DEVELOPMENT OF IPAS TEACHING MATERIALS IN THE INDEPENDENT CURRICULUM FOR GRADE IV ELEMENTARY SCHOOL BASED ON METACOGNITIVE STRATEGIES

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Abstract

Metacognition is one-factor influencing students' processes and learning achievement. Many studies have shown that metacognition helps individuals become more effective learners, enabling them to regulate and improve their thinking and learning methods more effectively. This study aims to produce metacognitive-based teaching materials for the subject of Science in Grade IV Elementary School with the Merdeka Curriculum and to test its validity. This research is a Research and Development (R & D) using the Borg and Gall development model, which is simplified into seven stages: a preliminary study, research planning, design development, limited trial, revision of limited trial, large-scale trial, and revision of large-scale trial. The samples were selected using a purposive sampling technique, with 10 students in the limited trial and 26 in the large-scale trial. The validity of the teaching materials was evaluated by subject matter experts, metacognitive experts, and educational media experts, as well as response questionnaires from teachers and students. The data analysis technique used is descriptive, which presents the product development results. The results of the study show that the development of metacognitive-based teaching materials for the subject of Science in Grade IV Elementary School with the Merdeka Curriculum is valid and feasible to use, based on the validation results from subject matter experts, metacognitive experts, and educational media experts, as well as student assessment questionnaires with average criteria of excellent. The results of the large-scale trial show an increase in student learning motivation, from 45% of students with high self-directed learning motivation to 70% of 26 students.

Keywords: teaching material; science; metacognitive strategies; merdeka curriculum

Abstrak

Metakognisi adalah salah satu faktor yang mempengaruhi proses dan prestasi belajar siswa. Banyak penelitian yang membuktikan bahwa metakognisi membantu seseorang menjadi pembelajar yang lebih efektif, karena metakognisi menjadikan seseorang mampu mengatur dan memperbaiki cara berpikir dan belajarnya secara lebih efektif. Penelitian ini bertujuan untuk menghasilkan bahan ajar yang berbasis metakognitif pada mata pelajaran IPAS kelas IV SD dengan Kurikulum Merdeka serta menguji kevalidannya. Jenis penelitian ini adalah *Research and Development* (R & D) dengan model pengembangan Borg and Gall yang disederhanakan menjadi tujuh tahap yaitu, studi pendahuluan, perencanaan penelitian, pengembangan desain, uji coba terbatas, revisi uji coba terbatas, uji coba skala luas, revisi hasil uji coba secara luas. Pengambilan sampel dilakukan dengan teknik *purposive sampling* yaitu 10 pesera didik pada uji coba skala terbatas dan 26 siswa pada uji coba skala luas. Validitas bahan ajar diupayakan melalui validasi ahli materi, ahli metakognitif, dan ahli media pendidikan, serta angket respon dari pendidik dan siswa. Teknik analisis data menggunakan teknik deskriptif yang memaparkan hasil pengembangan produk. Hasil penelitian menunjukkan bahwa pengembangan bahan ajar berbasis metakognitif pada mata pelajaran IPAS kelas IV SD dengan Kurikulum Merdeka valid dan layak digunakan berdasarkan hasil validasi dari ahli materi, ahli metakognisi dan ahli media serta berdasarkan angket penilaian siswa dengan rata-rata kriteria sangat baik. Hasil ujicoba skala luas menunjukkan peningkatan motivasi belajar siswa yaitu dari 45% siswa yang mempunyai motivasi belajar mandiri tinggi meningkat menjadi 70% dari 26 siswa.

Kata Kunci: bahan ajar; ipas; strategi metakognitif; kurikulum merdeka

Introduction

Education is very important for the survival of a person's life and will impact the nation's progress (UNESCO, 2015; World Bank, 2018; Kemdikbud, 2019). In education, metacognitive skills play an important role in optimizing students' learning success, especially in managing and improving their understanding of a concept or material (Efendi and Khusna, 2020; Mulyono and widiastuti, 2020; Santoso dkk, 2021; Artini dkk, 2021). Students who have good metacognitive skills can effectively manage their learning time and effort, continuously evaluate their understanding, and modify their learning strategies when needed. (Kurniawan, 2019). Good metacognitive skills can help students identify weaknesses in their learning process to help them improve their learning performance in the future. Improving students' metacognitive abilities can be pursued by applying metacognitive strategies in the learning process.

