

Development of ICARE-Based Physics Teaching Materials to Improve Students' Critical Thinking Ability



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ABSTRACT: Research on the development of ICARE-based teaching materials aims to: 1) analyze the results of the content validity of ICARE-based physics teaching materials which meet valid criteria, 2) analyze practitioners' assessments of ICARE-based physics teaching materials, 3) analyze the effectiveness of ICARE-based teaching materials. The test subjects of this research were 28 students of class XI Science at Sma Muhammadiyah 1 Unismuh. Research method with 4D models. The instruments used in this research were validation sheets, practitioner assessment questionnaires, and test instruments for students' critical thinking abilities. Practicality criteria are seen from practitioners' assessments of teaching materials, and effectiveness criteria are seen from the average percentage of students' critical thinking ability improvement scores. Based on the results of the analysis, the following conclusions were obtained: (1) ICARE-based teaching materials which were developed based on expert assessment using Aiken's V index analysis were declared valid and suitable for use with slight revisions; (2) ICARE-based physics teaching materials in terms of teacher responses were in the category Very good; (3) the effectiveness of ICARE-based physics teaching materials analyzed using N-gain obtained an average value of 0.50, which is included in the medium category, meaning there is an increase in students' critical thinking abilities so it can be said that the ICARE-based physics teaching materials developed are effective and can improve abilities. students' critical thinking.

KEYWORDS: Teaching Materials, ICARE Based Learning Model, Critical Thinking Ability

INTRODUCTION

Education is a conscious and planned effort to create a conducive learning atmosphere and learning process. The aim is for students to actively develop their potential such as religious spiritual strength, self-knowledge, personality, intelligence, noble morals, and the abilities needed by themselves, society, nation and state. Education in the 21st century, as a learning century, demands a change in the learning and teaching paradigm. Students must be able to learn independently, manage time, solve problems, and access information. The learning process is the most important part of an activity, namely an effort to achieve educational goals. Educational goals will not be achieved without a learning process in an educational institution. In every educational process at school, learning activities are the most important activities. The success or failure of educational goals depends on how the learning process is experienced by students. The most important hope in the teaching and learning process at school is that students can achieve satisfactory results or good learning outcomes to achieve success. One of the subjects in Senior High School (SMA) is Physics. Physics is a science that has a very important role in everyday life and is closely related to students' critical thinking abilities in solving problems in physics. This is in accordance with the opinion of Zubaidah (2010), "critical thinking describes a basic skill and plays an effective role in aspects of life". This statement emphasizes that critical thinking is a fundamental ability and can be used in all aspects. In line with previous opinions, Nuryanti (2018). Says that "critical thinking is needed by someone to solve various problems faced in society or personally." Critical thinking skills are the ability to think reflectively and the ability to judge, so that students can decide on the right type of information and the type of action that must be taken in an effort to solve a problem. The characteristics of each student are different from other students because the personality of each human being has different imaginations and thoughts. Every educator is expected to be able to see the characteristics of students in improving critical thinking skills, such as educators who teach in front of the class must be able to see the potential of students by using appropriate teaching materials, so that in learning there is good interaction so that learning objectives can be achieved. The use of appropriate teaching materials is very important so that learning objectives can be achieved. Even though the learning objectives are well formulated, the learning model used is correct, but the teaching materials used are inadequate, so the expected objectives will not be achieved well. So, teaching materials are an important component of learning and are very determining in the success of the learning process. Teaching materials should be a medium for interaction between educators and students, as well as interaction between students which will form a synergy that is mutually beneficial to all members, so that learning can produce optimal results, educators should

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be clever in designing teaching materials that are able to attract the potential of students . This research was conducted at SMA Muhammadiyah 1 Unismuh because it is one of the schools in Makassar City, which has the aim of creating better conditions for the school to become a place for learning and create a school community that excels not only in understanding the material but also in implementation. In the learning process, Muhammadiyah High School always links concepts to the surrounding conditions so that educators and students are active in exchanging ideas not only in class but also outside of class. In line with this, the teaching materials used at Muhammadiyah High Schools are still in the form of teaching materials such as textbooks which only provide a brief explanation of the material, but are also less interesting. Apart from that, one of the basic competencies that will be achieved in learning is observing and applying. Meanwhile, textbooks used in schools only present basic material and concepts that lack application and do not attract students' critical thinking potential. So it can be seen that the textbooks used do not fully reflect the achievement of the basic competencies set out in the curriculum and still require supporting references to make this happen. One solution to overcome this problem is to develop Physics Teaching Materials based on *introduction, connection, application, reflection, extension* (ICARE). Development of teaching materials based on *introduction, connection, application, reflection, extension* (ICARE) to ensure that students have the opportunity to understand what they have learned, by fully applying physics teaching materials based on *introduction, connection, application, reflection, extension* (ICARE) .) on student learning and supporting students' critical thinking abilities. Based on the description above, the author was motivated to conduct research with the title "Development of ICARE-Based Physics Teaching Materials to Improve the Critical Thinking Ability of Class XI Science Students at SMA Muhammadiyah 1 Unismuh"

METHOD

This type of research is development research (*research & development*). The development research in question is research carried out to produce ICARE-based physics teaching materials. This development research uses the 4-D Model (*Four-D Model*) developed by Sivasailan & Thiagarajan (1974) including the Define , Design , Develop , and *Disseminate stages* . This research used research subjects from class XI Science, totaling 28 people, held in the odd semester of the 2023/2024 academic year at SMA Muhammadiyah 1 Unismuh Makassar, located on Jalan Sultan Alauddin No. 259, Gn, Sari, Kec. Rappocini, Makassar City. The instruments used in this research were validation sheets, practitioner assessment questionnaire sheets, and students' physics critical thinking ability test instruments. Which has been validated by experts and analyzed using the expert agreement index (Aiken's V). Researchers used data collection techniques in the form of validation, questionnaires and critical thinking ability tests. In this research, testing was carried out twice at the implementation or product testing stage. The trial design used was "One Group Pre-test and Post-Test Design". The analysis used to determine the level of relevance by three experts used the content validity coefficient. (Aiken's V) with the following formula (Azwar, 2012):

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

Aiken test conditions if $V \geq 0.4$ then the expert agreement index is said to be valid .

