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Design of Teaching Materials in Outdoor Class Learning to Improve Students' Critical Thinking Skills

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Abstract: This type of research is Research and Development (R&D). This study aims to design teaching materials for outdoor class learning. The results of the study showed that expert research on teaching materials for outdoor class learning that had been developed was then analyzed using the Aiken'V formulation, obtaining an average aspect of content feasibility of 0.82, presentation feasibility of 0.84 and language aspect of 0.78 and declared to meet the feasibility criteria (valid). The results of the teacher's assessment of the teaching materials obtained aspects of the feasibility of instructions with an average of 3.67, aspects of the coverage of questionnaire components of 3.67 and aspects of language feasibility of 3.33 with a very practical category. So, it can be concluded that the teaching materials in this outdoor class learning are declared worthy of being tested. The effectiveness of teaching materials in outdoor class learning can be seen from the increase in critical thinking skills of students based on the results of the pretest and posttest which were analyzed using the N-Gain test. Overall, the average value of students' N-Gain in critical thinking skills is 0.61 in the moderate category. So, it can be concluded that there is an increase in critical thinking skills of class XI students of SMAN 3 Enrekang. This shows that teaching materials in outdoor class learning are effective for use in the learning process.

Keywords: Critical thinking skills; Outdoor class; Teaching materials

Introduction

Simply to education that is carried out in a modern way. The changes made in the world of education are aimed at obtaining better results. Learning resources Education today has undergone many changes (Aditya, 2021; Kerr et al., 2024). Starting from the education that is carried out is all the sources that can be used by students in learning (Kamalov et al., 2023; Darling-Hammond et al., 2020). The learning resources are usually in the form of people (educators), data (learning materials or materials), the environment (where learning takes place), and media (tools used by educators in the learning process). Various efforts to improve the quality of education are always carried out, adjusted to the development of the situation and conditions, and the era that occurs. Various countries in the world are trying to formulate the characteristics of the 21st century (Meyer & Norman, 2020). There are a number of basics of 21st century learning, one of which is critical thinking skills and problem solving, namely skills that are able to think critically, laterally and systemically, especially in the context of problem solving (Suherman & Vidákovich, 2022; Tanty et al., 2022).

Education is divided into two domains, one of which is environmental education. Environmental education is a process of understanding the surrounding environment (Van De Wetering et al., 2022; Ardoin et al., 2020). Understanding the surrounding environment is one of the most important things in order to be able to adapt well and get a comfortable and safe life (Altomonte et al., 2020; Ruggeri et al., 2020; Kumar et al., 2019). Environmental education in schools is expected to be able to educate students to care about their

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environment. Children who are the next generation must be equipped with knowledge about nature from an early age. They must understand how to behave towards their environment. However, in reality, environmental education in the current era is relatively low. Observation results show that students' critical thinking skills still need to be improved. This can be seen from several indicators, namely: difficulty in working in groups, namely there are some students who are still hesitant to contribute to group discussions, express opinions, and work together with other group members; less capable in communicating such as students are not used to conveying their ideas and thoughts clearly and in a structured manner, both verbally and in writing; weak problem-solving skills such as when faced with an example of a problem, many students are still confused in analyzing the problem, finding solutions, and choosing the best solution; difficulty in making decisions such as students are not yet skilled in weighing various alternatives and choosing the most appropriate solution to a problem.

In addition, at SMAN 3 Enrekang it was also found that the use of textbooks as the only teaching material in the teaching and learning process was found to have several limitations. This resulted in a lack of strengthening of scientific process skills for students. The textbooks have shortcomings, namely the appearance is less attractive so that it does not trigger students' interest in learning, the content of the material seems simple and not deep enough, so that it does not provide a comprehensive understanding for students and the use of physics formulas that are too long and complicated, making it difficult for students to understand the concept and its application. Another thing found in the observation is that students' interest in reading is still very minimal because the textbooks used are not interesting. This has an impact on the learning outcomes obtained by students, but educators never use learning tools in the form of teaching materials that support the learning process, most educators are less creative in using learning media in physics learning. Critical thinking skills are students' skills in analyzing and evaluating information to decide whether the information obtained is reliable so that it can be used to draw valid conclusions (Dwivedi et al., 2023).

