flowchart of ADDIE development research.

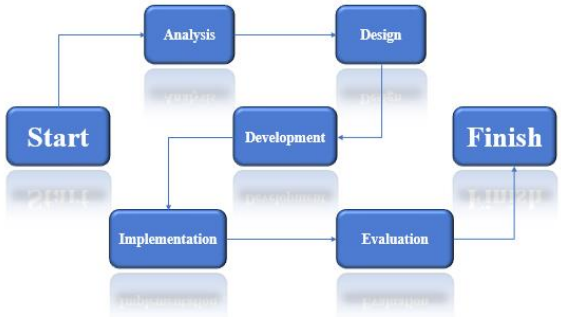



**Figure 1.** Flowchart of ADDIE model development research

The ADDIE model in the image above is a systematic approach consisting of five main stages:

**Analysis,** which aims to identify the initial needs of physics learning at Mts At-Taqwa Beru. This stage includes a literature review to find the main problem, namely the low scientific literacy of students. In addition, an analysis was carried out on the potential for integrating local culture as part of an effort to improve students' understanding of physics concepts.

**Design,** an ethnoscience-based physics magazine was designed using the Canva application. This process includes compiling the layout of the magazine, selecting content in the form of physics articles, illustrations based on local culture, as well as learning activities and simple experiments that are relevant to scientific literacy.

**Development** is carried out by producing a physics magazine that integrates physics concepts with local culture. This magazine is designed to provide an interesting learning experience, different from previous studies that focused more on learning tools or traditional games.

**Implementation**, the magazine was tested on a small scale in class VIII MTS At-taqwa Beru. This activity involves giving pretests and posttests to students to measure the increase in science literacy.

**Evaluation,** where the implementation data is analyzed to evaluate the effectiveness of the learning media. Quantitative analysis is carried out using the t-test to determine the increase in students' science literacy. Based on the results of this evaluation, recommendations for the improvement and development of learning media in the future can be prepared. This research is expected to provide a real contribution to improving students' science literacy through the integration of physics and local culture.

The research subjects were grade VIII students of MTs At-Taqwa Beru, selected through purposive sampling. Grade VIII was chosen because students at this level have sufficient basic physics knowledge to understand the concepts in the ethnoscience-based physics magazine. The study focused on developing physics magazine learning media.

**Data collection techniques**

This study used three instruments: tests, material expert validation, and media expert validation. The test measured students' scientific literacy (pretest–posttest) based on indicators like competence, knowledge, and critical thinking. Material expert validation assessed content feasibility, curriculum relevance, scientific accuracy, and cultural integration, while media expert validation evaluated design quality, readability, and attractiveness. Expert validation data were analyzed descriptively, and test data were analyzed to measure the media's effectiveness in improving scientific literacy.

**Research instruments**

The basis for creating media and learning material validation instruments is based on the principles of validity, reliability, and relevance. Validity ensures that the instrument actually measures the aspects to be assessed, such as the suitability of the material to the curriculum, the accuracy of the science, and the appeal of the media. Reliability ensures that the assessment results are consistent even if carried out by different validators or at different times. The following is presented in table 3 about media expert instrument indicators.

**Table 3.** Media expert instrument indicators

| No. | Aspect | Indicator | Number of Statements | Statement Number |
|---|---|---|---|---|
| **1** | Media design | a. Layout and readability | 4 | 1,2,3*,4 |
| | | b. Visualization and Illustration | 3 | 4,5,6,7 |
| | | c. Design Consistency | 4 | 8,9,10,11 |
| **2** | Media Content | d. Material Relevance | 4 | 12,13,14,15 |
| | | e. Scientific Accuracy | 3 | 16, 17*,18* |
| **3** | Interactivity and Attraction | f. Reader Appeal | 3 | 19,20*,21 |
| | | g. User Engagement | 4 | 22,23,24,25 |
| | | h. Ease of Access | 2 | 26,27 |
| **4** | Media aesthetics | i. Aesthetic Appeal | 4 | 28,29,30*,31 |
| **5** | Media Sustainability | j. Sustainability of Use | 2 | 32,33 |

*negative statement

The media expert validation instrument evaluates five aspects of the ethnoscience-based physics magazine: (1) design—layout, readability, visualization, and consistency; (2) content—curriculum relevance and scientific accuracy; (3) interactivity and appeal—student engagement and accessibility in print/digital formats; (4) aesthetics—color, layout, and visual attractiveness; and (5) sustainability—long-term usability and ease of updates. Assessment uses a Likert scale with space for validator comments and suggestions.

