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Development of Discovery Learning-Based Teaching Materials to Improve Students' Critical Thinking Abilities in the *Kurikulum Merdeka* in Class V of Elementary Schools

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Abstract: This research was motivated by findings from initial identification through interviews and observations at SDN 18 V Koto Timur, which revealed that fifth grade students faced difficulties in science and technology subjects, especially regarding low enthusiasm and active participation in learning. The type of research used is Research and Development with the ADDIE development model. In this development research, the research subjects were 30 class V students and the research object was the development of DL-based teaching materials to improve students' critical thinking skills. Data collection techniques use validation sheets, practicality questionnaires and learning outcomes tests. Based on the results of the development research carried out, the validity results of the Merdeka Curriculum teaching module obtained an average of 89% (very valid), the material expert validator obtained a result of 90.6% (very valid), the results for the language expert were 93.3% (very valid).), and media expert acquisition was 85.4% (valid). The practicality of the module was tested through individual trials on 8 students at SDN 18 V Koto Timur and 8 students at SDN 01 V Koto Timur resulting in an average total score of 88.96% and 86.46%, which was categorized as "very practical." In small group trials with 10 students in each school, average scores reached 93.17% and 88.17%, also in the "very practical" category. Limited group trials with 15 students in each school showed average scores of 92.11% and 91.67%, remaining in the "very practical" category. These results confirm that the module was well received and demonstrated consistent practicality across different groups of learners, proving its effectiveness and usefulness as a teaching material.

Keywords: Critical thinking; Discovery learning

Introduction

Basic education is the initial education for every child well formal and informal which takes place from around 3 years of age to with at least 12 to 15 years of age. Basic education is a passport that individuals really need to live and able to choose what they do, take part in building a future society collectively and continuously learning (Annisa et al., 2023).

Basic education is the lowest level of education in the National Education System as stipulated in Law Number 20 of 2003 concerning the National Education System. Basic education can develop attitudes and abilities, provide the basic abilities and skills needed to prepare students for further education. Education is a

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process in order to influence students so that they can adapt as best as possible to their environment and thereby bring about changes in themselves that enable them to function strongly in society (D. M. Sari et al., 2023).

In the world of education, there are many components that support the continuity of education, one of which is the curriculum. The curriculum is defined as a program that is facilitated to support students (Miladiah et al., 2023). The program referred to in this case is a learning process. Meanwhile, according to Law no. 20 of 2003 concerning the National Education System, the curriculum is a set of plans and arrangements regarding objectives, content and learning materials as well as methods used as guidelines for implementing learning activities to achieve educational goals (Prahastina et al., 2024; Pratikno et al., 2022). So it can be concluded that the curriculum is a learning tool that acts as a reference in carrying out the learning process in accordance with the expected educational goals. As time goes by, it cannot be denied that the curriculum in force in Indonesia will continue to undergo changes to make it more adaptive to the demands of the times. As is currently happening, a new curriculum has been launched which is designed not only to meet educational goals but to be more adaptive to increasingly rapid developments and the curriculum in question is the *kurikulum merdeka*.

One of the learning resources that can be used in learning with the *kurikulum merdeka* approach is modules (Nurdiyanti et al., 2024). A module in this context is a learning unit designed in a structured and modular manner, where students can study independently or in small groups according to their respective learning rhythms. According to Aminah et al. (2023) modules in the Merdeka Curriculum are learning resources designed to provide comprehensive guidance to students in independent or group study, with a focus on flexibility and freedom in exploring the material. Teachers play a key role in this process by providing initial guidance, facilitating discussion and problem solving, and providing meaningful feedback to move students toward deeper understanding (Sarjana, 2022). They are also responsible for ensuring that the modules are well designed, according to curriculum needs and student potential, so as to increase student motivation and interest in learning through meaningful and student-centred learning experiences.

The role of teachers is very much needed to motivate students' enthusiasm for learning. Because teachers are seen as people who know a lot about learning conditions and also the learning problems faced by students (Sari et al., 2021). Critical thinking is very useful for fifth grade students, because from the age point of view, students have entered the stage of concrete thinking development (Varenina et al., 2021). This development comes not only from external factors but also internal factors, because students experience continuous change. The brain is a thinking organ that develops through a repetitive learning process and interacts with the world through perception and action. Therefore, critical thinking skills for class V students are expected to be more concrete. The problem that occurs is that students are less enthusiastic about taking science subjects because most of them experience a lack of motivation in learning. Apart from that, the lack of innovation from teachers in delivering material (through lectures and presentations) is also an influencing factor. Insufficient support from parents for the development of good social attitudes and its impact on students' interest in learning has shown significant findings (Sethi & Scales, 2020).