Metacognition can be defined as the ability to recognize, monitor, and regulate our thinking and learning. Thus, metacognitive strategies are techniques designed to help students monitor, evaluate, and organize their thinking to achieve set learning goals (Flavell, 1979). This suggests that metacognitive strategies can assist a person in understanding and organizing their thinking. Flavell also mentioned, "Metacognitive strategies refer to the conscious monitoring of one's cognitive strategies to achieve specific goals, for example, when learners ask themselves questions about the work and then observe how well they answer these questions" (Flavell, 1981). Metacognitive strategies refer to awareness of thinking process strategies to achieve certain goals. With this awareness, people can control their thoughts by designing, monitoring, and assessing/evaluating what they learn (Soinbala & Mulyatna, 2019; Sucipto, 2017). In metacognitive strategies, there are three main components: planning, monitoring, and evaluation.

The planning stage in the metacognitive strategy is a very important initial stage. This stage is carried out before the teaching and learning process begins. The goal is to help students recognize learning objectives, understand the material to be learned, set personal goals, identify available resources, and determine the learning strategies to be used. Some of the activities in the planning stage include identifying learning objectives, determining the resources and learning strategies needed, setting personal goals, making time plans, and evaluating learning progress. In the planning stage, teachers can also help students understand how to organize themselves, develop a positive attitude towards learning, and increase learning motivation. Students can also be encouraged to develop social and collaborative skills by working in groups (Flavell, 1979; Tanner, 2012).

The monitoring stage in the metacognitive strategy is where students actively pay attention and evaluate their progress in understanding the material being studied. At this stage, students learn to monitor their understanding of the material, difficulties or obstacles encountered, and strategies or tactics used to overcome problems. According to Tanner (2012), in the monitoring stage, individuals must pay close attention to their progress and measure their performance using predetermined criteria. Individuals must also check their understanding of the material and determine if some things are still unclear. In addition, individuals need to recognize and record difficulties or obstacles that arise and evaluate the strategies used

successfully or not (Dignath and Büttner, 2018; Manfra and Li, J, 2019; Van Laer and Elen 2015).

The assess or evaluate stage in metacognitive strategies is where students evaluate their problem-solving results and consider whether or not they achieved their goals. At this stage, students also consider what strategies were most effective and how they can be improved in the future. Evaluation can also help students identify errors and weaknesses in their problem-solving so that they can correct and improve their performance in the future (Alqahtani, 2020; Liao et al, 2021; Çamurcu and Şimşek, 2021). According to Tanner (2012), in the assessing or evaluating stage, students should consider questions such as "Have I achieved my goal?", "Did I use the right strategy?" and "How can I improve my strategy in the future?" Tanner emphasizes that good evaluation is reflective evaluation, and students should reflect on what they learned and how they learned.

Applying metacognitive strategies in learning will provide significant benefits in learning various subjects. Such as research conducted by Sari (2019) at SDN in Bandung City shows that applying metacognitive strategies in social studies subjects can improve student learning outcomes. Research conducted by Shabrina (2021) at SDN in Bogor Regency also shows that applying metacognitive strategies in Mathematics subjects can improve student learning outcomes. Other research by Suherman, Sutarno, and Jumadi (2018) shows that applying metacognitive strategies in science learning can improve student learning outcomes. Also, research by Yaqoob and Majoka (2021) shows that applying metacognitive strategies impacts by applying metacognitive strategies in learning. Students will become more independent in learning, more confident in making learning decisions, and improve their learning outcomes and critical thinking skills.

However, the results of an interview with one fourth-grade teacher at Gandekan Elementary School in Surakarta showed that in classroom learning, the teacher has not yet optimally implemented metacognitive-based learning because metacognition is difficult to understand even though its importance is recognized. The teacher feels difficulty in implementing metacognitive-based learning, and is less able to access the metacognitive abilities of students. The focus of teaching and learning activities is often dominated by delivering as much information as possible, without giving students the opportunity to construct their own knowledge. This leads to a lack of awareness for students to control their cognitive activities.

Understanding the importance of applying metacognitive strategies in educational success and realizing the issues faced by classroom teachers as described above, there is a need for teaching materials that can assist teachers in implementing metacognitive-based learning.. Therefore, this study aims to develop metacognitive-based teaching materials for IPAS subjects in fourth grade of elementary school with the Merdeka Curriculum. With these teaching materials, it is hoped that teachers will be able to optimize students' cognitive and metacognitive activities.