The percentage of practitioner responses to each statement uses the criteria according to Table 1 below, adapted from Riduwan (2018).

Table 1. Percentage of practitioner assessment score criteria

Percentage (%)	Criteria
81 – 100	Very good
61 – 80	Good
41 – 60	Currently
21 – 40	Not enough
0 – 20	Very less

The effectiveness of ICARE-based Physics teaching materials can be measured using critical thinking ability test instruments given to students using the N-gain Score formula. According to Sundayana (2014), to find out N-gain, the following formula is used:

$$N \text{ Gain } (G) = \frac{X_{\text{posttest}} - X_{\text{pretest}}}{X_{\text{Max}} - X_{\text{pretest}}} \quad (2)$$

The gain score results obtained are then grouped based on the criteria as in Table 2 below:

Table 2. Normalized Gain Criteria

Normalized Gain Value	Interpretation
$0.70 < g \leq 1.00$	Tall
$0.30 < g \leq 0.70$	Currently

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$0.00 < g \leq 0.30$	Low
$g = 0.00$	No increase occurred
$-1.00 \leq g < 0.00$	There was a decline

The interpretation of the categorization of the effectiveness of the gain score in the form of percent (%) is as in table 3 below:

Table 3. Effectiveness Interpretation Categories

Percentage (%)	Category
>76	Very effective
56 – 75	Effective
40 – 55	Effective enough
< 40	Ineffective

RESULTS AND DISCUSSION

Validity results: Aspects of ICARE-based physics teaching materials assessed by the three experts/experts, namely aspects of appropriateness of content, presentation, language and graphics. The score obtained from the content validity coefficient analysis test of the expert agreement index using the Aiken's V index analysis is presented in Table 4 below:

Table 4. Content Validity Analysis Test of ICARE-Based Physics Teaching Materials

Aspect	V	Category
Content Eligibility	0.75	Valid
Feasibility of Presentation	0.76	Valid
Language Eligibility	0.69	Valid
Graphic Feasibility	0.74	Valid

The validity analysis that has been carried out is shown in Table 4. Which states that ICARE-based physics teaching materials are declared feasible/valid to proceed to the trial stage. In the content feasibility aspect, a validity index (v) was obtained with an average score of 0.75 and it was in the valid category, then for the presentation aspect, a validity index (V) was obtained with an average score of 0.76 and it was in the valid category. For the language aspect, a validity index (V) was obtained with an average score of 0.69, which was in the valid category, and for the graphic aspect, a validity index (V) was obtained with an average score of 0.74 and was in the valid category.

Table 5. Practitioner Assessment Scores on ICARE-Based Physics Teaching Materials

Aspect	Percentage	Category
Content Eligibility	86.8%	Very good
Presentation	85.3%	Very good
Language	85.3%	Very good
Graphics	87.3%	Very good

The practitioners in this assessment were 10 SMA/MA level physics subject teachers who were members of the Makassar City High School Physics MGMP group. The practitioner assessment questionnaire consists of 50 statement items related to the ICARE-based physics teaching materials that have been developed. As for the results of the practitioner assessment questionnaire analysis, it was concluded that an average of 10 practitioners gave a very good assessment of the ICARE-based physics teaching materials developed.

Table 6. N-Gain Score Thinking Ability of Class XI Science Students at Muhammadiyah 1 Unismuh

Criterion Interval	Interpretation	Frequency	Value Percentage
$0.70 \leq g \leq 1.00$	Tall	4	14.3%
$0.30 \leq g < 0.70$	Currently	21	75.0%

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$0.00 < g < 0.30$	Low	3	10.7%
$g = 0.00$	No increase occurred	0	0.0%
$-1.00 \leq G < 0.00$	There was a decline	0	0.0%
Amount		28	100%

The N-Gain Score analysis in Table 6, there were 21 students or 75.0 % of test subjects who experienced an increase in critical thinking skills in the medium category. So ICARE-based teaching materials can be said to be effective in improving students' critical thinking skills. Students who experienced an increase in low critical thinking abilities were 3 people or 10.7 % of test subjects, and only 4 students experienced a high increase in critical thinking skills or 14.3 % . And there were no students who were in the category of no improvement or decline after implementing ICARE-based physics teaching materials .

CONCLUSION

Based on the results of research and limited trials that have been carried out, the following conclusions have been obtained: 1) Results of the content validity coefficient test, the ICARE-based physics teaching materials that have been developed have met the criteria of being valid/fit to be tested based on the results of expert agreement index analysis using the validity coefficient the contents of Aiken's V and can be used as a learning resource in physics learning. 2) Assessment of practitioners' responses to the ICARE-based physics teaching materials that were developed gave a positive response in the very good category. 3) The effectiveness of ICARE-based physics teaching materials can be seen from the critical thinking abilities of the analyzed students. with N-gain being in the medium category, this means that there is an increase in students' critical thinking abilities. So it can be said that the ICARE-based physics teaching materials developed are effective in improving students' critical thinking skills in class XI Science at SMA Muhammadiyah 1 Unismuh.

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