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Development of Comic-Based Teaching Materials on Ocean Literacy in Elementary Schools

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ABSTRACT

The availability of contextual and engaging teaching materials is essential for improving the quality of learning, particularly in the IPAS (Natural and Social Sciences) subject. This study aims to: (1) Develop marine literacy-based comic teaching materials for fifth-grade elementary students; (2) Determine the validity and feasibility of the developed materials; and (3) Assess their effectiveness in enhancing students' marine knowledge, behavior, and attitudes toward the sea. This research employed the Research and Development (R&D) method using the ADDIE model, which includes the stages of Analyze, Design, Development, Implementation, and Evaluation. The limited trial subjects were fifth-grade students at SD Negeri 5 Rupat Utara, Bengkalis Regency, Riau Province. Data were collected through observation, interviews, documentation, questionnaires, and tests. The results showed that the developed comic teaching materials were highly valid (average score of 94.79%), highly feasible (teacher response 94.28% and student response 94.99%), and effective in improving student learning outcomes (N-Gain score of 0.82, categorized as high). Therefore, the marine literacy-based comic is suitable for use in IPAS learning as a medium that enhances students' understanding and awareness of the sea from an early age.

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INTRODUCTION

The ocean is under increasing pressure from human activities (O'Hara et al., 2021). Threats such as overexploitation and climate change necessitate sustainable management of marine resources (Dewi et al., 2023; Gkargkavouzi et al., 2020; Legionosuko et al., 2019; Rinika et al., 2023). Ocean Literacy or understanding the interactions between the ocean and humans is key to addressing these challenges (Worm et al., 2021). The United Nations recognizes ocean literacy as a vital step toward ocean sustainability and has declared the Decade of Ocean Science for Sustainable Development (2021–2030) (Mokos et al., 2020). Ocean Literacy has become a global concern because it encompasses understanding the ocean's role in providing food (Costello et al., 2023), regulating

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Earth's climate (Dalpadado et al., 2024), supporting recreation and tourism (Garcia & Cater, 2022), and serving educational purposes (Fielding et al., 2019).

In Indonesia, efforts to integrate ocean Literacy into the educational curriculum still face challenges (Kautsari et al., 2022; Prastianto et al., 2022; Utami et al., 2021). So far, knowledge of marine issues has only received limited attention in the national curriculum. This can be seen in elementary school textbooks, where in-depth marine-related content is still lacking, potentially limiting students' understanding of marine issues. In facing this challenge, it is increasingly important to instill ocean Literacy from an early age—even from the first year of school—by integrating ocean Literacy topics into the curriculum(Kautsari et al., 2023; Mogias et al., 2019). One possible solution is the development of teaching materials.

One type of teaching material that can be utilized is comics (Mamolo, 2019). Teaching materials can be presented in comic narratives so that students feel as though they are not reading academic content, but enjoying a comic that is integrated with the subject matter (Syaflita et al., 2023). Several studies in Indonesia have used comics to deliver science education with marine themes, such as increasing understanding of marine conservation (Syarah et al., 2019) and introducing basic disaster knowledge (Astria, 2019). However, these studies have not specifically focused on ocean Literacy as the main theme, particularly within the context of IPAS (Natural and Social Sciences) learning in elementary schools. Furthermore, most of the studies have focused on comic media development without integrating IPAS content relevant to the national curriculum, such as understanding Indonesia's geographical position, marine resource wealth, and the importance of marine conservation.

This study aims to fill that gap by developing comic-based teaching materials on ocean Literacy for Grade V elementary school students. Students are expected not only to understand information about the ocean but also to demonstrate responsible attitudes and behaviors toward the marine environment. Comics have proven effective in motivating students through engaging combinations of text and visuals (Çiçek Şentürk & Selvi, 2024). Comics serve as ideal pedagogical tools because they stimulate creativity (Golding & Verrier, 2021) and enhance student engagement in marine conservation efforts. The development of these materials aims to improve students' perceptions of the ocean and support the ocean Literacy movement. Ultimately, this initiative can foster behavioral change in protecting the marine environment for a sustainable future (Kelly et al., 2022).

In addition, the learning process in elementary schools still relies heavily on conventional methods, which often limits students' enthusiasm and participation. This situation highlights the need for alternative learning resources that are more engaging and relevant to students' daily lives. Responding to this gap, the researchers conducted this study with the following objectives: (1) to explore the development of comic-based teaching materials on ocean literacy for elementary school students; (2) to evaluate the validity and feasibility of the developed materials in terms of content, media, and language; and (3) to examine the effectiveness of these materials in enhancing students' understanding and attitudes toward ocean literacy.

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LITERATURE REVIEW

Teaching Materials

Teaching materials are an essential component of the learning process as they help students develop skills such as reading, writing, critical thinking, and the use of technology (Bukoye, 2019). According to (Anwar, 2023) teaching materials are systematically structured learning content, either in written or non-written form, that supports the achievement of learning objectives. These materials present competencies that students must master in a complete and structured manner. They should be systematically designed and include various media formats, such as videos and digital platforms (Erlina, 2018). (Kochhar, 2000) emphasized that innovative and contextual teaching materials are vital to meet the learning needs of the 21st century.

