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Development of Illustrated Books on the Theme of Coral Reef Conservation to Improve the Character and Conservation Ethics of Elementary School Students

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Abstract: Indonesia's coral reefs face a serious threat of degradation due to destructive human activities such as bombing, potash and ship anchoring and climate change, while marine conservation education at the primary school level is still very limited. This research aims to develop a picture animation book with the theme of coral reef conservation as a valid, practical, and effective learning medium to improve general knowledge, specific knowledge, character, and conservation ethics of grade IV elementary school students. The development model used is ADDIE (Analysis, Design, Development, Implementation, Evaluation). The research subjects consisted of 32 grade IV students in two elementary schools of State 2 Labuhan Kananga in the coastal area of Moyo Satonda National Park. Data was collected using validation sheets of material experts, media experts, teacher and student response questionnaires, as well as pre-tests and post-tests. The results of the validation of material experts obtained an average score of 89.6% (very feasible) and the validation of media experts 91.2% (very feasible). The teacher's response reached 93.4% and the student's response was 88.7%. The effectiveness test using N-Gain showed an increase in general knowledge by 0.63 (moderate) and specific knowledge by 0.48 (moderate). The score of conservation character increased by 31.4% and conservation ethics increased by 27.8% based on observation rubrics. This study concludes that the illustrated book with the theme of coral reef conservation developed is feasible and shows a moderate but meaningful effect as a learning medium for marine environmental conservation in elementary schools.

Keyword : Illustrated Animated Books; Coral Reefs; Conservation; Character; Environmental Ethics; Elementary School

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Introduction

Indonesia is an archipelagic country with the highest marine biodiversity in the world, including coral reef ecosystems that cover around 51,000 km² or about 18% of the total global coral reefs (Ginting, 2023). Coral reefs serve as a place to live and breed more than 25% of all marine species, as well as being the lifeblood of fishermen and the coastal tourism industry. However, the condition of Indonesia's coral reefs is currently under serious threat due to a combination of anthropogenic factors and global climate change.

Recent studies show that more than 35% of Indonesia's coral reef ecosystems have suffered moderate to severe damage (Ginting, 2023). The phenomenon of coral bleaching triggered by rising sea temperatures, coupled with destructive fishing practices such as the use of bombs and cyanide, domestic waste pollution, and unsustainable tourism activities, is the main cause of the degradation of this ecosystem (Ginting, 2023). On the other hand, legal protection efforts through various environmental regulations have not

been effective enough without being accompanied by conservation awareness and ethics from the community, especially the younger generation (Putri et al., 2024).

Marine environmental conservation education at the elementary school level is one of the strategies that is considered the most fundamental and has a long-term impact. A number of studies show that pro-environmental awareness and behaviors instilled from an early age tend to persist into adulthood and influence real decisions related to the environment (Bellgrove et al., 2023). Elementary school-age children are at a stage of cognitive and moral development that is highly receptive to new values, including conservation values, so they are the target of strategic educational interventions.

However, surveys and field studies have found that coral reef conservation materials are almost not available in the formal curriculum of primary schools in Indonesia. Even among tourism vocational high school students in coastal areas such as Pangandaran, understanding of coral reef conservation is still low, which is exacerbated by the absence of teaching materials that systematically address this topic (Hidayat & Wijaya, 2021). This gap reflects a significant research gap: although the need for coral reef conservation education is urgent, the development of specific learning media for primary school students that targets the formation of conservation character and ethics at the same time is still very rarely researched.

Animation-based picture books offer a promising solution because they combine the power of visual narrative with elements of animated characters that appeal to children. Recent systematic studies confirm that nature-themed picture books effectively help children connect with nature and internalize conservation values through visual appeal and integrated design (He & Wang, 2025). In Indonesia, the development of picture storybooks and animated media for character education and environmental concern has proven to be valid and pedagogically effective at various levels and themes (Megawati et al., 2022; Saputra et al., 2022; Masykuroh & Khairunnisa, 2022), but none have specifically targeted the theme of coral reefs and targeted the improvement of marine conservation ethics in elementary school students.

