

ANALYSIS OF COMPONENTS OF THE SCIENTIFIC APPROACH IN THE X-GRADE STUDENTS OF PHYSICS FOR SMA

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ABSTRACT

Teachers as educators must be selective in choosing the right physics textbooks to help students achieve the expected competencies. However, textbooks that are suitable for use by the demands of the 2013 Curriculum, especially in Padang Pariaman Regency, have not been carried out. Therefore, research was conducted which aims to determine the application of the components of the scientific approach in the second class X Semester 2 SMA Physics textbook used in SMA throughout the Padang Pariaman Regency. This research was a descriptive study with a qualitative approach. The population in this study was the 2013 class X high school physics textbook used by 20 public high schools in Padang Pariaman Regency. Textbook sampling for analysis using a saturated sampling technique. The data in this study were taken using an analytical instrument of the application of the scientific approach component developed from Regulation of the minister of education and culture Number 103 of 2014. The results showed that the application of the scientific approach component of the textbooks analyzed was categorized quite appropriately, but that overall the five textbooks analyzed had not facilitated each component of the scientific approach optimally. Textbooks with the highest percentage of the fulfillment of the Scientific approach components were found in textbooks with the code Book A with an average percentage of 45.8%, and the lowest percentage is in Book C with an average percentage of 32.3%.

Keywords : Curriculum 2013, scientific approach, textbook.



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I. INTRODUCTION

Education functions to prepare human resources that have high competitiveness and quality. The quality of human resources is needed today to support people who are creative, critical, innovative, productive, able to solve problems, and can interact well[1]. Quality human resources can be built based on quality education. The government always strives to improve all aspects of education, including changing the curriculum to the 2013 curriculum.

The 2013 curriculum is implemented according to the eight National Education Standards set out in Government Regulation Number 32 of 2013. Eight National Education Standards related to learning activities are: (1) Graduate Competency Standards, are graduate competencies that cover knowledge, attitudes, and skills; (2) Content Standards, relating to the scope of competence and material for each subject; (3) Process Standards, relating to learning activities to achieve competency standards of graduates[2]. The policy on the implementation of the 2013 Curriculum is a change in the learning paradigm which places a strong emphasis on student-focused learning. The 2013 curriculum is directed at determining the competence and character of students, in the form of a combination of knowledge, attitudes, and skills to create innovative, productive, and creative Indonesians. Regulation of the minister of education and culture Number 22 of 2016 emphasizes that one of the principles of learning in the 2013 Curriculum is that there is an emphasis on the application of the scientific approach[3].

A scientific approach is an approach that is structured by the steps of scientific activity[4]. The implementation of the scientific approach in learning does not only focus on developing student skills in observation and experimental activities but on how to develop knowledge and thinking skills that can support creativity to innovate and work. Thinking skills can be described as a scientific method that students apply to

learn activities to obtain effective learning outcomes and improve problem-solving skills[5]. The basic component of the scientific approach is an increase in curiosity (Foster a sense of wonder), increased ability to observe (Encourage observation), carry out analysis (Push for analysis), and communicate (Require communication)[6]. According to Regulation of the minister of education and culture No. 103/2014 "the scientific approach consists of five components, namely observing, asking questions, gathering information, reasoning, and communicating"[7]. The five components are related to one another. Learning through the use of scientific approach steps can train students' process skills in finding and learning a concept[8]. The scientific approach is in line with the nature of physics as a process.

Physics as a process is the ability of how scientific knowledge of physics is obtained through the implementation of measurement, observation, investigation, and publication[9]. Physics describes various natural phenomena systematically based on scientific investigation and observation. Learning Physics does not only ask students to master facts, laws, principles, and concepts but is expected to master them all through discovery activities[10]. One aspect that supports the achievement of the physics learning process through a scientific approach is the use of teaching materials.

Teaching materials can help teachers carry out learning activities and help students to achieve predetermined competencies[11]. Teaching materials that are often used for learning activities are student books. Student books are standard books that contain lesson descriptions or subject matter from certain fields of study and are used in educational institutions[12]. Student books are also known as study manuals, textbooks, or text books. According to Mudzakir, there are three approaches to writing student books, namely: (1) a curricular approach that refers to the curriculum; (2) the linguistic approach, which refers to the position and status of a language; (3) a learning approach that refers to psychological theory[12]. Student books include a section on educational facilities and infrastructure standards in writing and their preparation must lead to educational goals. Student books are a means of conveying knowledge. This means that the student books used must be able to communicate concepts, knowledge, and information so that both teachers and students can understand them.