Comics

Eisner defines comics as sequential art that combines words and images to convey information (Lo et al., 2022). According to Hayman and Pratt, a comic can be considered a work of art if it consists of a sequence of juxtaposed images that form a narrative either on their own or when combined with text (Mamolo, 2019). As a learning medium, comics excel at conveying complex concepts in a lighter and more comprehensible way. The visual and narrative combination allows students to build understanding through enjoyable learning experiences (Al Faruque, 2023).

Ocean Literacy

Ocean Literacy includes an understanding of the ocean's role in life, the ability to communicate marine-related issues, and the capacity to make responsible decisions (McCauley et al., 2019; Winks et al., 2020). (Worm et al., 2021) stated that ocean-literate individuals must understand the reciprocal influence between humans and the ocean. (Strang et al., 2007) outlined three key aspects of marine literacy: (1) knowledge about the ocean, (2) positive attitudes toward the marine environment, and (3) responsible behaviors in maintaining marine ecosystems. These three aspects are interrelated in shaping environmentally conscious citizens.

Mokos et al. (2020) described seven core principles of marine literacy: the ocean as a single interconnected system, its influence on Earth's features, its role in climate regulation, ecological functions, biodiversity, human-ocean interactions, and the fact that much of the ocean remains unexplored. These principles form the foundation for comprehensive marine education.

Development of Comic-Based Teaching Materials on Marine Literacy

The development of these materials aims to raise student awareness of the ocean's importance and the impact of human activity on it. As an archipelagic country, Indonesia requires contextual and engaging learning media, one of which is comics. The products developed include two main teaching materials for Grade V students: (1) IPAS Teaching Materials based on marine literacy, integrated with the Merdeka Curriculum and incorporating ocean Literacy principles, and (2) A Ocean Literacy Comic presenting an adventure story set on North Rupat Island, introducing Indonesia's geographical location and fostering concern for the ocean. Both are developed using digital platforms tailored to students' visual preferences and learning needs.

Development Platforms for IPAS Teaching Materials Based on Ocean Literacy

The development of IPAS teaching materials and ocean Literacy comics in this study utilizes various digital platforms to support creativity and visual appeal. Canva is the main platform due to

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its easy access and complete design features, such as templates, animations, and visual element arrangements (Sandi et al., 2024; Wulandari & Mudinillah, 2022). ToonApp and ToonMe applications are used to create character illustrations from photos, automatically converting them into cartoon images, although with some limitations in precision depending on photo quality (Nasution et al., 2024). The Snow app is used to edit backgrounds with attractive cartoon filters, while Adobe Photoshop 2020 enhances visuals through professional image editing features (Bangun et al., 2024; Minarni, 2020). This combination of platforms produces informative and appealing teaching materials and comics, tailored to the characteristics of elementary school students.

METHOD

This study is a Research and Development (R&D) project aimed at producing a product in the form of IPAS teaching materials and a comic based on ocean literacy for Grade V elementary school students. The development model used is ADDIE, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation

This study is a Research and Development (R&D) project aimed at producing a product in the form of IPAS teaching materials and a comic based on ocean Literacy for Grade V elementary school students. The development model used is ADDIE, which consists of five stages: Analysis, Design, Development, Implementation, and Evaluation (Molenda, 2003).

In the analysis stage, observations and interviews were conducted with two teachers and five Grade 5 students at SD Negeri 5 Rupat Utara, along with a curriculum review of the IPAS theme “Indonesiaku Kaya Raya.” The design stage included the preparation of content, a comic storyboard, and validation and evaluation instruments. Product development was carried out digitally using applications such as ToonApp, ToonMe, Snow, Adobe Photoshop, and Canva. Validation was conducted by experts in content, media, and language, followed by product revisions based on their suggestions. Product testing was carried out in three stages: individual, small group, and large group trials. The effectiveness of the product was measured through pretest-posttest using 20 multiple-choice questions based on the seven principles of ocean literacy, namely: (1) The ocean is a major feature of Earth and has unique characteristics, (2) The ocean and life in the ocean shape the features of Earth, (3) The ocean is a major driver of weather and climate, (4) The ocean makes Earth habitable, (5) The ocean supports a great diversity of life and ecosystems, (6) The ocean and humans are inextricably interconnected, (7) The ocean is largely unexplored.

Qualitative data were obtained from interviews and expert feedback, while quantitative data came from test results and questionnaires. Data were collected using a four-point Likert scale with both positive and negative statements aligned to indicators as shown in Table 1 and Table 2.