**Table 4.** Material expert instrument indicators

| No. | Aspects | Indicators | Number of Statements | Statement Number |
|---|---|---|---|---|
| **1.** | Suitability of Material | a. Conformity to Curriculum | 4 | 1, 2, 3, 4* |
| | | b. Relevance of Physics Concepts | 3 | 5, 6, 7* |
| **2.** | Accuracy and Depth of Material | c. Accuracy of Science | 4 | 8, 9, 10, 11* |
| | | d. Depth of Material | 3 | 12, 13, 14* |
| **3.** | Integration of Ethnoscience | e. Authenticity of Local Culture | 3 | 15, 16, 17* |
| | | f. Integration of Culture and Science | 5 | 18, 19, 20, 21, 22* |
| **4.** | Understandability of Material Aspects | g. Understandability by Students | 3 | 23, 24, 25* |
| | | h. Development of Literacy Skills | 3 | 26, 27, 28* |

*negative statement

The material expert instrument evaluates the magazine's content based on curriculum alignment, relevance to daily life and culture, scientific accuracy, integration of cultural elements, clarity, and its ability to develop students' literacy and critical thinking, ensuring it is accurate and effective for junior high students.

Next, the creation of test instruments that refer to the theory of scientific literacy that emphasizes the understanding, analysis, and communication of scientific concepts, as well as the theory of ethnoscience that integrates local wisdom with the concept of physics that has been revealed by several experts previously. Learning standards, such as the national curriculum and basic competency indicators (KD), are used as references to ensure that the material is relevant to students' needs. The form of the instrument will be multiple-choice questions with four answer options. The following is presented in Table 5 about Question indicators.

**Table 5.** Question indicators

| No. | Question indicators | Cognitive level | Question number |
|---|---|---|---|
| **1** | Understand the definition of force and its effect on objects | Understand (C2) | 1 |
| **2.** | Explain the relationship between thrust and static friction | Understand (C2) | 2 |
| **3.** | Identify friction that affects the movement of objects | Understand (C2) | 3 |
| **4** | Understand Newton's first law in explaining the motion of objects | Understand (C2) | 4 |
| **5** | Determine the effect of force on stationary objects based on Newton's law | Analysis (C4) | 5 |
| **6** | Analyze Newton's first law in conditions without gravity (outer space) | Analysis (C4) | 6 |
| **7** | Analyze the principle of Newton's third law in rocket launches | Analysis (C4) | 7 |
| **8** | Analyze the concept of inertia during a collision | Evaluation (C5) | 8 |
| **9** | Evaluate the effect of force on swing oscillations | Evaluation (C5) | 9 |
| **10** | Evaluate the effect of inertia on vehicle passengers who brake suddenly | Evaluation (C5) | 10 |

| | | | |
|---|---|---|---|
| **11** | Evaluate the factors that affect the distance of an athlete's jump | Synthesis (C6) | 11 |
| **12** | Evaluate the relationship between the angle of throw and the horizontal distance of the object | Synthesis (C6) | 12 |
| **13** | Evaluate how to reduce air resistance and friction to increase the efficiency of electric vehicles | Synthesis (C6) | 13 |
| **14** | Calculate the time it takes for an object to reach its highest point based on Newton's second law | Synthesis (C6) | 14 |
| **15** | Calculate the final velocity of an object given constant acceleration | Synthesis (C6) | 15 |
| **16.** | Design shoe modifications to reduce air resistance and increase the speed of a runner | Synthesis (C6) | 16 |
| **17.** | Design changes in the shape of a vehicle to be more aerodynamic according to Newton's law | Synthesis (C6) | 17 |
| **18.** | Develop innovations in launching spacecraft based on Newton's third law | Apply (C3) | 18 |
| **19.** | Apply the concept of inertia in use of seat belts in vehicles | Apply (C3) | 19 |
| **20.** | Implementing the best strategy in increasing the swing movement using the thrust force | Apply (C3) | 20 |

The question indicator table is designed to measure students' scientific literacy through culturally relevant physics tests. Indicators cover conceptual understanding, phenomenon analysis, data interpretation, concept application, cultural integration, critical thinking, and evidence-based conclusions. Cognitive levels follow Bloom's taxonomy (understanding, analysis, application, evaluation, synthesis). Question numbers map each indicator to the competencies being assessed, ensuring systematic evaluation of students' science mastery and connection to local culture.