Research Methods

This research is a type of research and *development* with Borg and Gall's development model (Borg and Gall, 1989). In this study, Borg and Gall's 10 development steps were simplified into seven steps without reducing the value of the development itself (Sanjaya, 2013). The seven development steps are preliminary studies, design planning, design development, limited trials, revision of limited trial results, wide-scale product trials, and revision of wide-scale trial results.

The research was conducted at Gandekan State Elementary School No.230 Surakarta for fourth-grade students. The sample of this research was 10 students for the limited-scale trial and 26 students for the wide-scale trial. The research data were taken by observation, interview, and questionnaire. Observations and interviews were used to obtain research problems. Questionnaires were used to obtain assessment data from experts related to the feasibility of teaching materials based on metacognitive strategies developed and to determine student responses to the teaching materials developed. The data obtained are quantitative data on expert validation, student responses, and qualitative data on expert suggestions and input related to the developed teaching materials. The data were analyzed and presented descriptively and qualitatively.

Results and Discussion

The results of this study are obtained from the implementation of 7 steps of developing teaching materials based on metacognition in the fourth-grade IPAS subject with the Merdeka Curriculum with the following stages. The preliminary study stage consists of two activities: field and literature. Field studies were conducted through interviews and observations. The results of interviews with fourth-grade teachers of SDN Gandekan No. 230 Surakarta showed that in classroom learning, teachers had not implemented metacognitive-based learning optimally because metacognition is difficult to understand even though it is recognized as very important. Teachers find it difficult to conduct metacognitive-based learning, and teachers are less able to access the metacognitive abilities of their students. While the observation results show that the teacher dominates the learning process, the focus of learning activities is often dominated by delivering as much information as possible without providing opportunities for students to construct their knowledge.

The literature study shows that teaching materials based on metacognitive strategies affect learning outcomes. Research conducted by Nur (2020) shows that metacognition-based teaching materials positively affect student learning outcomes in elementary schools in social studies subjects. Meanwhile, the results of research by Siswanto et al. (2021) show that the development of metacognitive-based teaching materials in Mathematics subjects positively affects the learning outcomes of grade IV elementary school students. Also, research was conducted by Yuniarti et al. in 2020. The results showed that teaching materials/modules based on metacognitive strategies could improve student learning outcomes. In this study, students who used teaching materials based on metacognitive strategies reached an average score of 80.78, while students who did not use teaching materials reached an average score of 75.89. In addition, research conducted by Fatmasari and Ulya (2020) at SDN 1 Kandangserang, Tangerang Regency, showed that the average student learning outcomes in the experimental group experienced a significant increase compared to the control group.

The research conducted by Syarifah and Tantowi (2018) showed that the use of metacognitive-based learning materials has a significant impact on students' learning outcomes in science subjects in fourth grade elementary school. This research was conducted on 40 students using the quasi-experimental pretest-posttest control group design method. The experimental group was given learning using metacognition-based teaching materials/modules, while the control group used conventional methods. The results showed a significant increase in student learning outcomes in the experimental group, with an average post-test score of 81.25 compared to the control group, which only reached an average post-test score of 64.75.

In addition, Rohman et al. (2019) research showed that using metacognition-based teaching materials/modules also positively affected student learning outcomes in fifth-grade science subjects. This research was conducted on 44 students using the quasi-experimental pretest-posttest control group design method. The experimental group was given learning using metacognition-based materials/teaching, while the control group used conventional methods. The results showed a significant increase in student learning outcomes in the experimental group, with an average post-test score of 85.16 compared to the control group, which only reached 71.84.

The design planning stage in this study was carried out by selecting the Learning Outcomes to be developed in teaching materials and making a flow of Learning Objectives following the current curriculum, namely the Merdeka curriculum. Furthermore, the teaching material that will be delivered in the teaching material is determined. The subject matter in this teaching material is about changing the form of energy, which contains 3 subchapters: the form and transformation of energy around us, stored energy, and energy in motion.

The Design Development Stage (*Develop Preliminary Form of Product*) in this research was completed by compiling a draft of teaching materials based on metacognition in the fourth-grade IPAS subject with the Merdeka Curriculum. The draft is made by paying attention to the curriculum, subject matter, components of metacognitive strategies, and aspects of learner development. From the draft that was made, it was consulted with material experts, namely grade IV elementary school teachers, metacognitive experts, as well as lecturers and media experts who are also lecturers. The material expert obtained the following results in filling out the validation questionnaire.