Physics is still a scary specter for students in schools, many assume that physics is very difficult, confusing, and unpleasant (Wea et al., 2023). In addition, subject teachers said that students' critical thinking skills were still very low, this can be seen from the difficulty of students in interpreting, analyzing and making conclusions (inferences). Through critical thinking skills, a person will be able to place themselves appropriately in various situations experienced (Widyapuraya et al., 2023). Critical thinking is one of the many important thinking skills that students must have because critical thinking makes it easy for someone to process and use information to find solutions to a problem (O'Reilly et al., 2022). Students' critical thinking skills are still in the low category (Arifah et al., 2023; Septiany et al., 2024; Azmi et al., 2022). In addition, the thing that makes students' reading interest very minimal is the textbooks used. One way to increase reading interest is the use of teaching materials in outdoor class learning. Interesting and easy-to-understand teaching materials are very important in order to improve students' critical thinking skills. There are three main functions of teaching materials in relation to the implementation of the learning and teaching process (Choppin et al., 2022).

Therefore, this study developed teaching materials in outdoor class learning. This learning method is carried out outside the classroom by involving students directly with the surrounding nature. Based on this description, the researcher is interested in conducting a study entitled "Design of Teaching Materials in Outdoor Class Learning to Improve Students' Critical Thinking Skills (Study on Fluid Subject Matter)".

Method

Type of Research and Research Design

This type of research is Research and Development or commonly called R&D. In the process of developing teaching materials in outdoor class learning, researchers use a 4D model that has several steps, namely: define, design, develop, and disseminate. This research on teaching material design in outdoor class learning was carried out in the 2023/2024 academic year and was implemented at SMAN 3 Enrekang. The data analysis carried out is as follows:

Validity of Teaching Materials

Data in the form of validation results for teaching materials in outdoor class learning, practitioner assessment questionnaire sheets and learning outcome tests were analyzed by considering input, comments, and suggestions from experts. The analysis used to determine the level of relevance by three experts used the content validity coefficient (Aiken's V). The Aiken's V formula is used to calculate the content validity coefficient based on the assessment results of each expert on an item using equation 1 (Ikhsanudin & Subali, 2018).

$$V = \frac{\sum s}{n\,(c-1)} \quad (1)$$

Aiken test requirements, after calculation if V ≥ 0.4 then the expert agreement index is said to be valid.

Teacher Response Analysis

The criteria for practicality of teacher responses can be seen in Table 1.

Table 1. Criteria for Practicality of Teacher Responses

Percentage Level	Criteria	Decision
80- 100	Very Practical	New product is feasible and can be used in the field for learning activities
60- 79	Practical	Product can be continued by adding something lacking with certain considerations, the additions made are not too large and fundamental
50- 59	Less Practical	Revise by examining again carefully and looking for product weaknesses to be revised
<50	Not Practical	Not feasible to use and major revision of product content

Analysis of the Effectiveness of Teaching Materials to Improve Critical Thinking Skills

To process the scores obtained from students according to Rafiqa et al. (2022) can be searched using the formula:

$$\text{PPS} = \frac{Score\ obtained}{maximum\ score} \times 100\% \quad (2)$$

To find out the increase in critical thinking skills, use the N-Gain formula, namely:

$$\textit{Normahzed Gain}\ (\text{G}) = \frac{X_{posttest} - X_{pretest}}{X_{\max} - X_{pretest}} \quad (3)$$

Table 2. Normalized Gain Criteria

Gain Value	Interpretation
0.70 <g≤100	High
0.30<g≤0.70	Medium
0.00<g≤0.30	Low
g = 0.00	No Increase
1.00≤g<0.00	Decrease

Population and Sample

The subjects of this research trial were students of SMAN 3 Enrekang class XI MIPA, while for the sample practitioners used were three people who were physics teachers of SMAN 3 Enrekang. The design used in the limited trial was one group pre-test and post-test design. According to Krasny-Pacini et al. (2018) the research design is as follows:

