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| **DESIGN OF TEACHING MATERIALS BASED ON BLOOM'S REVISED TAXONOMY ON THE CONCEPT OF A MAGNETIC FIELD FOR HIGH SCHOOL PHYSICS LEARNING** |
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| **ABSTRACT** |
| *Physics teaching materials used in physics learning should be able to develop knowledge and improve students' cognitive processing abilities. The reality on the ground shows that the existing teaching materials have not met these expectations. This study aims to develop teaching materials based on Revised Bloom's taxonomy on magnetic field concept in high school physics learning and determine the validity and feasibility of the results of developing revised Bloom's taxonomy-based teaching materials on magnetic field concept for class XII SMA. The type of research is Research And Development (RnD) by taking the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model which is reduced to the development stage. The research subjects were 3 UNP physics lecturers and 3 physics teachers from SMAN 1 Kampar Timur, SMAN 2 Kampar and SMAN 1 Kampar Utara, with the object of research being Bloom's taxonomy-based teaching materials. Revision of learning tools consisting of lesson plans, teaching materials, and instruments. Evaluation of magnetic field materials. Based on the results of data analysis that has been carried out, the validity of teaching materials based on Revised Bloom's taxonomy on magnetic field concept in physics learning in class XII SMA, according to the expert team, results from the analysis with an average of 82.4% and according to the practitioner team with an average of 91, 73%. Overall obtained a percentage of 87.06% in the very valid category theoretically and can be continued with field trials to determine its practicality and effectiveness in learning physics in high school.* |
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| **Keywords :** Physics teaching materials; Revised Bloom's taxonomy; Knowledge; Cognitive Processes; Magnetic Concept. |
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# INTRODUCTION

The development of science and technology in the 21st century is felt so rapidly. Various advances have been achieved in almost multiple fields, including transportation, communication, design, and household needs, including in education. In the field of education, learning can be carried out boldly, in addition to being attractive. During the Covid 19 pandemic since early April 2020, more than 80 percent of the teaching was carried out boldly. Through bold education, it is hoped that students' independent learning can grow and develop well. The role of the teacher changes from being an instructor and the primary learning resource for students to increasingly shifting and acting as facilitators and mentors for students who find problems in their learning. And the role of students is as active learners how to explore, find knowledge concepts that must be mastered [4].

Shifting the teacher's role and the student's role, the learning created by the teacher is not just dictating knowledge information to students, and student learning activities are not only in the form of Sit, Listen, Record and Memorize. But the teacher tries to facilitate learning by providing various stimuli as a reference for students' thinking and reasoning that allows the creation of student learning activities as a response to the teacher's stimulus. All forms of stimulation, and learning guidelines designed by the teacher, are usually stated in teaching materials. In line with the things described above, teachers should make learning centered on students, encourage students to work in teams, make learning oriented to skills, and process-oriented learning [6].

In line with technological developments, nowadays, in addition to printed teaching materials, non-printed teaching materials have been developed in the form of audio, video, web-based teaching materials, and computer-based teaching materials that are more sophisticated and require special equipment. Nevertheless, the existence of printed teaching materials in the form of textbooks or sheets containing student knowledge and activities is still the primary source of learning used at various levels of education because standardization is still maintained, easy to obtain, does not require special equipment, and students can study anywhere and at any time with a relatively low-cost standard.

Physics is one of the specialization group subjects taught in high school from class X to class XII. Physics is fundamental to be mastered as a provision for life in society. Physics explains nature's various material objects and phenomena through concepts, principles, theories, and applicable natural laws [2]. By mastering physics, each individual can adapt and interact with nature well. Besides that, physics is the backbone of honest management and technological development because some of the technologies currently developing are dominated by physical science [3]. Therefore, studying physics and mastering it is very important as a provision for life in society. Difficulties in studying physics, such as difficulties in choosing a suitable formula for solving physics problems, can be overcome [5].

Teaching materials used in learning should be a guide for teachers and students for the smooth learning process in understanding the material and a reference in assessing the learning process [8]. Suitable physics teaching materials should contain prior knowledge information to reference student learning, learning activities, and evaluation of student achievement outcomes. By using teaching materials as teaching guides, students are expected to be able to upgrade their cognitive processing abilities from the lowest (memorization ability) to medium level (ability to understand and apply) to higher-order thinking skills (ability to analyze, evaluate and create). In line with that, by using teaching materials, it is hoped to increase students' knowledge from factual, conceptual, procedural, and metacognitive knowledge.