Table 1. Material Expert Validation of Teaching Materials

No	Assessed Aspect	Score
1.	Learning Outcomes are relevant to the independent curriculum	4
2.	Learning Objectives are relevant to Learning Outcomes	4
3.	Learning Indicators are relevant to Learning Objectives	4
4.	Material exposure is relevant to the Learning Objectives that must be	4
5.	Mastered	3
6.	Group and individual assignments are relevant to the Learning Objectives that	3
7.	students must master	4
8.	Exercises and questions are relevant to the Learning Objectives to be mastered	4
9.	Depth of material description following Learning Objectives	4
10.	Completeness of material description following Learning Objectives	2
	Instrument Value	**3,6**

Table 1 above shows the validation test results by material experts who gave an assessment related to the relevance of teaching materials to the curriculum of 3.6. This value is included in the very valid criteria. The suggestions and comments of the material experts are as follows (1) In general, the teaching materials have been well prepared and are relevant to the independent curriculum (2) The images in the teaching materials should be closely related to the material being taught. Reduce unimportant decorative images.

Furthermore, teaching materials are also validated by metacognition experts. The expert is a lecturer who has an educational background in educational psychology. The results of filling out the validation questionnaire by metacognition experts obtained the following results.

Table 2. Metacognition Expert Validation of Teaching Materials

No	Assessed Aspect	Score
1.	Title of teaching materials oriented to metacognitive strategies	4
2.	Instructions for using teaching materials oriented to metacognitive strategies	4
3.	Objectives in metacognitive strategy-oriented teaching materials	4
4.	There is a stage of planning learning activities in the textbook	4
5.	Presentation of material descriptions in teaching materials oriented to metacognitive	3
6.	Strategies	3
7.	Providing group and individual assignments in metacognitive strategy-oriented teaching	4
8.	Materials	2
9.	There is a self-monitoring stage in the textbook.	4
10.	Learning outcome evaluation test questions in metacognitive strategy-oriented teaching	4
	Instrument Value	**3,6**

Table 2 above shows the results of the validation test by metacognition experts who gave an assessment related to the relevance of teaching materials to the metacognitive strategy component, which was 3.6. This value is included in the very valid criteria. The suggestions and comments of metacognition experts are as follows (1) Teaching materials already contain components of metacognitive strategies described in each section, (2) In the evaluation test questions section of learning outcomes, it is necessary to provide story texts that are associated with metacognitive strategies.

In addition to being validated by material and metacognition experts, teaching materials are also validated by educational media experts. The expert is a lecturer who has a background in Educational Technology education. After filling out the validation questionnaire, educational media experts obtained the following results.

Table 3. Educational Media Expert Validation of Teaching Materials

No	Assessed Aspect	Score
1.	The attractiveness of the cover design of teaching materials oriented to metacognitive strategies	2
2.	The appropriateness between the material and illustrations/images used	4
3.	Consistent use of title spacing, subtitles, and typing material	4
4.	Consistent use of font size in Teaching Materials	4
5.	Clarity of writing/typing	4
6.	Color, font, and background selection	4
7.	Text quality of teaching materials used	4
8.	Quality of tables in teaching materials	4
9.	Integration of images and text	3
10.	Images using local context	2
11.	Quality of images used	3
12	Image size accuracy	4
13.	Accuracy of image placement	4
	Instrument Value	**3,53**

In table 3 above, it can be seen that the validation test results by educational media experts who gave an assessment related to the construction of teaching materials were 3.53. This value is included in the criteria very valid. The suggestions and comments of educational media experts are as follows (1) All parts of teaching materials have been well organized (2) In the selection of images is attempted to be more related to the experiences that students have or contextualize the student's environment.

Based on the research provisions, the product is said to be feasible if it is at least included in the good category. It is feasible regarding media considerations, material, and relevance to metacognition strategies. Even though it is feasible, the teaching materials are still revised or refined based on the suggestions/insertions of the experts.

Limited trials (*Preliminary Field Testing*)**.** The results of the observation of students using metacognitive-based teaching materials in IPAS subjects for grade IV elementary school with the Merdeka Curriculum are as follows: (1) All students admitted to enjoying using the teaching materials, (2) All students completed the metacognitive strategy component form, (3) Two students had difficulty writing their learning activity plans, (4) The process of explaining the material on changing energy forms went smoothly without obstacles, and (5) The implementation of metacognitive strategies consisting of planning, monitoring, and evaluation was successful.

