

Development of E-Comic Media Based on Ethnoscience in Improving Scientific Literacy Ability in Physics Science Material

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Abstract: This study aims to (1) determine the development of ethnoscience-based comic media on scientific literacy skills in junior high schools in Kabangka District, and (2) determine the level of students' scientific literacy skills after using ethnoscience-based E-Comic media. This study is development research, or Research and Development (R&D), using the ADDIE development model, which is carried out in only 4 stages: analysis, design, development, and implementation. The population in this study comprised students in class VIII at SMPN Satu Atap 1 Kabangka and SMPN 1 Kabangka. The developed ethnoscience-based E-Comic media was measured for its validity and effectiveness to determine its feasibility. The instruments used were questionnaires and tests of scientific literacy. The results of the study are (1) the development of ethnoscience-based e-comics based on expert validation results is in the very feasible category, with a value of 89.50%, with user responses at SMPN Satu Atap 1 Kabangka of 86% strongly agree, and at SMPN 1 Kabangka of 84.13% strongly agree. (2) The scientific literacy skills of class VIII of SMPN Satu Atap 1 Kabangka experienced an increase with an average post-test score of 79.75, with an N-Gain value of 0.64 and was in the moderate category. Meanwhile, the scientific literacy skills of class VIII at SMPN 1 Kabangka also increased, as indicated by an average post-test score of 80.22, an N-Gain value of 0.66, and a moderate category.

Keywords: E-Comic Media; Ethnoscience; Science Literacy Skills

Introduction

State Science and technology are the most important elements supporting human activities in daily life. As time progresses, they become increasingly sophisticated and support the creation of new technologies that have influenced this life and are unavoidable because they provide many benefits and make work easier (Zebua, 2023), becoming an important key in the 21st century (Zebua, 2023). The development of science and technology in the current era of globalisation demands that humans continually

improve their abilities and skills to compete not only nationally but also internationally. One of the basic sciences that plays a very important role in supporting science and technology is science in learning (Sayadi & Pangandaman, 2025). Science is the study of natural objects and phenomena, derived from the thoughts and research of scientists, carried out through experimental methods (Faizin et al., 2024). One of the skills that students are expected to master after studying science is scientific literacy (Sutiani et al., 2021). Scientific literacy is a person's ability to solve problems using scientific knowledge (Jufrida et al., 2019). Scientific literacy plays

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a crucial role in the 21st century and is a skill that students must strengthen. With these skills, students can effectively apply the knowledge they acquire to solve real-life problems (Iskandar et al., 2023). Science literacy needs to be enhanced and instilled in students, particularly in physics, so that students can directly engage with the impact of science on their daily lives (Hasanah et al., 2023).

Literacy development in physics learning plays a crucial role in innovation and technology. Scientific literacy is the ability to use scientific knowledge to explain phenomena, design investigations, interpret data, and present scientific evidence (OECD, 2016). Scientific literacy encompasses not only understanding scientific concepts but also applying science to students' real-life situations. Based on the 2018 Program for International Student Assessment (PISA), Indonesia ranked 71st out of 79 countries with an average score of 396, well below the OECD average of 489. The 2022 PISA test showed a slight improvement in literacy scores, with scores rising by 5-6 positions in each literacy category (Kemendikbudristek, 2023). This indicates that Indonesian students are still unable to understand and apply scientific concepts in real-life contexts, meaning their scientific literacy remains low (Lestari et al., 2021).

Physics, a branch of science, remains difficult for students to learn independently (Susilawati et al., 2020). This is because students perceive physics as having too many formulas, making it boring (Halmuniati et al., 2022). Student learning outcomes in physics are generally still unsatisfactory. One way to achieve this is by utilising modern technology, such as mobile learning, which can make learning more enjoyable (Pamungkas et al., 2018).

Student learning outcomes in physics are generally unsatisfactory. One way to achieve this is by utilising modern technology, such as mobile learning, which can make learning more enjoyable (Zakaria & Nawati, 2020). The currently recommended approach to science in Indonesia is ethnoscience, which integrates local culture and students' scientific knowledge. By using ethnoscience, students can directly observe objects (Pertwi et al., 2019). Teachers must be able to incorporate local cultural values into their teaching (Ilwandri et al., 2023). Integrating local wisdom into learning positively impacts the quality of physics learning. Empirical evidence shows that this approach facilitates the integration of physics with students' everyday experiences, thereby enhancing their scientific understanding (Masita et al., 2020). Furthermore, this learning enables a meaningful, abstract understanding of physics concepts.

Teachers' lack of technology skills and knowledge leads to limited implementation of digitalisation in the learning process. Learning media are supporting tools

that can make the delivery and reception of material in the classroom more interactive (Pea et al., 2021). One learning medium that can be used to improve scientific literacy is comics. Comics in learning are usually packaged in an attractive, interactive format, using online media rather than textbooks (Sanny & Hendawati, 2021). Comics in physics learning also encourage students to think more imaginatively when viewing characters and stories in physics comics, and are expected to foster scientific literacy skills. This is supported by research (Filjinan et al., 2022), which found that the use of e-comics is very effective in improving students' scientific literacy.