Problems that occur require immediate problem-solving action. One effort that can be made is to develop appropriate, interesting and effective learning strategies so that they can improve teacher skills, student activities and student learning outcomes, namely by using Discovery Learning (DL) based module development. DL is a learning strategy that tends to encourage students to be actively involved in the process of discovering or exploring new concepts through direct experience (Purwaningsih et al., 2020; Rahayu, 2022). This approach emphasizes independent learning where students are welcome to explore, observe, and face challenges in discovering new knowledge. By giving students the freedom to discover for themselves, DL not only improves their understanding of the material, but also develops critical skills such as problem solving, analysis and synthesis (Idrus & Irawati, 2019). Through this model, students are invited to discover for themselves what they have learned and then construct that knowledge by knowing its meaning. In this model the teacher is only a facilitator. According to Safitri et al. (2022) DL is useful in: increasing students' intellectual potential; moving away from giving extrinsic rewards; holistic learning through the discovery process; and a tool for training memory.

Critical thinking skills are a competency that must be trained in students because this ability is very necessary in the learning process and in life (Rini & Aldila, 2023). Critical thinking skills are also defined as students' ability to analyze arguments, make conclusions based on reasoning, assess or evaluate, and make decisions or solve problems **(Lai, 2011)**. Critical thinking skills are an important aspect that needs to be improved through the learning process at school. Learning activities do not only rely on the role of the teacher, but are also designed to help students develop

thinking skills and problem-solving skills, as well as preparing them to become independent individuals. This process allows students to gain in-depth knowledge, which in turn can improve their ability to solve problems with more empathy, use critical thinking approaches, and produce various creative and effective solutions.

One effective strategy to improve students' critical thinking is to use Discovery Learning-based teaching materials. This model allows students to learn independently and exploratively, helping them overcome complex problems. Educators need to have the right tools to train students' critical thinking skills, and Discovery Learning provides a good platform for that purpose (Chusni et al., 2021; Warlinda et al., 2022). In this learning model, students participate in group learning that allows them to discuss, express opinions, and explore various points of view. This encourages students to develop critical thinking skills in a more structured and sustainable way in the context of teaching and learning activities.

Method

This type of research is a type of development research (Research and Development) which is oriented towards products developed in the field of education which aims to increase the effectiveness and understanding of students' material in learning and the results (Sukmadinata, 2013).

The development steps adapted according to the ADDIE Model can be described by Figure 1.

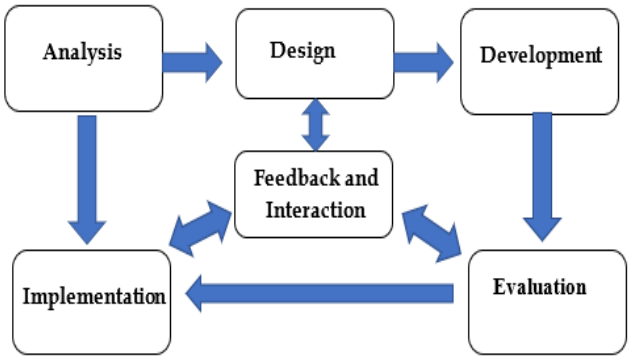

Figure 1. Development Scheme according to the ADDIE Model

Trial Design

Product trials are intended to test the feasibility of learning media developed based on material aspects, module aspects and user assessments. There are two stages in product testing to determine the level of suitability of learning media, namely expert validation and user testing (Sudarman & Ardian, 2021).

Expert Validation

Expert validation aims to determine the level of feasibility of Discovery Learning-based learning media which was developed based on material (Aswirna & Ritonga, 2020), teaching materials, language, design and technology aspects. The feasibility test is carried out by showing the Discovery Learning-based teaching materials being developed along with a number of assessment questionnaires which will be filled out by material and media experts to assess whether the teaching materials are suitable or not along with suggestions and criticism that can be used as improvements in developing Discovery Learning-based teaching materials.

Test use

The use trial is intended to determine the level of suitability of Discovery Learning-based learning media for users (Utomo & others, 2023). The Discovery Learning-based teaching materials developed are used as teaching materials for teachers and students in the learning process. Teachers and students then fill out an assessment questionnaire after the learning process ends to assess the level of usefulness of the Discovery Learning-based teaching materials developed.