The success of achieving the objectives of learning physics can be determined by the effectiveness of learning experienced by students. The accuracy of the teacher's learning process will be able to improve aspects of the knowledge and thinking skills of students contained in the Revised Bloom's taxonomy. Core Competencies (CC) and Basic Competencies (BC) in the 2013 curriculum have described what scope and aspects of knowledge will be achieved through learning that includes ability: factual, conceptual, procedural, and metacognitive [1]. Besides, the curriculum also reveals the levels of cognitive processes that must be trained to students, consisting of 6 groups of cognitive process dimensions, ranging from low-level cognitive abilities to high-level cognitive skills, which include capabilities; remember, understand, apply, analyze, evaluate and create [1]. With the provision of knowledge and cognitive process abilities, it is hoped that educators can prepare Indonesia's golden generation for the future to come.

The efforts made by the government to improve the quality of education to prepare the golden generation of Indonesia continue to be carried out, such as the Indonesian government revising the curriculum regularly to suit the developments and needs of the times. One form of improving this curriculum itself is the birth of the 2013 curriculum. Another effort made is to teach. In general, teachers are given the training to apply the 2013 curriculum to the schools where they lead. The government has also procured various learning equipment and media, improved educational facilities and infrastructure, empowered MGMP, procured textbooks, etc. With multiple government efforts through the implementation of the 2013 curriculum, it is hoped that the quality of learning processes and outcomes at various levels of education units can improve.

The conditions found where the research sample was taken were not by the expectations and mandate of the 2013 curriculum. The preliminary study results obtained at SMAN in Kampar Regency, which coincided with the Educational Field Experience Practice semester July-December 2020 in learning physics on magnetic field material class XII has the lowest learning outcomes compared to other materials, namely direct current circuit material and static electricity. Based on the Daily Assessment value, the magnetic field material in 3 high school schools in Kampar Regency has a lower average PH value. The data can be seen in Table 1.

**Tabel 1. PH Value Data For Class XII Physics Subjects For The 2020/2021 Academic Year**

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| --- | --- | --- | --- |
| **No.** | **School** | **Class** | **Average PH Value** |
| **BC 3.1 & 4.1****(Direct Current Circuit)** | **BC 3.2 & 4.2****(Static electricity)** | **BC 3.3 & 4.3****(Magnetic field)** |
| 1. | SMAN 1 Kampar Timur | XII MIPA 2 | 83,97 | 87,03 | 75,17 |
| 2. | SMAN 2 Kampar | XII MIPA 1 | 82,95 | 81,5 | 78,04 |
| 3. | SMAN 1 Kampar Utara | XII MIPA 1 | 80,27 | 77,8 | 73,24 |

(Source: Physics teacher at SMAN 1 Kampar Timur, 2 Kampar, and 1 Kampar Timur

Based on the data in Table 1, the results of this pH indicate that the magnetic field material still needs to be developed. The magnetic field material was chosen in this study because the expected student learning outcomes have not been achieved.

Researchers also conducted interviews with teachers of physics subjects in 3 schools in the Kampar Regency. The results of interviews with teachers can be concluded that most teachers are still copying and taking devices from those that already exist and the internet, so they are not suitable to be used as guidelines in implementing learning. From the results of the interview, it was also explained that teachers still need the development of learning tools based on the revised bloom taxonomy. This is intended because learning tools like this are expected to improve the thinking skills and diversity of students' knowledge and improve student learning outcomes.

Preliminary studies are also carried out in the form of observations of physics learning and teaching materials used by teachers, while the results of observations made can be described as follows; First, the results regarding the implementation of learning in the classroom during online learning during the Covid 19 pandemic, show aspects of activities for reasoning and communicating and communicating from the 5 M components of the scientific approach that are generally not carried out well, the recapitulation of the data obtained can be seen in Figure 1.

**Fig. 1.** Physics graph of the percentage of implementation of the scientific approach in physics learning

Second, the results of observations on the implementation of cognitive process levels in Physics learning at SMAN in Kampar Regency are still dominated by the cognitive process levels in the aspects of remembering, understanding, and applying, while for the elements of analyzing, evaluating, and creating/creating very little is seen. This data can be seen in Figure 2.

**Fig. 2**. Graph of percentage of implementation of cognitive process dimension levels in physics learning

Third, the results of the observation of the implementation of the knowledge dimension in physics learning at SMAN in Kampar Regency still do not look evenly distributed where it is dominated by factual knowledge and conceptual knowledge only, and it can be seen that low intensity is found in metacognitive knowledge and knowledge. The data obtained can be seen in Figure 3.