Data analysis techniques

This study used two analysis techniques: descriptive analysis for expert validation data (assessing design, content, readability, and cultural integration) and quantitative analysis for test data, including normality, homogeneity, and paired t-tests to measure improvements in scientific literacy. Averages and percentages were also calculated, while qualitative data from observations and interviews were thematically analyzed to evaluate media effectiveness and cultural relevance.

**Data Analysis Techniques**

1. **Likert scale analysis**

   The validity test of the learning media instrument was carried out through validation by several experts. This process involves filling out a validation questionnaire to assess the level of feasibility and validity of the media. The validation instrument uses a Likert scale with four answer choices: very feasible (4), feasible (3), less feasible (2), and not feasible (1). After the questionnaire was filled out, the data was analyzed to determine the validity of the learning media based on a predetermined formula.

$$NP = \frac{R}{SM} \cdot 100\% \quad (1)$$

Information,
*NP* = score presentation value
*R* = total score
*SM* = maximum score

The results are then compared with the assessment criteria as in Table 6.

**Table 6.** Assessment Criteria

| No. | Intervals (P) | Eligibility Criteria |
|---|---|---|
| 1 | 80% - 100% | Very Valid |
| 2 | 66% - 79% | Valid |
| 3 | 56% - 65% | Less Valid |
| 4 | 0% - 55% | Not Valid |

After the level of validity is known, the next thing that needs to be studied is the quality of the media product. Quantitative data that was originally in the form of numbers is converted into qualitative data into the following four scales like in Table 7.

**Table 7.** Conversion of quantitative to qualitative data (Azwar, 2015)

| No | Score | Criteria |
|---|---|---|
| 1 | $M_i + 1{,}5S_{D_i} \le X \le M_i + 3{,}0S_{D_i}$ | Very Good |
| 2 | $M_i + 0S_{D_i} \le X \le M_i + 1{,}5S_{D_i}$ | Good |
| 3 | $M_i - 1{,}5S_{D_i} \le X \le M_i + 0S_{D_i}$ | Enough |
| 4 | $M_i - 3{,}0S_{D_i} \le X \le M_i - 1{,}5S_{D_i}$ | Less |

Information:
$X$ = score achieved
$M_i$ = average ideal score = $\frac{1}{2}$ (ideal highest score + ideal lowest score)
$S_{Di}$ = ideal standard deviation = $\frac{1}{6}$ (ideal highest score – ideal lowest score)
Ideal highest score: ∑criteria items × highest score
Ideal lowest score: ∑criteria items × lowest score

**2. Effectiveness Analysis**

In this study, the effectiveness of media implementation is measured using effect size and KKM.

a. **Effect Size**

Effect size measures the level of effectiveness of a learning method by comparing it with other methods. In this study, effect size is used to determine the extent to which learning with ethnoscience-based physics magazine media is more effective than conventional methods on the same material. The calculation of effect size can be determined using the following equation.

$$Sgab = \frac{\sqrt{(N1-1)S1^2+(N2-2)S2^2}}{N1+N2-2} \quad (3)$$

Information:
N1 = number of samples before
N2 = number of samples after
$S1^2$ = Previous variant index

$S2^2$ = Variance index after
From the results obtained, the effect size results were then categorized into categories which can be seen in Table 8.

**Table 8.** Effect size criteria

| *Effect size* | Criteria |
|---|---|
| 0,8< *d* <2,0 | Large |
| 0,5< *d* <0,8 | Same |
| 0,2< *d* <0,5 | Small |

b. **KKM Analysis**

Analysis of Minimum Completion Criteria (KKM) is used to measure the effectiveness of learning based on student achievement. In physics subjects, KKM is generally set at 70, so students with a score of ≥70 are considered to have met the KKM, while students with a score of ≤69 do not meet the KKM and require remedial.

## Results and Discussion

**Research Results**

This study uses the R&D method with the ADDIE model (analysis, design, development, implementation, evaluation). The analysis showed low scientific literacy due to unengaging media, leading to the development of an ethnoscience-based physics magazine integrating physics concepts with local wisdom. The magazine presents stories, illustrations, and simple experiments to make learning contextual and engaging, aiming to improve students' scientific literacy, critical thinking, and appreciation of local culture.