Data Analysis Techniques

This research utilizes quantitative and qualitative analysis approaches to gain a comprehensive understanding of the effectiveness of learning modules (Whatoni & Sutrisno, 2022). Quantitative data was obtained through validation results from experts, as well as practicality assessments involving students and teachers, which were analyzed using a Likert scale to measure the level of validity and practicality of the module. In addition, qualitative data was collected through evaluating students' pretest and posttest test scores, which allowed researchers to assess changes in students' understanding and skills before and after using the module. To systematically measure product effectiveness, this research applies a Pretest-Posttest Control Group Design, which compares test results between groups that use the module and a control group that does not use the module (Rahmawati et al., 2021). This approach provides a clear picture of the impact of the module on improving students' abilities, as well as the validity and effectiveness of the module in real educational contexts.

Results and Discussion

Expert Validation Results

The Discovery Learning-based module developed has been comprehensively evaluated from various important aspects, namely material, language and

media. The results of this validation process show that the module meets the standards set in these three aspects. Material evaluation ensures that the content presented is relevant and appropriate to learning needs, while language assessment assesses the readability and clarity of information delivery. The media aspect involves evaluating the quality of the media used in the module. A summary of the validation results from these three aspects can be seen in Table 1.

Table 1. Validation Results of *kurikulum merdeka* Teaching Materials

Assessment Aspect	Score of Validity
Format	22
Learning Activities	44
Language	10
Total Score	76
Maximum Score	85
Total Score	76
Average Percentage Validity	89
Validity Category	Very valid

Based on the data listed in the table, the results of the validation assessment by validators show an average total score of 89%, which is within the qualification of "very valid." This score reflects that the Merdeka Curriculum Teaching Materials have been assessed very well by experts, indicating that the materials meet high quality standards in various aspects. This highly valid assessment indicates that the teaching materials are not only accurate and relevant but also presented in an effective way and in accordance with curriculum needs. With these results, it can be concluded that the *kurikulum merdeka* Teaching Materials are ready for widespread use, providing a strong basis for successful implementation in the field.

Validation carried out by material experts, language experts and media experts provides a comprehensive picture of the quality and feasibility of the module being developed. The assessments from these three experts cover various important aspects that ensure that the module is not only relevant and accurate in content but also delivered in clear language and effective media. The results of each validation show that the module meets the established criteria in all dimensions, with material experts and language experts providing highly valid assessments, while media experts provide valid scores. Overall, this evaluation confirms that the module has been evaluated comprehensively and declared ready to be tested in the field. The results of the validator can be seen as a whole in Figure 2.

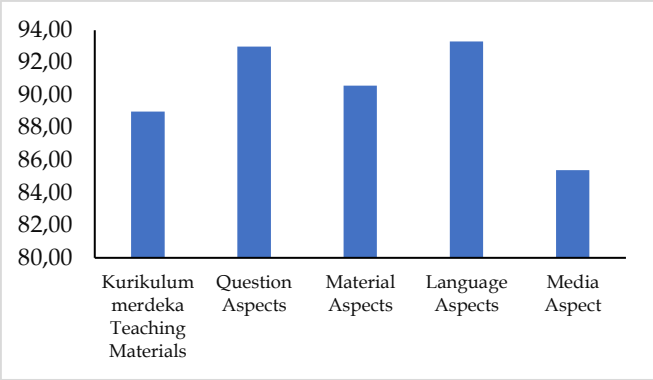

Figure 2. Validity Results for All Aspects

Module Practicality Test Results

After validating the module, the next stage is testing the module. Trials were carried out to obtain direct input in the form of responses from students as the target users of the module.

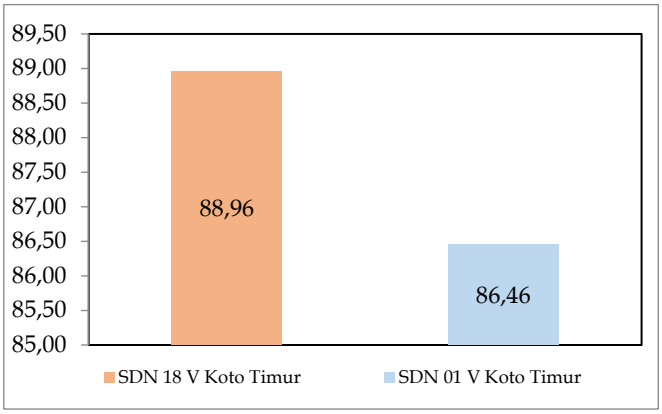

Figure 3. Individual trials at SDN 18 V Koto Timur and SDN 01 V Koto Timur

The diagram provides a comparison of the trial results between the two schools, offering a comprehensive visual picture of the practicality and acceptability of Discover Learning-based modules at each school. With this visualization, we can easily assess the extent to which the module was accepted and implemented effectively in both schools, as well as see the differences in user experience.