Table 1. Grid of Attitude Assessment Items on Concern for the Marine Environment

Indicators	Item Number	
	Positive Statement	Negative Statement
Eco Crisis	1	2
Limit to growth	3	4
Anti anthroprocenism	5	6
Balance of nature	7	8
Anti exemptionalism	9	10
Total		10

Source: Adapted from (Hindrasti, 2018)

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Table 2. Blueprint of Items on Environmentally Caring Behavior toward the Marine Environment

Indicators	Item Number	
	Positive Statement	Negative Statement
Persuasion	1,3	2, 4
Consumer Actions	5,7	6,8
Ecological Management	9	10
Total		10

Source: Adapted from (Hindrasti, 2018)

The research instruments were tested for validity and reliability to ensure their feasibility as tools for measuring the effectiveness of the marine literacy-based comic teaching materials. Validity testing was conducted using the Pearson Product Moment correlation in SPSS version 23. With 30 student respondents, the critical r value at $\alpha = 0.05$ (df = 28) was 0.361. An item was considered valid if r calculated > r table. Of the 27 multiple-choice items used for the pretest and posttest, 20 items were found valid and were used in the study. Meanwhile, the attitude and behavior questionnaire on ocean care consisted of 20 items, which also passed the validity test.

Reliability testing was conducted using the Cronbach's Alpha formula. An instrument is considered reliable if $\alpha > 0.60$. The results showed that both the pretest-posttest items and the questionnaire had reliability values exceeding the minimum threshold, making them suitable for measuring the effectiveness of the teaching materials.

Table 3. Reliability Test Results for the Marine Knowledge Pretest

Reliability Statistics	
Cronbach's Alpha	N of Items
.723	28

Table 4. Reliability Test of Marine Knowledge Posttest

Reliability Statistics	
Cronbach's Alpha	N of Items
.723	28

Table 5. Reliability Test of Questionnaire Statements on Attitudes and Behavior Toward the Marine Environment

Reliability Statistics	
Cronbach's Alpha	N of Items
.730	21

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Based on Tables 3, 4, and 5, the reliability test results show that the pretest and posttest items have a Cronbach's Alpha value of 0.723, while the attitude and behavior questionnaire has an Alpha value of 0.730. Therefore, all three instruments are considered reliable.

This study employed both qualitative and quantitative data analysis techniques. Qualitative data, such as interview results, expert feedback, and student responses, were analyzed descriptively to improve the product. Quantitative data from the pretest-posttest and questionnaires were analyzed using descriptive quantitative methods to evaluate the effectiveness and quality of the comic-based teaching materials.

The validity of the teaching materials was analyzed based on assessments from content, media, and language experts. Meanwhile, the feasibility was analyzed from teacher and student questionnaire results. Both were analyzed by calculating the average percentage score for each assessment aspect using a four-point Likert scale, namely: Setuju (S), Cukup Setuju (CS), Kurang Setuju (KS), dan Tidak Setuju (TS). The criteria for validity and feasibility assessments are as follows:

Table 6. Validity Criteria for Teaching Materials

Validity Score Range	Validity Level
81.00% – 100%	Very valid or can be used without revision
61.00% – 80%	Valid or usable with minor revisions
41.00% – 60%	Less valid, not recommended for use due to major revisions needed
21.00% – 40%	Not valid or should not be used
00.00% – 20%	Very invalid or must not be used

Source: Akbar in (Rosita, 2022)

Table 7. Feasibility Criteria for Teaching Materials

Average Score Interval (%)	Category
85% < score ≤ 100	Highly Feasible
70% < score ≤ 85	Feasible
50% < score ≤ 70	Moderately Feasible
1% < score ≤ 50	Not Feasible

(Leonardy, 2023)

Improvement in Marine Knowledge was analyzed using the N-Gain test, calculated from pretest and posttest scores. The N-Gain formula is as follows:

$$G = \frac{S_{post} - S_{pre}}{S_{maks} - S_{pre}}$$

Explanation:
G : N-Gain
Spost : Posttest score (after using the comic-based teaching materials)
Spre : Pretest score (before using the comic-based teaching materials)
Smaks : Maximum possible score

The average N-Gain score obtained was then categorized according to the following table:

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Tabel 7. N-Gain Score Interpretation Categories

N-Gain Range	Interpretation Category
$g > 0.7$	High
$0.3 < g \leq 0.7$	Medium
$g \leq 0.3$	Low

(Agustin, 2020)

Normality testing was conducted using the Shapiro-Wilk test in SPSS version 23 to determine whether the pretest and posttest data were normally distributed, which is essential for selecting the appropriate statistical test.
If Sig. > 0.05, the data are considered normally distributed.
If Sig. ≤ 0.05, the data are considered not normally distributed (Hamasha et al., 2022).

The effectiveness of the teaching materials was examined using a T-test, comparing the mean pretest and posttest scores.
If the data were normal, a parametric test was used.
If the data were not normal, a non-parametric test was used.

Decision criterion: If Sig. < 0.05, it indicates a significant difference, and the teaching materials are considered effective. In addition, effectiveness was also analyzed using a questionnaire on attitudes and behaviors related to marine environmental care, measured with a Likert scale containing both positive and negative statements.