Revision of the results of the limited trial (*Main Product Revision*) was carried out by considering suggestions and input from students who were interviewed after the limited trial was conducted. Suggestions that can be used to improve teaching materials are (1) Pictures that are included are more interesting, (2) Practical tasks should not be too much, and (3) Teaching materials need to add interesting stories related to the subject matter. Based on these suggestions, the teaching materials were revised again.

The *main field testing* was conducted by testing the teaching materials on all SD Negeri Gandekan No. 230 Surakarta fourth-grade students, as many as 26 students. The class teacher conducted learning for 3 meetings using the developed teaching materials. After the learning was completed, students were asked to fill out a questionnaire on the results of the field trial that had been prepared. The results of the trial are shown in the table below.

Table 4. Results of a wide-scale trial of teaching material

No	Assessed Aspect	Score
1.	Is the cover of the teaching material attractive and easy to understand?	4
2.	Is the manual easy to understand	3.2
3.	Is the material presented in an interesting and easy-to-understand way	3.4
4.	Are the stories included interesting and related to the material?	3.8
5.	Are the images included interesting and related to the material?	4
6.	Are individual and group tasks interesting and easy to do	3.3
7.	Did you easily understand the meaning of the evaluation questions	3.6
8.	Did you find it easy to fill out the metacognition strategy form?	3.8
9.	Do you like learning with this teaching material	3.8
10.	Do you find it easy to learn with this teaching material	3.5
	Instrument Value	**3.64**

Table 4 above shows that the results of the broad-scale teaching material test get a score of 3.64 which is included in the very good criteria. After the trial, students were asked to fill out a questionnaire to determine how these teaching materials affect student activities. The results showed an increase in student learning motivation, from 45% of students with high independent learning motivation to 70% of the 26 elementary school students. The results obtained are presented in the following figure:
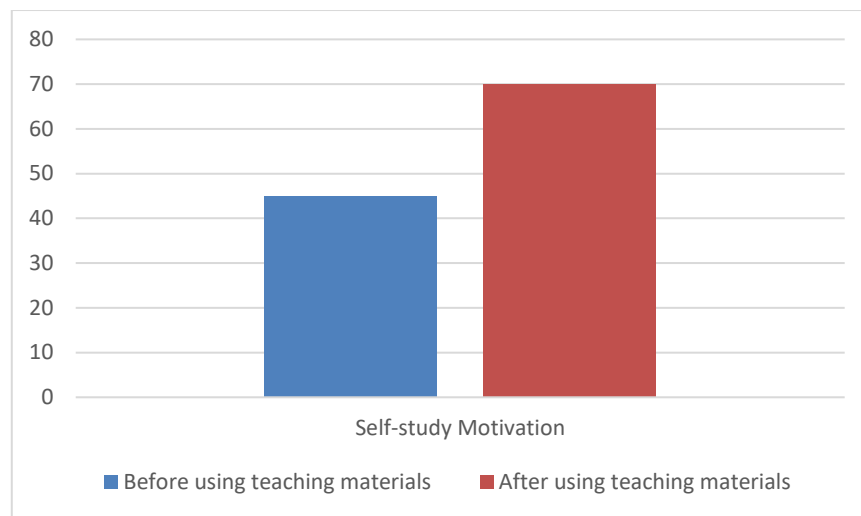
Figure 1. Improvement in self-learning motivation

Revision of the Results of the Broad Scale Trial (*Product revision*) is carried out after a broad-scale test using students being asked to provide oral input or suggestions. Of the 26 students, only 2 students provided input or suggestions, namely as follows (1) Guidelines for using the book are made simpler and easier to understand, and (2) Group assignments should be made more challenging. Based on this input, the teaching materials were refined again.

Conclusion

The results showed that the development of metacognitive-based teaching materials in the fourth grade IPAS subject with the Merdeka Curriculum was valid and feasible to use based on the validation results from material experts, metacognition experts, and media experts as well as based on student assessment questionnaires with an average of very good criteria. The results of the broad-scale trial showed an increase in student learning motivation, from 45% of students with high independent learning motivation to 70% of 26 students. However, further research needs to be done with relatively heterogeneous subjects to apply field tests to obtain better results. It is also necessary to validate all instruments that will be used so that their validity is clear. In addition, the effectiveness of using these teaching materials also needs to be studied more deeply.

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