Based on the results of initial interviews with science teachers at SMPN Satu Atap 1 Kabangka, it was found that the school's facilities and infrastructure were still inadequate, particularly in projectors, making it difficult to implement audio-visual learning media. As a result, teachers rarely used learning media. So, when interviewed, students still considered physics difficult to learn and very boring, which contributed to their low scientific literacy. Based on the background above, the researcher was interested in researching the Development of E-Comic Media Based on ethnoscience to improve scientific literacy skills in Physics Science Materials for Junior High Schools.

Method

This research is a Research and Development (R&D) study aimed at producing ethnoscience-based e-comic learning media to improve scientific literacy. This study uses the ADDIE model, which comprises five stages: Analysis, Design, Development, Implementation, and Evaluation (Sugiyono, 2019). The effectiveness of the developed e-comic was evaluated using pre-experimental research with a one-group pretest-posttest design, which included only the experimental class to observe post-treatment conditions. The subjects of this study were junior high schools in Kabangka District in grade VIII. The instruments used were expert validation sheets and pretest-posttest questions. Data collection techniques used test instruments (science literacy questions) and non-test instruments (questionnaires and observation sheets) (Aryanto, 2021).

The data analysis technique used a data validation test consisting of content and construct validity tests by the validator and an empirical validity test by students before the field trial. The feasibility of the ethnoscience-based E-Comic media was reviewed from the expert validator's assessment in the form of a score using the formula (Arikunto, 2014):

$$\bar{x} = \frac{\sum x}{n} \quad (1)$$

With $\bar{x}$ is the average score obtained and n is the number of assessors. Next, use the assessment criteria as in Table 1.

Table 1. Assessment criteria

Interval Shoes	Category
$X > \bar{X} + 1.8 S_{Bi}$	Very good
$\bar{X} + 0.6 S_{Bi} < X \leq \bar{X} + 1.8 S_{Bi}$	Good
$\bar{X} - 0.6 S_{Bi} < X \leq \bar{X} + 0.6 S_{Bi}$	Pretty good
$\bar{X} - 1.8 S_{Bi} < X \leq \bar{X} - 0.6 S_{Bi}$	Not Good
$X \leq \bar{X} - 1.8 S_{Bi}$	Very Poor

The test of the effectiveness of ethnoscience-based e-comic media is based on data analysis of students' scientific literacy abilities before and after treatment. *Paired Sample t-test* to find out how much students' scientific literacy skills have improved, *N-gain*. The test of e-comics' effectiveness on students' scientific literacy skills is based on a comparison between the control and experimental classes. Data processing using a *one-sample t-test* with a significance level of 5%. The *N-Gain* category refers to Table 2.

Table 2. N-Gain value categories

Index	Category
≥ 0.7	High
$0.3 \leq (<g>) < 0.7$	Currently
< 0.3	Low

Result and Discussion

The product of this research and development is a science-based e-comic media on the topic of physical changes. The results of the series of studies conducted are:

Results of the Analysis Phase

In the analysis stage, two activities were carried out: a literature review to determine the curriculum used and its suitability for the learning objectives. Field studies, through interviews and initial observations, found that the learning media commonly used by teachers were still limited to simple teaching aids. The school's limited facilities and infrastructure prevented teachers from making much use of learning media, resulting in low student interest in learning, especially in science. Furthermore, based on the analysis of student characteristics at SMPN Satu Atap Kabangka and SMPN 1 Kabangka, scientific literacy skills remained low, with inadequate facilities and infrastructure. These findings highlight the urgent need for innovative learning tools that not only support conceptual mastery but also motivate students to be actively involved in the learning

process. Previous research has shown that low motivation and a lack of infrastructure often contribute to passive learning behaviour (Kooloos et al., 2023), thereby impacting higher-order thinking skills.

Design Phase Results

Based on the results of the analysis stage, the next step is the design stage. Several steps taken and obtained from the design stage are: (1) developing learning media quality assessment instruments (material assessment instruments and user assessment instruments). At this stage, (2) designing the product using the Canva and CapCut applications, including the storyline, characters, and comic script.

Development Stage

The development stage begins with the creation of e-comic media based on the previously prepared design. Some results from the e-comic media creation are presented in Figures 1 and 2.



Figure 1. Examples of E-Comic Media Content

Figure 1 shows Zuan, Zelda, and Viren playing together. Zuan and Zelda explain the state of matter (why farts smell so bad) and particle models (why farts can spread their odour).