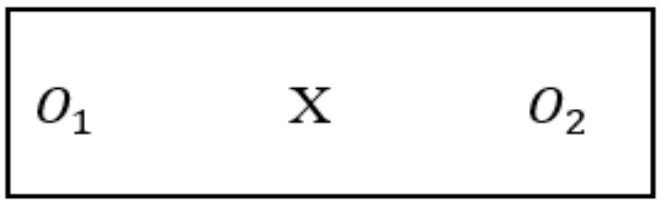

Figure 1. Research trial design

Description:

X : Teaching Materials in Outdoor Class Learning (Independent variables)

O_1 : Pre-test score (before teaching materials are given)

O_2 : Post-test score (after teaching materials are given)

Result and Discussion

Define Stage

The first stage of this development is the define stage. The define stage is interpreted as the stage of defining or determining the learning requirements. This stage consists of various analyses. Each analysis is useful for determining various objectives and limitations of learning materials. This stage consists of initial analysis, student analysis, and analysis of learning objectives. The initial analysis was carried out to determine the description of the physics learning process at SMAN 3 Enrekang, measure students' critical thinking skills, confirm the learning desired by students, and identify the causes of problems that arise in the physics learning process. This analysis was obtained from the results of observations and interviews with one of the physics teachers of class XI at SMAN 3 Enrekang regarding the implementation of learning, the suitability of teaching materials, and obstacles in teaching physics.

The analysis of students aims to examine the characteristics of students which include the background knowledge of students. The results of this study are used as considerations for the design and development of learning devices. In terms of student learning styles, each student has their own way of understanding physics material. There are three learning styles possessed by students, namely visual, auditory and kinesthetic. Based on the results of data analysis, among the three types of learning styles (audio, visual and kinesthetic) students in grade XI tend to have a kinesthetic learning style, this can be seen based on data analysis, where as many as 65% of students have a kinesthetic learning style, 20% Auditory, and 15% Visual. Furthermore, an analysis of learning objectives was carried out. The material taken is fluid. This material is associated based on outdoor class learning.

Design Stage (Design)

The second stage of the 4D developer model is the design stage. This stage is a continuation of the define stage. At this stage, the product is designed according to what is needed. This stage is an important stage in research because at this stage teaching materials will be developed for outdoor class learning. Product design at this stage cannot be separated from the definition stage.

Development Stage

At this stage, the components of the teaching material content have been created, then printed, and bound so that it becomes a teaching material for outdoor class learning that is ready to use. In addition, instrument development has also been carried out so that a draft instrument is obtained in the form of a practitioner assessment questionnaire instrument, and a test instrument used in the trial stage. The development stage consists of making teaching materials for outdoor class learning. Data obtained from the validation of teaching materials for outdoor class learning, validation of teacher responses and validation of critical thinking tests. Revision of teaching material validation, validation of teacher responses and validation of critical thinking tests are carried out until they are declared feasible by experts to be implemented in the field. The expert assessment of teaching materials for outdoor class learning is as follows:

Table 3. Validity Analysis Test of Teaching Material Content for Outdoor Class Learning

Aspects	Total Validity Item Score	V	Category
Content Suitability	16.44	0.82	Valid
Presentation Suitability	5.89	0.84	Valid
Language Suitability	10.11	0.78	Valid

Table 4. Percentage of Eligibility of Teaching Materials in Outdoor Class Learning

Aspects	Total Score Obtained	Ideal Score	Percentage (%)
Content Suitability	208	240	87
Presentation Suitability	74	84	88
Language Suitability	130	156	83

Disseminate Stage (dissemination)

The fourth stage of 4D is dissemination. At this stage, dissemination is carried out and requests for practitioner responses using a validated practitioner response questionnaire. The teachers who provided responses were 3 physics teachers at SMAN 3 Enrekang and the provision of critical thinking test instruments for students.