Table 8. Scoring Criteria for Attitudes and Behaviors in Marine Environmental Care

Score (%)	Category
81–100	Very Good
61–80	Good
41–60	Fair
21–40	Poor
0–20	Very Poor

(Oktaviani, 2021)

RESULTS

This study focused on the development of comic-based teaching materials on ocean Literacy for Grade V IPAS learning, with the topic “Indonesiaku Kaya Raya”, particularly the subtopics “Bagaimana Bentuk Indonesiaku” and “Indonesia Kaya Alamnya”. The research was conducted at SD Negeri 5 Rupat Utara, located in Bengkalis Regency, Riau Province, during the odd semester of the 2024/2025 academic year, from July to December 2024. The study applied the ADDIE development model, which consists of five stages:

Analyze

The analysis stage was conducted to identify the need for developing teaching materials that are contextualized to students' environments. Observations at SD Negeri 5 Rupat Utara revealed that the IPAS textbook in use did not specifically include ocean Literacy content, even though the school is located in a coastal area with great potential to be used as a learning resource.

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Interviews with classroom teachers indicated that ocean Literacy is an important topic but has not been adequately addressed in current textbooks. Teachers believed that visual and narrative approaches, such as comics, could help students understand marine issues in a more enjoyable way. Meanwhile, interviews with five students revealed that they had a high interest in the ocean and expressed a preference for learning media in the form of comics.

In addition, a curriculum analysis of the IPAS material under the theme “Indonesiaku Kaya Raya” showed that the learning focus remains general and does not emphasize the ocean as part of Indonesia's natural wealth. These findings reinforce the urgency of developing teaching materials based on marine literacy.

Design

At this stage, two main products were designed: IPAS teaching materials and ocean Literacy comics. The teaching materials aim to enhance students' knowledge of marine science, while the comics focus on shaping attitudes and behaviors that promote caring for the ocean. The design process included structuring the content of the teaching materials and storyboarding the comics. The components of the teaching materials included: an introduction, learning objectives, main material, student activities (LKPD), evaluation, and a summary. The entire design was created to be engaging and suitable for the characteristics of elementary school students.

The comic storyboard was developed with a teacher and five students as main characters. The story was narrative and featured direct interaction with the marine environment, such as visits to the beach and discussions on marine issues. The comics were designed visually using Canva and other image processing applications to be more contextual and communicative.

Development

The teaching materials and comic products were developed digitally by adapting the school environment and students' faces into cartoon illustrations. The illustration process was done using ToonApp, ToonMe, Snow, and Adobe Photoshop applications, then arranged into the comic layout using Canva. The comic creation process began with taking pictures of the characters using a smartphone camera. The characters in the comic were played by students of SDN 5 Rupat Utara, while the researcher played the role of the female teacher.

Figure 1. Original photos of the comic characters

Next, comic character editing was done using ToonApp and ToonMe applications to transform photos into cartoon illustrations, and the Snow application wa.s used for background editing. Cartoon effects were chosen as needed, such as 3D Cartoon for faces and Full Body Cartoon for full-body photos.

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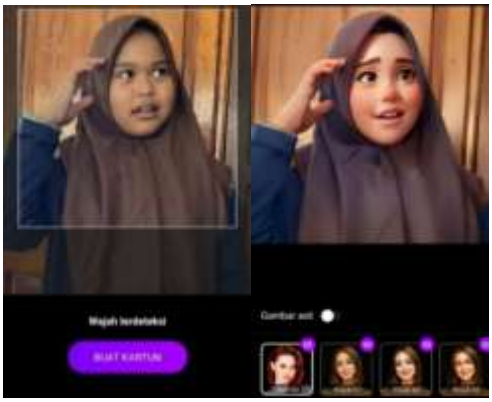

Figure 2. Image transformation to 3D cartoon feature

The next stage was combining images and backgrounds. Backgrounds were edited with an AI Cartoon effect via the Snow application, then replaced using Adobe Photoshop. Cartoonized characters were combined with backgrounds suitable for the story, then saved in PSD or JPG format.

Figure 3. Changing background in Adobe Photoshop

The final stage was arranging the comic layout in Canva. Illustrations and dialogues were systematically inserted into the comic pages, including the cover, foreword, story content, and conclusion. Speech bubbles were added to clarify conversations between characters according to the scene.

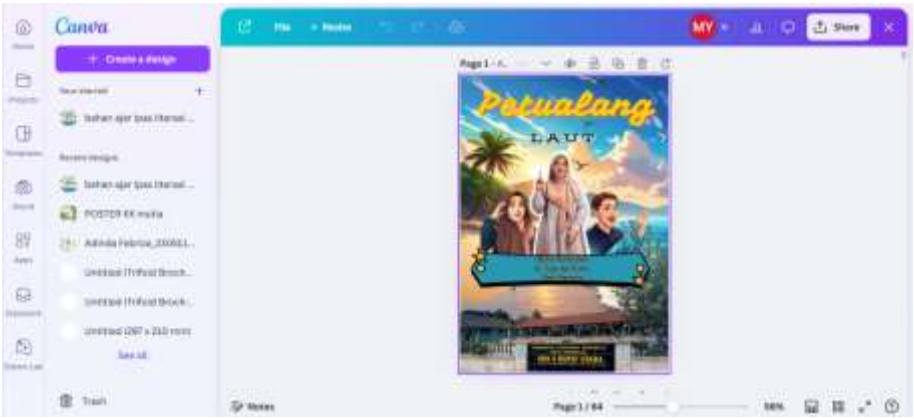

Figure 4. Comic cover design

After the products were completed, validation tests were conducted by material, language, and media experts. The validation results are shown in the following table.