Based on the analysis of the research gap, this study is designed to answer the following questions: (1) What is the process of developing a picture animation book with the theme of coral reef conservation with the ADDIE model? (2) What is the level of product feasibility based on the validation of material experts and media experts? (3) How effective is the product in improving general knowledge, specific knowledge, character, and conservation ethics of elementary school students?

Methodology

1)Research Type And Design

This research uses a research and development (R&D) approach with the ADDIE (Analysis, Design, Development, Implementation, Evaluation) model (Adeoye, 2024; Nuryadin et al., 2021). The research design integrates a qualitative approach at the formative analysis and evaluation stage, as well as a quantitative approach to testing the feasibility and effectiveness of the product. Effectiveness testing uses a one-group pretest-posttest design.

2)Development Procedure (ADDIE Model)

The Analysis stage includes needs analysis through observation and interviews with teachers and students in the target school, curriculum analysis to identify the integration points of coral reef conservation materials, and analysis of the characteristics of grade IV elementary school students. The findings of the analysis show that: (a) teachers do not have a specific medium to teach marine conservation; (b) students show

high interest in marine themes; and (c) the competency standards of the Independent Curriculum IPAS support the integration of marine ecosystem materials.

The Design stage includes the preparation of a storyline for a picture animation book that contains the main character in the form of a clown fish named 'Nemo Muda' and his friends in the coral reef ecosystem. The story script is designed to contain general knowledge (what coral reefs are, their functions, the biodiversity in them) and specific knowledge (how corals grow, the impact of pollution, destructive behaviors and protects corals) narratively. The rubric of conservation character and ethics to be assessed is also developed at this stage based on indicators adapted from Leksono et al. (2021) and Masruroh (2021).

The Development stage includes the production of animated illustrations using digital software, book layouts, and the preparation of research instruments (validation sheets, response questionnaires, pre-test and post-test questions for general knowledge and specific knowledge, as well as character observation rubrics and conservation ethics). All instruments are expertly validated before use.

The Implementation phase was carried out in two coastal elementary schools for three learning sessions, each lasting 70 minutes. The teacher acts as a facilitator who reads and discusses the content of the book with students.

The Evaluation stage includes formative evaluation (individual trial, small group) and summative evaluation (field test with pre-test and post-test). Product revisions are carried out in stages based on the input from each evaluation stage.

3)Research Subject and Location

The research was carried out in two elementary schools located in coastal areas, selected purposively with the following criteria: (1) the school is near sea waters; (2) have never used coral reef conservation learning media before. The research subjects consisted of 32 grade IV students (16 students per school) with an age range of 9-10 years, 2 classroom teachers, 1 material expert (marine science lecturer), and 1 media expert (learning technology lecturer).

4)Data Collection Instruments and Techniques

Data were collected using four types of instruments: (1) Validation sheets of material experts (aspects of conservation accuracy, curriculum suitability, and character value content) and media experts (aspects of visual design, readability, and animation appeal); (2) Questionnaire responses of teachers (practicality and ease of use) and students (attractiveness, ease of understanding); (3) Pre-test and post-test questions to measure general knowledge and specific knowledge about coral reefs; and (4) Observation rubrics to measure indicators of conservation character and ethics.

5)Data Analysis Techniques

Validation and response data were analyzed using the percentage of eligibility with the criteria: ≤60% (not feasible), 61-70% (moderately feasible), 71-80% (feasible), 81-90% (very feasible), >90% (very feasible). The increase in knowledge was analyzed using the formula N-Gain (g = (post-test score – pre-test score) / (maximum score – pre-test score)) with the following categories: $g > 0.70$ (high), $0.30 \leq g \leq 0.70$ (moderate), $g < 0.30$ (low). Changes in conservation character and ethics were calculated as a percentage increase in pre- and post-implementation observation scores.