Evaluation Stage

The evaluation stage in this research consists of three main steps designed to assess the overall effectiveness of the product being developed. The first step is carrying out a pre-test, which aims to measure students' initial level of knowledge before the learning process begins, thereby providing a basic picture of their understanding. The second step is implementing a post-test, which is carried out after the learning process to assess changes in students' understanding and skills, as

well as measuring the extent to which the module contributes to improving critical thinking abilities.

To systematically evaluate product effectiveness, this research used a Pretest-Posttest Control Group Design. This design allows researchers to compare the pre-test and post-test results between the group that used the module and the control group that did not use the module, thus providing clear and measurable data about the impact of the module on improving students' critical thinking skills. With this approach, research can accurately assess the effectiveness of modules and provide deep insight into their contribution to the learning process.

Descriptions of the pretest data and posttest data for the two sample groups are briefly summarized in the following table.

Table 2. Description of pretest and posttest data

Value	Class	$\overline{X}$	X min	X max	S
Pretest	Experiment	59.0	30	80	12.45
	Control	46.8	30	80	10.94
Posttest	Experiment	74.1	53	100	12.45
	Control	51.4	30	80	10.94

From the results of the pretest and posttest analysis, the experimental group showed significant improvement compared to the control group. In the pretest, the average score of the experimental group was 59.0 with a standard deviation of 12.45, while the control group had an average of 46.8 with a standard deviation of 10.94. After treatment, the average score of the experimental group increased to 74.1 with a fixed standard deviation of 12.45, while the control group only increased to 51.4 with a fixed standard deviation of 10.94. The increase in the average score from pretest to posttest in the experimental group (15.1) was much greater than that in the control group (4.6), indicating that the treatment in the experimental group was more effective in improving results. Although the range of scores on the pretest and posttest was consistent across the two groups, the difference in mean improvement indicated a positive impact of the experimental treatment.

The findings of this research are in line with the results of previous research conducted by Triandini et al. (2021) concluding that module development was feasible, effective and students responded well to the use of the module. Apart from that, it can also improve students' computational thinking skills, obtaining an average n-gain score of 0.66 in the medium category. This is in line with research by Khasyyatillah & Osman (2019) concluding that the CT-S module has good validity, improves computational thinking skills, and can help students master learning objectives, further research conducted by Syah & Anistyasari (2020) concludes that Using the Scratch module can improve learning outcomes and students' computational thinking skills are good.

Conclusion

This research produces a product, namely Discovery Learning-based teaching materials which were developed using the ADDIE development design. Development of Discovery Learning-based science and science teaching materials can be declared valid, practical and effective. The validity test of the *kurikulum merdeka* teaching module obtained an average of 89% (very valid), the material expert validator obtained a result of 90.6% (very valid), the result of the language expert was 93.3% (very valid), and the result of the media expert was 85%. .4% (valid). Practicality of the module carried out by educators and students. Individual trials on 8 students at SDN 18 V Koto Timur and 8 students at SDN 01 V Koto Timur produced an average total score of 88.96% and 86.46%, which were categorized as "very practical. In small group trials with 10 students in each school, the average scores reached 93.17% and 88.17%, also in the "very practical" category. Limited group trials with 15 students in each school showed average scores of 92.11% and 91.67%, remaining in the "very practical" category. These results confirm that the module was well received and shows. consistent practicality across different groups of learners, proving its effectiveness and usefulness as a learning aid. The effectiveness of the module developed using pretest and posttest analysis shows that the experimental group experienced significant improvement compared to the control group. The average score of the experimental group rose from 59.0 on the pretest to 74.1 on the posttest, while the control group only rose from 46.8 to 51.4. The increase in the average score of the experimental group (15.1) was much greater than that of the control group (4.6), indicating that the experimental treatment was more effective in improving students' critical thinking. The range of values was consistent in both groups, but the difference in mean improvement confirmed the positive impact of the experimental treatment

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Author Contributions

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Conflicts of Interest
The authors declare no conflict of interest.

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