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Table 9. Recapitulation of Teaching Material and Comic Product Assessment by Media, Material, and Language Experts

No.	Type of Validator	Teaching Material Validation (%)	Comic Validation (%)	Average (%)	Category
1	Content Expert	95.00%	93.18%	94.09%	Very Valid
2	Language Expert	96.05%	91.66%	93.86%	Very Valid
3	Media Expert	96.42%	96.42%	96.42%	Very Valid
	Combined Average	**95.82%**	**93.75%**	**94.79%**	**Very Valid**

Based on this data, the teaching material and comic products were declared very valid and suitable for implementation. Some feedback from validators included: the need for illustration refinement to better reflect coastal community life, layout improvement to be more proportional, and consistency in terminology usage. Product revisions were made based on this input, such as: adjusting font size and background color, adding explanations of ocean Literacy principles, refining the foreword, and reducing visual ornaments for clearer backgrounds.

Implementation

The implementation stage in this research aimed to determine the effectiveness of marine literacy-based comic teaching materials in increasing the knowledge, attitudes, and behaviors of caring for the ocean among fifth-grade elementary school students. Trials were conducted at two scales: small group trials and large group trials. The small group trial involved five fifth-grade students, yielding an average percentage of 97.91%, which falls into the very good category. The aspects of content, language, presentation, appearance, learning effects, and accessibility each scored between 95% and 100%.

Furthermore, the large group trial was conducted at SD Negeri 5 Rupat Utara, involving 23 students and two fifth-grade teachers. The trial activities lasted for three meetings, covering pretest administration, learning two IPAS topics using comic teaching materials, posttest, and filling out teacher and student response questionnaires. The teachers' response to all assessed aspects (content, language, presentation, design, learning effects, and accessibility) showed an average percentage of 94.79% in the very good category. Student responses were also very positive, with an average percentage of 94.99%. When combined, the total average from both respondents reached 94.89% and was categorized as very good.

Evaluation

The effectiveness of the teaching materials was evaluated through the analysis of pretest and posttest results, normality tests, statistical tests using paired sample t-test, and filling out questionnaires on attitudes and behaviors of caring for the ocean. The N-Gain calculation results showed an average score increase of 0.6491 or 64.91%, which falls into the medium or moderately effective category.

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The Shapiro-Wilk normality test yielded significance values of 0.144 for the pretest and 0.115 for the posttest, both greater than 0.05, indicating that the data were normally distributed. The complete normality test results are presented in Table 10 below:

Table 10. Normality Test Results

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pretest – Marine Knowledge	.103	23	.200*	.936	23	.144
Posttest – Marine Knowledge	.178	23	.056	.931	23	.115

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Meanwhile, the results of the paired sample t-test showed a significance value of 0.000 (<0.05), meaning there was a significant difference between the pretest and posttest scores. The detailed test results are displayed in Table 11.

Table 11. Paired Sample T-Test Results

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Pretest – Posttest (Marine Knowledge)	-25.000	10.225	2.132	-29.422	-20.578	-11.726	22	.000

Thus, the use of comic teaching materials has proven to have a significant impact on increasing student understanding. In addition, questionnaires on attitudes and behaviors of caring for the sea, given to 23 students, showed positive results, with an average attitude score of 83,89% (good category) and behavior of 88,21% (very good category). These findings confirm that marine literacy-based comic teaching materials are not only effective in improving cognitive aspects but also positively influence students' affective aspects.

DISCUSSION

This research proves that marine literacy-based comic teaching materials are valid, feasible, and effective for use in science learning in elementary schools. The discussion covers three main aspects: development, feasibility, and effectiveness of teaching materials.

First, the development of teaching materials follows the ADDIE model, which has proven relevant for designing media according to the needs of coastal students. The lack of marine-themed learning media reinforces the findings of (Prastianto et al., 2022; Utami et al., 2021) and (Kautsari et al., 2022) regarding the lack of integration of ocean Literacy in education. Comics were chosen because they are liked by students and easy to understand, in line with (Lo et al., 2022).

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Second, validation by experts showed an average of 94.79% (very valid category), and student-teacher trial responses were also high (97.91% and 94.99%). This proves that comics as teaching materials meet content, language, and design standards and can convey learning messages effectively (Lo et al., 2022).

Third, in terms of effectiveness, the increase in N-Gain score of 0.6491 (medium category) and the results of the t-test ($p = 0.000$) show a significant increase in student understanding. Questionnaires on attitudes (85.42%) and behavior (88.57%) also show a positive influence on students' affective aspects. This result supports the concept of ocean Literacy from (Strang et al., 2007) which includes knowledge, attitudes, and behavior.

Overall, these results are in line with research (Astria, 2019; Tri, 2021), and emphasize the importance of local-based contextual media in developing 21st-century literacy and the character of Pancasila students.