Result and Discussion

1. Finding

1) Developed Product Description

The final product is in the form of a picture animation book entitled 'The Adventures of Young Nemo: Guarding the Coral House' consisting of 32 pages in A4 landscape format, printed in full color. The book contains six main story sequences: (1) introduction to coral reef ecosystems and their biodiversity (general knowledge); (2) the process of coral formation and growth (specific knowledge); (3) threats to coral reefs (specific knowledge and character strengthening); (4) the moral dilemma of the character when facing a friend who destroys the coral (conservation ethics); (5) real actions for coral protection carried out by figures (conservation characters); and (6) an invitation to the reader to participate in conservation (internalization of values).

Each page contains colorful animated illustrations with short narrative text that is appropriate to the reading ability of grade IV students. Visualization uses a semi-realistic approach to marine life to build accurate scientific knowledge, while maintaining high aesthetic appeal. The 'Did You Know?' feature is inserted on six pages to convey specific facts of knowledge directly.

2) Expert Validation Results

Validation of material experts is carried out on 5 aspects of assessment: conservation accuracy, conformity with basic competencies, general knowledge content, specific knowledge content, and character-ethical value integration. The average validation score of material experts reached 89.6% with a very feasible category. The material expert noted that the illustration of marine life was very scientifically accurate and the narrative of moral dilemma in the fourth sequence succeeded in showing an authentic and proportionate conflict of values for the age of grade IV students.

Media expert validation was carried out on 5 aspects: visual design and layout, quality of animation illustrations, readability of text, color suitability, and overall appeal. The average validation score of media experts reached 91.2% with a very feasible category. Media experts gave positive notes on the consistency of the illustration style and the compatibility of the chosen color palette.

Table 1. Recapitulation of Expert Validation Results

Assessment Aspects	Subject Matter (%)	Media Member (%)	Categories
Conservation Accuracy/Quality	91,2	93,0	Very Feasible
Curriculum/Layout Suitability	88,0	90,4	Very Feasible
General Knowledge Content	90,4	-	Very Feasible
Specific Knowledge Content	87,2	-	Very Feasible
Integration of Character and Ethics	91,6	-	Very Feasible
Readability and Appeal	-	91,8	Very Feasible
Overall Average	89,6	91,2	Very Feasible

3) Teacher and Student Responses

The teacher's response to the practicality of illustrated animation books reached an average of 93.4% (very feasible). The teacher stated that the book is very easy to use without the need for special training, the story narrative is able to stimulate meaningful class discussions, and the character observation rubric instrument is easy to apply. Student responses reached an average of 88.7% (very feasible). Most students (91%) stated that the illustrations of the book were very interesting, and 87% stated that the story of 'Young Nemo' made them want to protect the sea.

4) Effectiveness: General Knowledge and Specific Knowledge

The results of the pre-test showed that the average student general knowledge score was 42.3 (out of 100) and specific knowledge was 36.8. After the implementation of three learning sessions using illustrated animation books, the average general knowledge post-test score increased to 78.6 and specific knowledge to 67.4. The calculation of N-Gain for general knowledge yields a value of g = (78.6-42.3)/(100-42.3) = 0.63, which is in the moderate category, while specific knowledge results in g = (67.4-36.8)/(100-36.8) = 0.48, which is also in the moderate category.

Item analysis showed that the largest increase in general knowledge occurred in the item about the ecological function of coral reefs (N-Gain = 0.81), while in specific knowledge, the largest increase occurred in the item about the causes of coral bleaching (N-Gain = 0.74). The item on coral reproduction shows the lowest N-Gain (0.52), which indicates the need to strengthen the content in the second sequence of the story.

5) Effectiveness: Character and Ethics of Conservation

Observations of character and conservation ethics were carried out using rubrics with three character indicators (concern, responsibility, respect for marine creatures) and two ethical indicators (ability to distinguish right and wrong actions related to conservation, ability to give moral reasons for conservation choices). The pre-implementation score showed an average of 54.2 out of 100. Post-implementation, the score increased to 71.2, or an increase of 31.4% for the conservation character dimension.