**Fig. 3.** Graph of percentage of implementation of knowledge dimensions in physics learning

Fourth, the results of observations regarding the teaching materials used in learning physics in schools show that; 1) the coverage of the four dimensions of knowledge in teaching materials has not been presented evenly, which is dominated by factual and conceptual knowledge only. The data obtained can be seen in Figure 4.

**Fig. 4.** Graph of percentage of availability of knowledge dimensions in physics teaching materials

2) regarding the scope of aspects of the cognitive process, dimension levels available in teacher teaching materials are still dominated by the ability to remember, understand and apply. In contrast, the ability to analyze, evaluate, and create is still very little found. The data from this processing can be seen in Figure 5.

**Fig. 5.** Graph of percentage availability of cognitive process dimensions in physics teaching materials

Based on the results of the analysis of the research needs described above, there are still many gaps between the ideal state and the actual state. Thus, it is necessary to have teaching materials based on the Revised Blom taxonomy, which contains the dimensions of knowledge and the level of cognitive process dimensions in the exciting field material for physical learning in high school. With these teaching materials, it is hoped to improve students' thinking skills and have a variety of knowledge and learning outcomes in magnetic field material.

# METHOD

The type of research conducted in this research is Research and Development (RnD) research. This type of research can be used in designing, developing, or validating a research product, be it in a model, design, or application of an educational curriculum, such as lesson planning, lesson implementation, or learning evaluation [9]. This research and development were chosen to consider that this research aims to produce or develop specific products and see the feasibility of these products. This study uses the ADDIE model because this model is more complete and more rational when compared to the 4D model [7], while this development model has five stages; 1) Analysis, at this stage aims to define a problem so that it can be followed up. 2) Design, at this stage, aims to design products so that the problems found can be resolved. 3) Development, at this stage, aims to realize the design that has been designed into reality or into a product to be tested for success. 4) Implementation, at this stage, aims to implement products that have been tested for feasibility. 5) Evaluation, at this stage, aims to see whether the products made are excellent and reliable, following the products developed with the objectives and product specifications needed [10]. This research and development are only carried out until the development stage because the conditions are still in the Covid 19 Pandemic. However, due to the requirements during the Covid 19 Pandemic.

This research was conducted in schools located in the Kampar district, Riau Province. The research sample was taken using a stratified random sampling technique. The schools were taken in high, low, and high categories through the 2017 national exam average scores, including SMAN 1 Kampar Timur, SMAN 2 Kampar, and SMAN 1 Kampar Utara. The subjects used in this study consisted of a team of experts consisting of 3 Physics lecturers, FMIPA UNP, and a group of practitioners composed of 3 subject physics teachers from the school where the research sample was taken to validate the resulting product. Meanwhile, the object of this research is a teaching material based on Revised Bloom's taxonomy on magnetic field material for high school physics learning.

The instrument used to assess the validity of the developed teaching materials is a product validation instrument, which consists of aspects of the requirements of teaching materials, parts of the dimensions of knowledge, and aspects of the dimensions of cognitive processes. The instrument is used to assess whether the product is feasible or not to be used. The data from the assessment results of the developed teaching material validation instruments can be analyzed using the following formula:

$validation value=\frac{sum of all scores }{maximum score }x100\%$ (1)

The assessment criteria for the final score obtained can be seen in Table 2.

**Tabel 2. Likert Scale Validation Criteria**

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| --- | --- | --- |
| No | Nilai Validasi | Kategori |
| 1 | 0% - 20% | Invalid |
| 2 | 21% - 40% | Not Valid |
| 3 | 41% - 60% | Quite Valid |
| 4 | 61% - 80% | Valid |
| 5 | 81% - 100% | Very Valid |

(Source: Ref [11])

The criteria for the validity value for the teaching materials developed are valid if the average final score obtained from the expert team validators and the practitioner team is in the range of 61% to 100%.