CONCLUSION

The findings indicate that the marine literacy-based comic is valid, feasible, and effective for use in elementary school science (IPAS) learning. Expert validation yielded an average score of 94.79% (very valid), while teacher responses reached 94.99% and student responses 97.91%, both categorized as very good. These results confirm previous studies (Kautsari et al., 2022; Prastianto et al., 2022; Utami et al., 2021), which highlight the need for contextualized learning media to promote marine literacy. Hence, this study supports the notion that comics can serve as an engaging and pedagogically sound medium for delivering educational content.

Contrary to the assumption that national textbooks sufficiently cover marine issues, observations and interviews with two teachers and five fifth-grade students at SD Negeri 5 Rupat Utara revealed that current teaching materials provide only limited marine-related content. This gap affects students' understanding of the ocean and its local significance, contradicting the belief that textbooks alone are adequate for fostering marine literacy from an early age.

Furthermore, the effectiveness test demonstrated significant improvements in students' marine knowledge, with an N-Gain score of 0.649 (moderate category) and paired-sample t-test results of $p = 0.000 < 0.05$. Beyond cognitive gains, the comic also fostered affective outcomes, with students' environmental attitudes rated at 85.42% (good) and behaviors at 88.57% (very good). These findings construct new insights, showing that comics not only enhance knowledge but also cultivate positive attitudes and responsible behaviors toward the marine environment.

Implications of this study highlight the potential of integrating locally contextualized comic-based teaching materials into the elementary school curriculum to foster marine literacy. Teachers are encouraged to utilize such media to enrich classroom instruction. Schools may adopt this comic as a supplementary resource to prepare environmentally literate students. Future researchers may explore similar comic-based innovations for other environmental or thematic content areas to support 21st-century learning goals.

REFERENCES

Agustin, D. A. (2020). *Mengajarkan SAINS Dengan Permainan*. Tata Akbar.

Al Faruque, S. N. (2023). The Unique Power of Comics: A Comprehensive Exploration of the VisualVerbal Medium and Its Impact on Storytelling, Communication, and Culture. *International Journal Of English and Studies (IJOES). Https://Www. Ijoes. in/Papers/V5i10/1. IJOES-Sadiya (1-11). Pdf.*

Anwar, S. (2023). *Metode Pengembangan Bahan Ajar Four Steps Teaching Material Development (4STMD)* (Hamidah, Ed.). Indonesia Emas Group. https://books.google.co.id/books?id=ZXWyEAAAQBAJ

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DOI: http://dx.doi.org/10.33578/jtlee.84.97
ISSN : 2615-4528 (Print) 2622-3023 (Online)

Astria, R. W. (2019). *Pengembangan Media Pembelajaran Komik Perairan Laut sebagai Dasar Pengetahuan Kebencanaan pada Materi Dinamika Hidrosfer dan Dampaknya terhadap Kehidupan di SMA Negeri Kebakkramat*.

Bangun, B., Irmayani, D., Harahap, R. D., Anjar, A., & Hasibuan, L. R. (2024). Pelatihan Disain Grafis Menggunakan Adobe Photoshop Pada Desa N-6. *Jurnal Pengabdian Harapan Bangsa*, *2*(1), 193–198.

Bukoye, R. O. (2019). Utilization of Instruction Materials as Tools for Effective Academic Performance of Students: Implications for Counselling. *The 2nd Innovative and Creative Education and Teaching International Conference*, 1395. https://doi.org/10.3390/proceedings2211395

Çiçek Şentürk, Ö., & Selvi, M. (2024). Argumentation-supported educational comics as a teaching tool for environmental education. *Environmental Education Research*, *30*(2), 170–189. https://doi.org/10.1080/13504622.2023.2227357

Costello, C., Cao, L., Gelcich, S., Cisneros, M. A., Free, C. M., Froehlich, H. E., Golden, C. D., Ishimura, G., Maier, J., Macadam-Somer, I., Mangin, T., Melnychuk, M. C., Miyahara, M., de Moor, C. L., Naylor, R., Nøstbakken, L., Ojea, E., O'Reilly, E., Parma, A. M., … Lubchenco, J. (2023). The Future of Food from the Sea. In *The Blue Compendium* (pp. 1–14). Springer International Publishing. https://doi.org/10.1007/978-3-031-16277-0_1

Dalpadado, P., Roxy, M. K., Arrigo, K. R., van Dijken, G. L., Chierici, M., Ostrowski, M., Skern-Mauritzen, R., Bakke, G., Richardson, A. J., & Sperfeld, E. (2024). Rapid climate change alters the environment and biological production of the Indian Ocean. *Science of The Total Environment*, *906*, 167342. https://doi.org/10.1016/j.scitotenv.2023.167342

Dewi, K. V. C., Pradesti, R., Nurlaela, S., Murnisari, Y., Suryanda, A., & Aulya, N. R. (2023). Dampak Perubahan Iklim dan Aktivitas Manusia terhadap Kerusakan Ekosistem Terumbu Karang dan Biota Laut di Sekitarnya. *Panthera : Jurnal Ilmiah Pendidikan Sains Dan Terapan*, *3*(1), 7–12. https://doi.org/10.36312/pjipst.v3i1.138

Erlina, D. (2018). *Pengembangan Bahan Ajar Membaca Terpadu*. NoerFikri.