Practicality of Teacher Responses

The practitioner assessment questionnaire sheet is an instrument used to obtain teacher responses to teaching materials in outdoor class learning. The questionnaire sheets that have been validated and declared valid are then given to teachers to see their responses to the implementation of teaching materials in outdoor class learning

Table 5. Results of the Validation Analysis of the Teacher Response Questionnaire

Aspect	Average	Category
Feasibility of Instructions	3.67	Very Valid
Aspect of Scope of Questionnaire Components	3.67	Very Valid
Feasibility of Language	3.33	Very Valid

Effectiveness of Teaching Materials in Outdoor Class Learning to Improve Critical Thinking Skills

The effectiveness of teaching materials in outdoor class learning can be measured using a critical thinking skills test instrument given to class XI students of SMAN 3 Enrekang. The critical thinking skills test was given to students before (pretest) and (posttest) after learning using teaching materials in outdoor class learning. The number of items for each test was 30 items which were divided into 3 indicators of critical thinking skills, namely analysis, interpretation and inference. The results of the analysis of students' critical thinking skills tests before and after being given teaching materials in outdoor class learning can be seen in Table 6 below.

Table 6. Results of Analysis of Students' Critical Thinking Skills Tests

Parameter	Pretest	Posttest
Number of Respondents	31	31
Maximum Ideal Score	30	30
Minimum Ideal Score	0	0
Maximum Empirical Score	25	28
Minimum Empirical Score	5	10
Average Score	11.45	21.20
Number of Classes	5	5
Class Interval	4	4

The percentage value of the pretest score for critical thinking skills can be seen in Table 7 below:

Table 7. Percentage of Pretest Score for Critical Thinking Skills of Class XI Students of SMAN 3 Enrekang

Criteria Interval	Category	Frequency	Percentage (%)
$21 < X \leq 25$	Very High	1	3
$17 < X \leq 21$	High	3	10
$13 < X \leq 17$	Medium	7	22
$9 < X \leq 13$	Low	8	26
$5 < X \leq 9$	Very Low	12	39
Amount		31	100

The percentage of post-test scores for critical thinking skills can be seen in Table 8. Furthermore, an analysis of the improvement of students' critical thinking skills was carried out using the pretest and posttest Gain and N-Gain data. The results of the N-Gain analysis can be seen in Table 9.

Table 8. Percentage of Posttest Scores of Critical Thinking Skills of Grade XI Students

Criteria Interval	Category	Frequency	Percentage (%)
26 < X ≤ 30	Very High	4	13
22 < X ≤ 26	High	8	26
18 < X ≤ 22	Medium	11	35
14 < X ≤ 18	Low	7	23
10 < X ≤ 14	Very Low	1	3
Amount		31	100

Table 9. N-Gain Score of Critical Thinking Skills of Class XI Students of SMAN 3 Enrekang

Criteria Interval	Category	Amount	Percentage
0.70 < g ≤ 100	High	6	19.35%
0.30 ≤ g ≤ 0.70	Medium	21	67.74%
0.00 < g ≤ 0.30	Low	4	12.90%
g =0,00	No increase	0	0%
-1.00 ≤ g < 0.00	Decrease	0	0%
Amount		31	100%

Discussion

Validity of Teaching Materials in Outdoor Class Learning

The results of the development stage are in the form of teaching materials in outdoor class learning that are ready to be used and tested on trial subjects. During the trial stage, a practitioner assessment of the teaching materials in outdoor class learning was also carried out. The trial stage was carried out to determine the practicality of teaching materials in outdoor class learning. After this trial stage was carried out, a limited distribution of products was carried out which was given to physics subject teachers. The teaching materials in outdoor class learning that have been developed can be a companion to printed books in schools and help students in the learning process, both during class hours and independent learning. The material presented in the teaching materials in outdoor class learning follows the development and characteristics of students, as well as the environmental conditions around the students. So that students can easily learn and understand physics concepts related to everyday life and the environment around them, especially in fluid material. In addition, teaching materials in outdoor class learning were developed with the help of the Canva, Preefik, and Microsoft Word editing applications.

The compilation of teaching materials is what differentiates the teaching materials compiled and used by physics teachers of SMAN 3 Enrekang from the teaching materials developed by researchers. The teaching materials in outdoor class learning that have been developed are then assessed by three experts to measure the validity of the content of the teaching materials. Each expert or specialist is asked to assess the product that has been made to determine the weaknesses and strengths of the product that has been designed (Puyt et al., 2023; Phadermrod et al., 2019). There are three aspects assessed by the three experts, namely the aspects of content feasibility, presentation feasibility, and language feasibility.