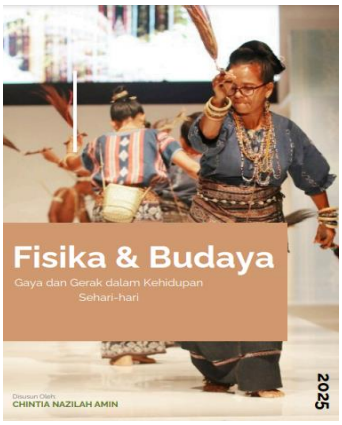



Figure 2. Physics Magazine Cover

Physics Magazine based on Ethnoscience on the subject of Force and Motion was developed using the (R&D) method. The following is the flow of stages of development of Physics Magazine based on Ethnoscience that has been completed.

1. **Analysis Stage**

This study found that junior high school students' scientific literacy is still low, which is caused by the lack of interesting and relevant learning media for their daily lives. Therefore, the Physics Magazine Based on Ethnoscience was developed, which integrates physics concepts with local culture to improve students' understanding. The results of validation by experts show that this magazine is feasible to use, with advantages in terms of layout, illustration, and integration of culture and science.

Figure 3. The observation process finds problems

Classroom observations revealed that students' low scientific literacy is due to a lack of engaging, contextual learning media. As a solution, an ethnoscience-based physics magazine was developed to make learning more meaningful, increase interest, and help students better understand physics concepts through a culturally relevant approach.

2. **Design Stage (Designing)**

**a.** Determining Theme

The theme of the ethnoscience-based physics magazine was determined through field observations to identify problems such as low scientific literacy and lack of contextual media. The study then focused on developing culture-based learning media, supported by literature review on scientific literacy, ethnoscience, and media effectiveness. The chosen theme was adapted to students' social, cultural, and educational context, ensuring novelty and providing solutions to improve scientific literacy through a culture-based approach.

**b.** Layout creation

The physics magazine is structured systematically, starting with an editorial, table of contents, main material, practice questions, and reflections. Images, infographics, and comparisons—such as Hegong Dance for distance-displacement and thrust on Sikka boats—make concepts clearer and relatable. The design uses clear text, organized subheadings, and cultural comparisons (e.g., Sikka boats vs. Pinisi ships) to show universal physics principles. Magazine development begins with concept planning and material selection, integrating Sikka culture, theory, experiments, illustrations, and exercises to enhance student understanding.


Figure 4 Sketch

**c.** Content creation

The physics magazine introduces ethnophysics, showing how physics is applied in Sikka traditions—such as house architecture, navigation, weaving, and dance. Examples include tension forces in ikat weaving and Newton's laws in Hedung Dance movements. Culture-based experiments, like making miniature pushboats, help students understand thrust and friction. Practice questions and reflections encourage students to observe local culture and identify physics principles, making learning interactive and relevant.

### 3. Development Stage

The ethnoscience-based physics magazine is designed to be interactive, visual, and contextual, unlike a standard textbook. It features an attractive cover, illustrated content, experiment pages, quizzes, and practice questions to make learning force and motion engaging and relatable. Canva was used for layout design, with colors, fonts, and images reflecting Sikka culture. Cultural documentation was conducted in Sikka Regency, capturing real photos of activities like Hedung Dance, weaving, and traditional boats to illustrate physics concepts authentically. These photos were edited with added graphics (e.g., force arrows, motion vectors) to visually strengthen the learning material.

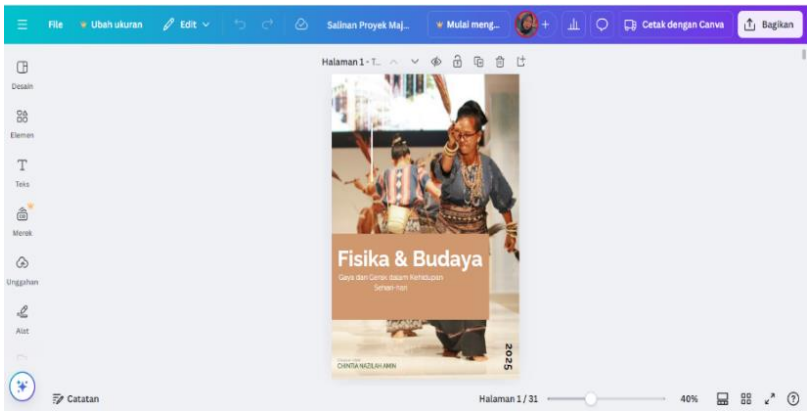
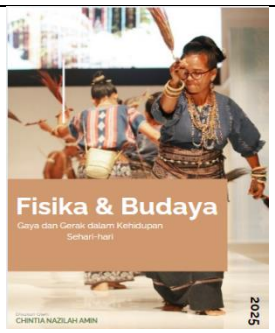