Figure 2. Examples of E-Comic Media Content

Figure 2 shows the process of heating water carried out by Zuan, Viren, and their father. Their father explains the material on the state of matter that

evaporates (why water that is continuously heated will run out). After obtaining the initial product of the ethnoscience-based e-comic and the scientific literacy skills, a validation test was conducted. The results of the data analysis on the validity of the ethnoscience-based e-comic learning media and on scientific literacy skills regarding changes in the state of matter at the junior high school level are presented in Table 3.

Table 3. Expert validation results

Indicator	Shoes Total	Presentation (%)	Category
Presentation		88.00	
Aspects	22.33		Very Worthy
Content/Material		93.33	
Aspect	26.667		Very Worthy
Language		90.00	
Aspects	27.667		Very Worthy
Graphic Aspects	27.333	86.67	Very Worthy
Total Aspect		89.50	Very Worthy

Based on Table 3, the presentation aspect is 88%, indicating that the e-comic media meets very feasible criteria. This is evident from the media display, which is very attractive and can stimulate students' scientific literacy skills. In the content/material aspect, the presentation achieved 93.33% and falls within a very feasible category, as evidenced by the suitability of the material (learning outcomes and learning objectives), conceptual truth, level of material accuracy, systematic delivery of material, and improvement of students' literacy skills. In the language aspect, the presentation is 90%, in a very feasible category, meaning the media has a very feasible criteria level, as reviewed from the level of language used, the use of appropriate terminology, and the suitability of the language. In the graphic aspect, the presentation has an 86.67% score and falls in the very feasible category, meaning the media is clearer and easier to understand, actively involves students, and considers usefulness and meaningfulness. For the overall presentation, the average is 89.50%, which is in a very feasible category. This very valid result criterion cannot be separated from the input or suggestions submitted by the validator.

After the validity test was conducted and a valid e-comic learning medium was obtained, the study proceeded to a practicality test. The practicality test was conducted on 20 students. Initially, the twenty students were asked to read and view an e-comic on the topic of changes in the state of matter for junior high school students, based on ethnoscience and scientific literacy skills, which had been revised according to the expert validator's directions or suggestions. After that, a practicality questionnaire was given. The results of the questionnaire indicated that 86% of students agreed that

the e-comic media on the material on changes in the state of matter helped with independent learning, was easy to understand, contained all the core lessons, increased learning interest, and stimulated students' scientific literacy skills.

Implementation Stage

After conducting validity and practicality tests on the ethnoscience-based e-comic learning media and scientific literacy skills, it was shown that the media met the criteria for validity and practicality. After that, a field trial was conducted. The results of the field trial revealed that the ethnoscience-based e-comic media and scientific literacy skills on the material of changes in the state of matter were effective in improving students' scientific literacy skills. These results were obtained from responses to the scientific literacy skills questions in the experimental class. Before the treatment, the average scientific literacy score was 42.39; after the treatment, it was 80.22. The results of the test analysis, a *paired sample t-test*, are presented in Table 4.

Table 4. Results of Paired Test Analysis

	Paired Differences Std. Deviation	t	Sig. (2 tailed)
pretest - Posttest	8.89664	-20.391	.000

Based on Table 4, the data obtained shows that the significance value of 0.000 means that the average scientific literacy ability of the experimental class when using ethnoscience-based e-comic learning media on the material of changes in the state of matter is better than the average final data of the scientific literacy ability of the experimental class without using e-comics. N-testGain A score of 0.66 was obtained, indicating that the increase in scientific literacy skills influenced by media is classified as moderate. These results align with the findings of several researchers who stated that it has several advantages, such as stimulating scientific literacy skills, especially for middle school students, because it contains many images appropriate to their developmental level (Wicaksono et al., 2020; Naila et al., 2022; Susanti et al., 2025). Meanwhile, according to Huda (2021), comics used in teaching and learning can foster desire, develop new character traits and interests, improve literacy skills, stimulate learning activities, and have psychological effects on students (Huda, 2021).

Conclusion

Based on the results of the research on the development of ethnoscience-based e-comic learning media on the material of changes in the state of matter at

the junior high school level, the average score of the validity test by experts was 89.50 so that it was included in the very feasible criteria, 86% of the participants in the practicality test stated that the media could be used in the learning process. E-comics effectively improve students' scientific literacy skills, with an n-gain score of 0.66, indicating an increase in these skills. So that ethnoscience-based e-comic media on the material of changes in the state of matter is declared feasible to use because it is valid, practical and effective in improving scientific literacy skills. Based on the analysis of each originality indicator, it receives the lowest average score among the indicators, so it needs special attention and warrants further research if developing other e-comic materials.

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Author Contributions

All authors have read and agreed to the published version of the manuscript." Please turn to the term explanation. Authorship must be limited to those who have contributed substantially to the work reported.

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Conflict of Interest

The authors state that there are no known personal relationships or financial interests that could be perceived as influencing the research discussed in this paper.

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