Teacher Responses to Teaching Materials in Outdoor Class Learning

The practitioner assessment questionnaire is an instrument used to obtain teacher responses to teaching materials in outdoor class learning. The questionnaire that has been validated and declared valid is then given to the teachers to see their responses to the implementation of teaching materials in outdoor class learning. Practitioners in this study were physics teachers at the high school level, totaling 3 physics teachers.

The practitioner assessment questionnaire consists of 12 statement items related to the teaching materials in outdoor class learning that have been developed, which are classified into three aspects, namely the instruction aspect, the component feasibility coverage aspect and the language aspect. The results of the analysis of the three aspects of the practitioner assessment questionnaire, it was concluded that the teaching materials were in the very valid and valid categories. The results of this assessment are supported by the direct responses of practitioners when assessing the developed teaching materials.

Effectiveness of Teaching Materials in Outdoor Class Learning to Improve Students' Critical Thinking Skills

The effectiveness of teaching materials in outdoor class learning can be seen based on the increase in students' critical thinking skills derived from the test results of class XI students of SMAN 3 Enrekang. Critical thinking skills tests were given before and after the provision of teaching materials in outdoor class learning (Achmad & Utami, 2023; Tan et al., 2023). The results of the critical thinking skills test before being given teaching materials in outdoor class learning showed that there was 1 student who had very high critical thinking skills with a percentage of 3%. In the low category, there were 8 students with a percentage of 26% and the medium category was 7 students with a percentage of 22%. Also, there were 12 students who had very low critical thinking skills with a percentage of 39%.

There are several reasons why students' critical thinking skills are still very low, one of which is that learning outcome tests that can train students to think

are still very rarely applied in learning (Aswanti & Isnaeni, 2023; Otu & Budiningsih, 2023; Hidayani et al., 2020). Most students have not been able to analyze questions properly, this is due to the lack of critical thinking skills-based training carried out in the learning process (Li, 2023; Arsyad et al., 2023). The low critical thinking skills of students are because schools still lack training in students' critical thinking skills (Smith et al., 2023). The use of teaching materials in outdoor learning can improve students' critical thinking skills (Putri, 2023; Ana et al., 2023). The development of riverbank environmental-oriented teaching materials states that learning outcomes as a measure of the effectiveness of the developed teaching materials also provide positive results (Eviyanti et al., 2022). The development of coastal-based Physics teaching materials on fluid material is stated to be effective and can improve student learning outcomes, supported by the results of calculating student learning outcome scores on fluid material that have reached the Minimum Completion Criteria (KKM) classically (Nurhayati et al., 2020). The results of research conducted by (Ribosa & Duran, 2022; Ramadhan et al., 2023; Sitepu et al., 2021), where this research aims to produce products in the form of teaching materials that are feasible, effective, and practical.

Conclusion

Based on the results of the research and limited trials that have been conducted, the following conclusions were obtained: the design of teaching materials in outdoor class learning consists of teaching material covers, forewords, instructions for using teaching materials, learning objectives, teaching material materials, sample questions, student activities, evaluations at the end of each material and bibliography; the results of the development of teaching materials in outdoor class learning are in the valid category so that they can be declared suitable for use. The teaching materials in outdoor class learning that have been developed are teaching materials with characteristics in the form of physics material, namely environmental fluid material around students, and a collection of sample questions and evaluation questions that are in accordance with critical thinking indicators; the practitioner's assessment of the teaching materials in outdoor class learning that were developed is in the very practical criteria. This shows that practitioners give a positive response to the teaching materials in outdoor class learning that were developed; the increase in critical thinking skills of students after the application of teaching materials in outdoor class learning analyzed with N-Gain is in the moderate category. This means that there is an increase in the critical thinking skills of class XI students of SMAN 3 Enrekang, and the teaching materials are declared effective for use in the learning process.

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Author Contributions

Z., conceptualized the research idea, research methods, and analyzed the data. S and M. A guided the writing of the review and editing, supervision and validation of the instruments used in the study.

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Conflicts of Interest

The author declares no conflict of interest.

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