Figure 5. The process of making a magazine using the Canva application


(a)




(b)

Figure 6. (a) Initial design of the magazine (b) Final design of the magazine

Cartoon illustrations were replaced with authentic photos of Sikka cultural activities to better connect physics concepts with local wisdom. The layout was adjusted for visual harmony, and image quality was enhanced (lighting, contrast, color) to create a more professional and engaging magazine, resulting in a more contextual and meaningful learning experience.

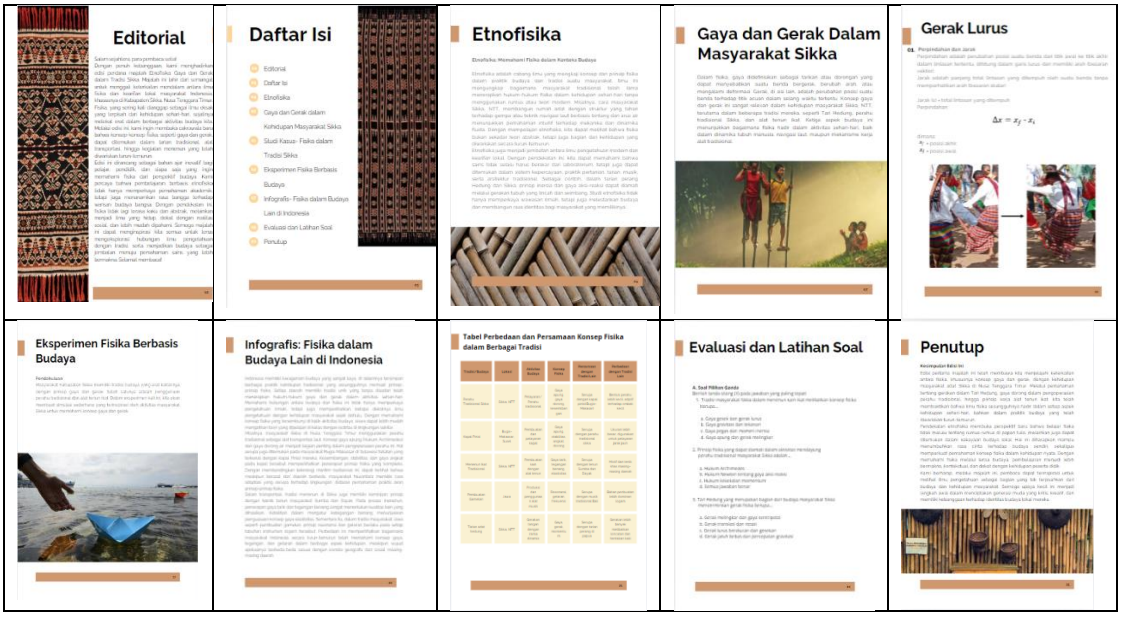



Figure 7. Magazine layout

The magazine layout follows a visually appealing, communicative style like popular magazines. Pages are arranged systematically, starting with an attractive cover featuring titles, cultural images, and ethnic colors, followed by a clear and concise table of contents for easy navigation. The main material uses a two-column layout combining text with cultural photos, supported by infographics and motion diagrams to clarify physics concepts. It includes experiment pages with steps and illustrations, as well as colorful, icon-filled quiz pages to keep students engaged and prevent boredom. Overall, the magazine layout is made sleek, visual, and contextual, so that it is able to convey physics material in a way that is fun and easy for junior high school students to understand.

Physics magazine that is worked on by going through several stages of revision. In its progress, improvements are made starting from the content and material contained in the magazine. The following is the cover of the magazine before revision


Figure 8. Unrevised magazine

The ethnoscience-based physics magazine was refined to align with the curriculum, add clear explanations and examples, and ensure accuracy through expert validation. Visuals were improved by adding physics elements like force vectors and buoyancy diagrams, making concepts clearer and easier to understand.