For the conservation ethics dimension, the average pre-implementation score of 49.6 increased to 63.4 post-implementation, or an increase of 27.8%. The ethical indicator that saw the greatest improvement was 'the ability to give moral reasons for conservation choices' (34.6% increase), which suggests that the moral dilemma sequences in the story successfully train students' ethical reasoning effectively.

2. Discussion

The results of this study confirm that the illustrated book on the theme of coral reef conservation developed with the ADDIE model meets high feasibility standards based on the validation of subject matter experts and media experts. The high validation score (89.6% and 91.2%) is consistent with the findings of the previous environmental picture book development research by Fatmah (2020) which obtained a very valid and very practical category. This confirms that systematic development procedures with the ADDIE model consistently produce high-quality products.

The increase in general knowledge with a corrected N-Gain of 0.63 (moderate category) indicates that illustrated animated books are reasonably effective as a medium for conveying a basic conceptual understanding of coral reefs, although the effect is more modest than initially reported. These findings are broadly in line with He & Wang (2025) who concluded that nature-themed picture books help children connect with nature and build conservation knowledge through strong visual appeal, though the present results indicate a moderate rather than high knowledge gain. The similarly moderate increase in specific knowledge (N-Gain 0.48) indicates that technical content on coral biology requires more repetition and elaboration, which can be addressed by adding a 'Did you know?' feature and additional practice items in the next revision.

The most significant findings of this study were the effectiveness of illustrated animation books in improving character dimensions (31.4%) and conservation ethics (27.8%). The increase in the ethical dimension, particularly in the indicator of 'the ability to give moral reasons for conservation choices' (34.6%), confirms that the technique of moral dilemma through narrative stories is an effective strategy to develop ethical reasoning in elementary school-aged children. This supports the argument of Masruroh

(2021) that the formation of environmental caring character needs to be combined with the development of moral reasoning capacity, not just information transfer.

These findings also have important implications for filling the research gaps identified in the introduction. This study empirically proves that learning media based on illustrated animation books with specific coral reef themes can simultaneously improve general knowledge, specific knowledge, character, and conservation ethics of elementary school students. No previous study has measured these four dimensions in an integrated development research instrument, so these findings make an original methodological and substantive contribution to the marine conservation education literature.

The results of this study also underline the importance of introducing coral reef conservation education as early as possible, namely from the elementary school level. As emphasized by Bellgrove et al. (2023) and Strand et al. (2023), environmental awareness instilled in childhood has a greater long-term impact on conservation behavior in adulthood than interventions that begin at higher education. Given the critical condition of Indonesia's coral reef damage (Ginting, 2023), investment in early conservation education is a strategy that is not only pedagogically important, but also ecologically urgent.

This study is not without limitations. The research subjects were limited to 32 grade IV students from two elementary schools in a single coastal region, so the findings may not generalize to other regions, grade levels, or non-coastal school contexts. The intervention was also relatively brief, consisting of only three learning sessions of 70 minutes each, which may be insufficient to produce durable long-term change in conservation character and ethics; longer-term follow-up measurements are recommended in future studies. In addition, the effectiveness test relied on a one-group pretest-posttest design without a control group, which limits the ability to rule out alternative explanations for the observed gains

Conclution

This research successfully developed a picture animation book with the theme of coral reef conservation using the ADDIE model for grade IV elementary school students. Based on the results of the research, the following three main points were concluded.

First, the development process with the ADDIE model starting from an in-depth needs analysis produces products that are content and design relevant to the characteristics of grade IV students and the needs of marine conservation education in elementary schools.

Second, the resulting products have a very high level of feasibility based on the validation of material experts (89.6%) and media experts (91.2%), as well as positive responses from teachers (93.4%) and students (88.7%).

Third, the illustrated animated books developed were shown to be effective in increasing general knowledge (N-Gain 0.63, moderate category), specific knowledge (N-Gain 0.48, moderate category), conservation characters (31.4%), and conservation ethics (27.8%) of elementary school students..

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