Fielding, S., Copley, J. T., & Mills, R. A. (2019). Exploring Our Oceans: Using the Global Classroom to Develop Ocean Literacy. *Frontiers in Marine Science*, *6*. https://doi.org/10.3389/fmars.2019.00340

Garcia, O., & Cater, C. (2022). Life below water; challenges for tourism partnerships in achieving ocean literacy. *Journal of Sustainable Tourism*, *30*(10), 2428–2447. https://doi.org/10.1080/09669582.2020.1850747

Gkargkavouzi, A., Paraskevopoulos, S., & Matsiori, S. (2020). Public perceptions of the marine environment and behavioral intentions to preserve it: The case of three coastal cities in Greece. *Marine Policy*, *111*, 103727. https://doi.org/10.1016/j.marpol.2019.103727

Hindrasti, N. eka kusuma. (2018). Pengembangan Instrumen Penilaian Literasi Kelautan untuk Siswa Sekolah Menengah Atas. *Jurnal Kiprah*, *6*(2), 1–7. https://doi.org/10.31629/kiprah.v6i2.855

Kautsari, N., Hidayat, P. R., Sapilin, A., Rahma, W. M., & Sary, R. (2023). Peningkatan Literasi Laut Anak-Anak Sekolah Dasar Tanjung Bele Sebagai Upaya Mendukung Pengelolaan Perikanan Berkelanjutan. *Jurnal Pengembangan Masyarakat Lokal*, *6*(1), 108–116.

Kautsari, N., Rhismanda, A., & Abdillah, D. (2022). Literasi Laut Untuk Anak-Anak Pesisir Prajak Sebagai Upaya Membentuk Generasi Yang Bertanggung Jawab Terhadap Pemanfaatan Laut. *Jurnal Pengembangan Masyarakat Lokal*, *5*(1), 6–13.

Kelly, R., Evans, K., Alexander, K., Bettiol, S., Corney, S., Cullen-Knox, C., Cvitanovic, C., de Salas, K., Emad, G. R., Fullbrook, L., Garcia, C., Ison, S., Ling, S., Macleod, C., Meyer, A., Murray, L., Murunga, M., Nash, K. L., Norris, K., … Pecl, G. T. (2022). Connecting to the oceans: supporting ocean literacy and public engagement. *Reviews in Fish Biology and Fisheries*, *32*(1), 123–143. https://doi.org/10.1007/s11160-020-09625-9

Kochhar, S. K. (2000). *Teaching of social studies*. Sterling Publishers Private Limited. https://books.google.co.id/books?id=nnOhN9vLaRkC

Legionosuko, T., Madjid, M. A., Asmoro, N., & Samudro, E. G. (2019). Posisi dan Strategi Indonesia dalam Menghadapi Perubahan Iklim guna Mendukung Ketahanan Nasional. *Jurnal Ketahanan Nasional*, *25*(3), 295. https://doi.org/10.22146/jkn.50907

Leonardy, J. (2023). *Peran Fisikawan Indonesia Dalam Pengembangan Ilmu Pendidikan, Sains, dan Teknologi Sebagai Upaya Membangun Sumber Daya Manusia Yang Berkualitas di Era Society 5.0*. uwais inspirasi indonesia.

Lo, P., Lyu, Y.-P., Chen, J. C., Lu, J.-L., & Stark, A. J. (2022). Measuring the educational value of comic books from the school librarians' perspective: A region-wide quantitative study in Taiwan. *Journal of Librarianship and Information Science*, *54*(1), 16–33. https://doi.org/10.1177/0961000620983430

Mamolo, L. A. (2019). Development of digital interactive math comics (DIMaC) for senior high school students in general mathematics. *Cogent Education*, *6*(1), 1689639. https://doi.org/10.1080/2331186X.2019.1689639

Vol. 8, No.2, August 2025, pp. 84 - 97
DOI: http://dx.doi.org/10.33578/jtlee.84.97
ISSN : 2615-4528 (Print) 2622-3023 (Online)

McCauley, V., McHugh, P., Davison, K., & Domegan, C. (2019). Collective intelligence for advancing ocean literacy. *Environmental Education Research*, *25*(2), 280–291. https://doi.org/10.1080/13504622.2018.1553234

Minarni, M. (2020). Pengembangan Bahan Ajar Dalam Bentuk Media Komik Dengan Adobe Photoshop Cs6 Pada Materi Laju Reaksi. *Jurnal Inovasi Pendidikan Kimia*, *14*(2), 2595–2607.

Mogias, A., Boubonari, T., Realdon, G., Previati, M., Mokos, M., Koulouri, P., & Cheimonopoulou, M. Th. (2019). Evaluating Ocean Literacy of Elementary School Students: Preliminary Results of a Cross-Cultural Study in the Mediterranean Region. *Frontiers in Marine Science*, *6*. https://doi.org/10.3389/fmars.2019.00396

Mokos, M., Realdon, G., & Zubak Čižmek, I. (2020). How to Increase Ocean Literacy for Future Ocean Sustainability? The Influence of Non-Formal Marine Science Education. *Sustainability*, *12*(24), 10647. https://doi.org/10.3390/su122410647

Molenda, M. (2003). In search of the elusive ADDIE model. *Performance Improvement*, *42*(5), 34–37.