The magazine content was revised to be more systematic and curriculum-aligned, with clearer explanations of force and motion, including Newton's laws in Hedung Dance and buoyancy on Sikka boats. Images were enhanced with force vectors, motion directions, and experiment diagrams to better support student understanding.

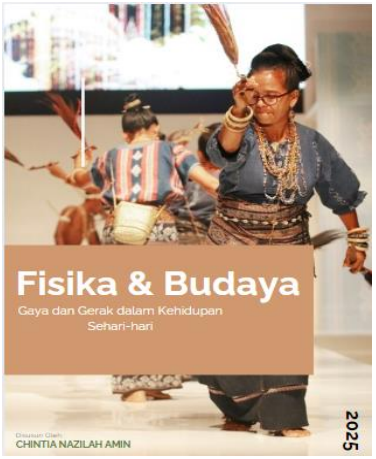



Figure 9. The revised magazine

a. Validation

This stage refines the initial design of the ethnoscience-based physics magazine through validation by two expert lecturers. The analysis produced an average score of 76.43, indicating very good quality and that the magazine is feasible for use.

**Table 9**. Media Validator Results

| Aspects | **Percentage (%)** |
|---|---|
| Layout and readability | 78,13 |
| Visualization and illustration | 83,33 |
| Design consistency | 81,25 |
| Material relevance | 87,5 |
| Scientific accuracy | 58,33 |
| Local cultural integration | 83,33 |
| Reader appeal | 66,67 |
| User engagement | 75 |
| Ease of access | 81,25 |
| Aesthetic appeal | 68,75 |
| Sustainability of use | 75 |

Media validation results show the ethnoscience-based physics magazine scored high in visualization (83.33%), material relevance (87.5%), and cultural integration (83.33%), proving its effectiveness in linking physics with local wisdom. Layout, readability (78.13%), and design consistency (81.25%) were good, while scientific

accuracy scored lower (58.33%) and needs improvement. Reader appeal (66.67%) and aesthetics (68.75%) were fair, with good user engagement (75%), accessibility (81.25%), and long-term usability (75%).

**Table 10**. Material Validation Result

| Aspects | Percentage (%) |
|---|---|
| Suitability to curriculum | 59,83 |
| Relevance of physics concepts | 66,67 |
| Property of science | 65,63 |
| Depth of material | 65,63 |
| Authenticity of local culture | 62,50 |
| Integration of culture and science | 70,83 |
| Understanding by students | 75 |
| Development of literacy skills | 65,63 |

Material validation results show the magazine excels in student understanding (75%) and culture-science integration (70.83%), effectively connecting physics with local culture. Scores for concept relevance, accuracy, depth, and literacy development (65%) indicate good support for learning but need refinement. Local culture authenticity (62.5%) and curriculum alignment (59.83%) require further improvement to fully meet standards.

b. Product Revision

Improvements to the Physics Magazine Based on Ethnoscience include adding image sources and numbering for better structure and clarity, as well as enhancing formula quality with sharper, more readable, and professionally formatted equations to support student understanding of physics concepts.

**1. Implementation Stage**

a. The pretest results were conducted to determine students' initial abilities before using the physics magazine. This analysis includes the average value, median, mode, standard deviation, and minimum and maximum values. The following is Table 11. Pretest

**Table 11.** Pretest

| Class | prettest |
|---|---|
| **Maximum value** | 70 |
| **Minimum value** | 20 |
| **Mean** | 43,25 |
| **Median** | 45 |
| **Mode** | 45 |

Pretest results showed varied student scores, with a maximum of 70, minimum of 20, and an average of 43.25—indicating most students are below the completion standard. The median and mode (45) confirm low understanding of physics material, highlighting the need for more effective learning interventions.