# RESULT AND DISCUSSION

Based on the research that has been done and analyzed, the results obtained from each stage of the ADDIE development model are as follows:

1. **Analysis Stage**

At this analysis stage, a preliminary study is carried out in two ways, namely literature analysis and needs analysis. The first is literature analysis, which aims to determine the study of theories that support research and why this development research is essential. Approaches that can support this research include Minister of Education and Culture Regulation No. 22 of 2016 concerning Process Standards, Anderson and Krathwohl's revised Bloom's taxonomy theory in the form of knowledge dimensions and levels of cognitive processes, as well as articles that are relevant to the research to be carried out, such as the article by Amali Putra (2015) which discusses the need for developing learning tools oriented to the revised Bloom's taxonomy [12]. The second needs analysis which aims to analyze the implementation of the 2013 curriculum in high school physics learning related to the performance of the scientific approach as a learning approach mandated in the 2013 curriculum, as well as the availability of knowledge dimensions and levels of cognitive processes carried out in the learning process. This stage was carried out in the form of observations and interviews with physics subject teachers at the three schools where the research was conducted using interview guide sheets and observation sheets to obtain data regarding the availability of knowledge dimensions and levels of cognitive processes in the learning process as well as teaching materials commonly used in schools. The results of the observations can be seen in Figure 1, Figure 2, Figure 3, Figure 4, and Figure 5.

1. **Design Stage**

The problems and information obtained at the analysis stage are used to design and create the developed teaching materials at this design stage. The material chosen is the magnetic field material in KD 3.3 and 4.3 Physics SMA class XII to be developed. The reason for choosing this material is because the material covered is small, and the learning outcomes in the magnetic field material produced are still very far from what is expected compared to direct current and static electricity circuit materials. This material has many formulas, concepts, and sufficient theories. Difficult to understand because this material is an application of the previous physics materials. So that in learning physics, this magnetic field material is suitable to be developed in the form of teaching materials based on Revised Bloom's taxonomy.

The final result of the design developed is teaching materials based on Bloom's taxonomy revision of magnetic field material for physics learning in high school. In the teaching materials, there is the development of knowledge dimensions that are in harmony with the essential material. The steps to produce teaching materials based on the Revised Bloom's Taxonomy are: 1) Linearizing (Basic Competencies) KD 3.3 and 4.3 on Core Competencies (KI) 3 and Core Competencies 4 to produce learning topics, 2) Breaking the topic into subtopics become essential learning material on magnetic field material, 3) Describe subtopics that have been divided into knowledge titles related to magnetic field material, 5) Formulate learning objectives for magnetic field materials, and 6) Analyze learning objectives to produce Bloom Revis taxonomy based teaching materials on magnetic field materials for high school physics learning.

1. **Development Stage**

At this development stage, the researchers developed teaching materials based on the Revised Bloom's taxonomy on valid magnetic field materials. There are two stages of validation, namely instrument validation, and product validation. Validation is carried out after being approved by the supervisor. Three physics lecturers, FMIPA UNP, will validate the product validation instrument that has been developed. If the validation instrument is completed with valid results, the tool can already be used for product validation. The results of the instrument validation obtained were 78.8% with a valid category and suitable for testing after revisions were made.

The product that has been developed will be validated by six validators, 3 of whom are an expert team from physics lecturers, FMIPA UNP. At the same time, the other 3 are a team of practitioners, namely teachers who teach class XI high school physics in 3 different schools according to the categories of high, low, and low. And low. Validation is carried out after being approved by the supervisor to be given advice and input so that later the product can be submitted to the validator. The results of the validation of the products developed according to a team of experts and a group of practitioners are as follows:

**Fig. 6.** Graph of teaching material validation results based on aspects of knowledge dimensions

Based on Figure 6, it is known that the results of the validation of teaching materials related to the analysis of aspects of the knowledge dimension from the expert team got a score of 80.2%, with a very valid category. Meanwhile, 91.60% of the practitioner team were in the very valid category so that the product is feasible to use for high school physics learning.

**Fig. 7.** Graph of teaching material validation results based on aspects of cognitive process dimensions

Based on Figure 7, it is known that the results of the validation of teaching materials related to the analysis of aspects of the cognitive process dimensions from the expert team got a score of 82.8% with very valid criteria. Meanwhile, 90% of the practitioner team had very valid criteria so that the product is feasible to use for high school physics learning.

**Fig. 8.** Graph of teaching material validation results based on aspects of teaching material requirements

Based on Figure 8, it is known that the results of the validation of teaching materials related to aspects of the requirements of teaching materials from the expert team scored 84.2%, with a very valid category. Meanwhile, 93.60% of the practitioner team were in the very valid category so that the product is feasible to use for high school physics learning.

# CONCLUSION

Design of teaching materials based on Bloom's taxonomy Revised the magnetic field material for high school physics learning based on the needs analysis developed and improved the teaching materials developed based on criticism and suggestions from the validator. The developed teaching materials got the final validation result according to the expert team of 82.4%. In comparison, according to the practitioner team, it was 91.73%. The results obtained were 87.06% with a valid category and can be used for the next stage, namely conducting practicality and effectiveness test.

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