Nasution, R. P. A., Putra, M. J. A., & Alim, J. A. (2024). Pengembangan Komik Digital untuk Siswa Sekolah Dasar 'Mengapa Kita Perlu Makan dan Minum.' *Jurnal Kiprah Pendidikan*, *3*(2), 114–127. https://doi.org/10.33578/kpd.v3i2.250

O'Hara, C. C., Frazier, M., & Halpern, B. S. (2021). At-risk marine biodiversity faces extensive, expanding, and intensifying human impacts. *Science*, *372*(6537), 84–87. https://doi.org/10.1126/science.abe6731

Oktaviani, N. (2021). *Pengaruh Pengetahuan Pencemaran Lingkungan Terhadap Sikap Peduli Lingkungan Di SMA Negeri 1 Krueng Barona Jaya.* Doctoral dissertation, UIN AR-RANIRY.

Prastianto, R. W., Rosyid, D. M., Rochani, I., Sambodho, K., Mulyadi, Y., & Mustain, M. (2022). Pengembangan Bahan Literasi Bertema Teknologi Kelautan bagi Siswa SD dalam Membentuk Pribadi Cinta Laut Sejak Dini. *SEWAGATI*, *6*(1), 127–135. https://doi.org/10.12962/j26139960.v6i1.205

Rinika, Y., Ras, A. R., Yulianto, B. A., Widodo, P., & Saragih, H. J. R. (2023). Pemetaan Dampak Kerusakan Ekosistem Mangrove Terhadap Lingkungan Keamanan Maritim. *Equilibrium: Jurnal Pendidikan*, *11*(2), 170–176.

Rosita, E. (2022). *Pengembangan Leaflet Angiospermae*. Mualimin. https://books.google.co.id/books?id=3-h9EAAAQBAJ&newbks=1&newbks_redir=0&lpg=PA66&dq=kriteria%20validitas%20bahan%20ajar%20%2C%20sangat%20valid%2C%20valid&hl=id&pg=PA66#v=onepage&q=kriteria%20validitas%20bahan%20ajar%20,%20sangat%20valid,%20valid&f=false

Sandi, M. D., Hafriyuliani, H., & Rekhoardriad, R. (2024). Kreatif dengan Canva : Pelatihan Desain Grafis untuk Anak SDN 32 Kota Bengkulu. *Journal Of Human And Education (JAHE)*, *4*(4), 8–12. https://doi.org/10.31004/jh.v4i4.1170

Strang, C., Schoedinger, S., & deCharon, A. (2007). Can you Be Science Literate Without Being Ocean Literate? *Current*, *23*, 7. https://doi.org/10.5281/zenodo.30563

Syaflita, D., Alvi, R. R., Adila, F., & Jaya Adi Putra, M. (2023). Needs Analysis of Comic as Science Teaching Material for Junior High School Students. *Journal of Physics: Conference Series*, *2582*(1), 012046. https://doi.org/10.1088/1742-6596/2582/1/012046

Syarah, E. S., Yetti, E., Fridani, L., Yufiarti, Y., Hapidin, H., & Pupala, B. (2019). Electronic comics in elementary school science learning for marine conservation. *Jurnal Pendidikan IPA Indonesia*, *8*(4), 500–511.

Tri, N. (2021). *Penerapan Video Pembelajaran Ekosistem Mangrove Sebagai Media Pembelajaran Terhadap Literasi Kelautan Dan Kemampuan Memecahkan Masalah*.

Utami, F. P., Karnan, K., Handayani, B. S., & Mahrus, M. (2021). Identifikasi Kemampuan Literasi Kelautan Siswa Sekolah Menengah Pertama (SMP) di Kawasan Ekonomi Khusus (KEK) Mandalika, Lombok Tengah. *Jurnal Ilmiah Profesi Pendidikan*, *6*(1), 81–86. https://doi.org/10.29303/jipp.v6i1.160

Winks, L., Ward, M., Zilch, J., & Woodley, E. (2020). Residential marine field-course impacts on ocean literacy. *Environmental Education Research*, *26*(7), 969–988. https://doi.org/10.1080/13504622.2020.1758631

Worm, B., Elliff, C., Fonseca, J., Gell, F., Serra-Gonçalves, C., Helder, N., Murray, K., Peckham, H., Prelovec, L., & Sink, K. (2021). Making ocean literacy inclusive and accessible. *Ethics in Science and Environmental Politics*, *21*, 1–9. https://doi.org/10.3354/esep00196

Wulandari, T., & Mudinillah, A. (2022). Efektivitas Penggunaan Aplikasi CANVA sebagai Media Pembelajaran IPA MI/SD. *Jurnal Riset Madrasah Ibtidaiyah (JURMIA)*, *2*(1), 102–118. https://doi.org/10.32665/jurmia.v2i1.245