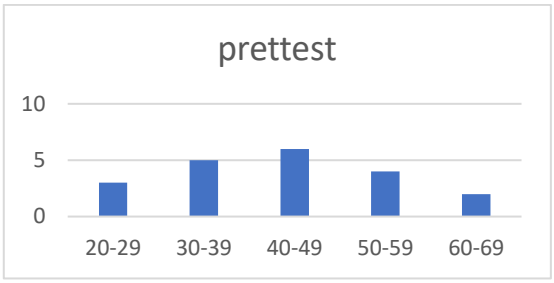



**Figure 10. Pretest frequency distribution**

b. Posttest results

Posttest results measured student understanding after using the ethnoscience-based physics magazine, analyzed descriptively (mean, median, mode, standard deviation, min–max) and compared with pretest scores to assess effectiveness.

**Tabel 12**. Posttest

| Class | posttest |
|---|---|
| Maximum value | 100 |
| Minimum value | 45 |
| Mean | 70 |
| Median | 70 |
| Mode | 85 |

Posttest menunjukkan peningkatan pemahaman siswa setelah menggunakan Majalah Fisika berbasis Etnosains, dengan skor 45–100, rata-rata dan median 70, serta modus 85, menandakan sebagian besar siswa mencapai standar kelulusan dan majalah efektif meningkatkan literasi ilmiah.

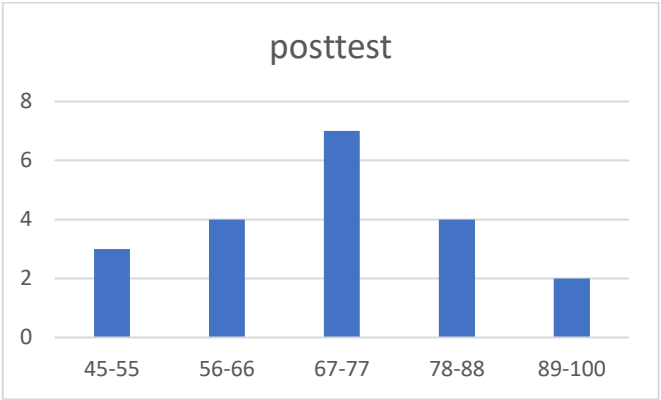



**Figure 11**. Posttest frequency distribution

**Normality Test**

Normality testing was conducted to ensure pretest and posttest data were normally distributed. The results confirmed normal distribution, allowing the use of a paired t-test to evaluate the increase in students' scientific literacy after using the Ethnoscience-Based Physics Magazine.

**Tabel 13**. Normality Test

| Calculation results | sig | Conclusion |
|---|---|---|
| **Prettest** | 0,171 | Data is normally distributed |
| **posttest** | 0,140 | Data is normally distributed |

The normality test showed pretest (sig = 0.171) and posttest (sig = 0.140) data were normally distributed (sig > 0.05). Therefore, a paired t-test could be used to accurately evaluate the increase in students' scientific literacy after using the Ethnoscience-Based Physics Magazine.

**Paired Sample T test**

The Paired Sample T-test showed a significant difference between pretest and posttest scores, with higher posttest averages. This indicates that the Ethnoscience-Based Physics Magazine effectively improves students' scientific literacy and understanding of physics concepts.

**Tabel 14**. Paired Samples Test

| Paired Samples Test | | | | | | |
|---|---|---|---|---|---|---|
| | **Mean** | **Std.deviation** | | **t** | **df** | **Sig. (2-tailed)** |
| | | | **upper** | | | |
| **Prettest-posttest** | -26.75000 | 17.18897 | -18.70532 | -6.960 | 19 | 0.000 |

The Paired Sample Test results showed a significant increase in student understanding after using the Ethnoscience-Based Physics Magazine. The mean difference of -26.75, t value of -6.960, and significance value of 0.000 (<0.05) indicate a statistically significant improvement, proving the magazine effectively enhances students' scientific literacy.

**Tabel 15**. Paired Samples

| | **Mean** | **N** | **Std.deviation** | **Std.eror mean** |
|---|---|---|---|---|
| **Prettest** | 43.2500 | 20 | 15.66718 | 3.50329 |
| **posttest** | 70.0000 | 20 | 16.14083 | 3.60920 |

Statistical analysis showed an increase in student scores after using the Ethnoscience-Based Physics Magazine, with the mean rising from 43.25 (pretest) to 70 (posttest). The standard deviations (15.67 and 16.14) and standard error means (3.50 and 3.61) indicate stable data, confirming the magazine's effectiveness in improving students' scientific literacy.

**Effect size analysis**

The effect size value = 1.68, which according to the criteria falls into the category:

**Table 16.** Effect size criteria

| Value d | Category |
|---|---|
| 1.68 | Large (0.8 < d < 2.0) |

The effect size calculation yielded a value of 1.68, classified as large (0.8 < d < 2.0), indicating that the Ethnoscience-Based Physics Magazine has a very strong and

significant impact on improving junior high school students' scientific literacy, both in practice and statistically.

**Table 17.** Analysis of Minimum Completion Criteria (KKM)

| Total Students | Score Category | Number of Students | Percentage % |
|---|---|---|---|
| 20 | >70 | 11 | 55% |
| | <70 | 9 | 45% |

Based on the posttest data, out of a total of 20 students who participated in ethnoscience-based learning using Physics Magazine, 11 students (55%) managed to achieve a score above 70, indicating a good understanding of the material. Meanwhile, there were still 9 students (45%) who scored below 70, indicating that they still needed further exploration of the concepts taught. Nevertheless, the majority of students have shown an increase in understanding, which confirms the effectiveness of using local culture-based learning media in improving students' scientific literacy.

**2. Evaluation**

Pretest results showed most students scored 40–49, with some as low as 20–39, indicating limited initial understanding. After using the traditional game-based Physics Magazine, posttest scores shifted upward, with most students scoring 67–77 and some reaching 78–99. This demonstrates that the magazine effectively improved scientific literacy, conceptual understanding, and students' ability to connect material to a broader context.

**Discussion**

The development of the Ethnoscience-Based Physics Magazine uses the ADDIE model (Analysis, Design, Development, Implementation, Evaluation) because it is systematic and flexible. This model enables thorough needs analysis, visual and educational design, product development, expert validation, student trials, and continuous evaluation, ensuring the magazine is well-planned, creative, and refined before wider use.

Several previous studies used different approaches. Hasan (2024) created a physics magazine based on traditional games without using the ADDIE model, focusing on practicality and narrative. Junita & Yuliani (2022) developed an ethnoscience-based e-LKPD with one-way validation and emphasized digital practicality. Kriswanti et.al, (2020) created ethnoscience-based syllabi and LKPD for elementary schools. None applied the five-stage ADDIE model, which is the strength of this study.

The use of the ADDIE model in developing this ethnoscience-based physics magazine proved comprehensive and systematic, with measurable data and strict validation at each stage. Media validation reached a very good score (76.43%), and effectiveness tests showed a significant pretest–posttest increase (43.25 to 70) with a large effect size (1.68). This indicates that ADDIE produces impactful media that improve students' scientific literacy and offers a more comprehensive development approach than similar studies.

Media expert validation of the ethnoscience-based physics magazine scored an average of 76.43% (very good). The highest score was in page layout, noted for its neat and symmetrical design using Canva, with natural and ethnic colors that matched the cultural theme and appealed to students. The lowest media validation score was in text readability,

mainly due to small font sizes and low contrast in some sections. This issue arose from design choices that prioritized aesthetics over readability for junior high school students.

Researchers improved the magazine by enlarging fonts, using clearer font types, and adjusting background colors for better contrast. These changes aim to enhance readability and make the magazine more effective and engaging for students. Paired t-test results showed a significant increase in scores from 43.25 (pretest) to 70 (posttest) with $p = 0.000$ ($<0.05$), indicating statistical significance. The effect size of 1.68 shows a very large impact, proving the magazine effectively improves students' understanding of force and motion and enhances scientific literacy. From 20 students, 15 (75%) met or exceeded the KKM of 70, while 5 (25%) did not. Students who met the KKM were engaged, understood the link between culture and physics, and actively participated in exercises. Those who did not meet the KKM struggled with reading, focus, and needed more time to grasp the material. Previous studies by Kahiking (2022) also showed that culture-based physics magazines improve understanding, make learning contextual, and boost interest and test results. These findings support that ethnoscience-based magazines effectively enhance students' scientific literacy by combining visuals, culture, and science in an engaging format.

## Conclusion

Based on the results of the study, the use of Physics Magazine based on traditional games has proven effective in improving students' scientific literacy. This increase can be seen from the comparison of the pretest and posttest results, where the majority of students experienced an increase in understanding after learning using the magazine. Before the treatment, most students had limited understanding, but after learning with the media, there was a significant increase. In addition, this magazine not only helps students understand the material better, but also increases their interest in learning physics through a more contextual and interactive approach.

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