Books for class X Physics students have been widely circulated because books are one of the media and sources in the learning process that will determine the quality of learning. Based on the survey results of 20 Public Senior High Schools in Padang Pariaman Regency, information was obtained that the Public Senior High Schools in Padang Pariaman Regency used a variety of Physics student books in their learning process, but it is not yet known how the quality of the student books used is. Teachers are expected to be able to choose the most appropriate student books for their students to use in learning activities.

Student books must be adapted to the applicable curriculum. The goals, objectives, materials, and presentation methods are elements that must be adapted to the curriculum[13]. The curriculum is the main reference in writing student books. According to the standard 2013 Curriculum process which emphasizes learning with a scientific approach, the student books used must also be following by the scientific approach. Therefore, the book Physics students must be examined from the scientific aspects of the application of the component approach if the presentation is already facilitating the students do activities that support learning with the scientific approach appropriate curriculum expectations, 2013.

In the preparation of books, students who use the scientific approach should pay attention to the five components of the existing scientific approach in the 2013 Curriculum. In the observing aspect, student books should make students interested in seeing and reading to obtain new information. In the questioning aspect, the student book should be able to stimulate students to ask questions or think critically about what they do not understand. In the aspect of gathering information, student books can accompany students to collect information independently through various sources and solve the problems presented. In the aspect of reasoning, with the book, students are stimulated to think critically in finding new information. In the aspect of communicating, the student book invites students to reveal facts based on the findings obtained from scientific activities. The five components must be accompanied by clear and concise instructions to make it easier for students to carry out the scientific method to obtain a concept or solve a physics problem.

This research was supported by Ramadhani's research in 2019 which analyzed the SMA class XI Semester I Physics textbook from the aspect of Science Process Skills (KPS). The results of his research revealed that the most frequent presentation of KPS indicators was the observation skill aspect with an average percentage of 97.9%, while the question-asking skill aspect was the lowest presentation of the KPS indicator with an average percentage of 1.4%. So it is concluded that the textbook used is categorized as less facilitating the PPP indicator[14]. Aulia's research in 2019 analyzed the SMA class X Semester 2 Physics textbook from the aspects of Contextual Teaching and Learning (CTL). The results of his research revealed that the presentation in the analyzed textbooks facilitated the implementation of CTL aspects[15]. Research Yusliani's in 2019 analyzed the integration of 21st-century skills in the SMA class XII Semester 1 physics textbook. The results of his research revealed that the book analyzed contained four components as desired by the 21st century. The highest skill in the five textbooks was collaboration skills at 93.57%, and the lowest skill was creative thinking and innovation skills at 65.45% [16].

Based on these problems, this study aims to analyze the books of class X high school Physics students with five different publishers in terms of implementing the components of the scientific approach whether they are under the provisions and objectives of the 2013 Curriculum. class for high school ”.

II. METHOD

This research is a descriptive qualitative approach to find out whether the SMA class X Semester 2 Physics student books used have facilitated the application of the components of the scientific approach. Analyze or describe the student book according to what it is without reducing or adding to existing data in the book being analyzed. The population is the whole subject/object that meets the criteria in the study[17]. The population for this study was a class X physics student book used in 20 public high schools in Padang Pariaman Regency. Samples were taken through a saturated sampling technique, where the sampling technique is if the entire population is sampled[17]. The sample used was all high school physics student books class X Semester 2 obtained based on the survey results, namely Physics student books by Aris Prasetyo published by Mediatama in 2016, Physics student books by Hari Subagya published by Bumi Aksara in 2016, Physics student books by Ketut Kamajaya published Grafindo in 2016, a physics student book by Marthen Kanginan published by Erlangga in 2016, and a physics student book by Pujianto published by Intan Pariwara in 2016.

The instrument is a data collection tool so that work becomes more focused and the results are better[18]. The instrument used was in the form of an analysis sheet instrument for the application of the scientific approach component which was prepared based on Regulation of the minister of education and culture Number 103 of 2014. The analytical instrument was made for each subject matter of high school physics class X Semester 2. The analysis was carried out by placing a checkmark or cross on each item of the indicator assessment. which was developed from Regulation of the minister of education and culture Number 103 of 2014 in each subject matter in the student book that was analyzed and wrote down the page where the item of the instrument was found. The instruments that have been made are then validated to the experts using an instrument validation sheet in the form of a checklist on a scale of 1 to 4.

This research is divided into three stages. The preparation stage: conducts a preliminary study to obtain information about the use of physics books for class X students of the 2013 Curriculum at Public Senior High Schools in Padang Pariaman Regency, prepares a research design, determines which student books will be used as research samples, prepares research instruments, performs instrument validity, analyze the results of the validity of the instrument, and improve the instrument. Implementation stage: analyzing the scientific approach of the physics student book class X Semester 2 with the code Book A, Book B, Book C, Book D, and Book E done by putting a checklist or cross on each of the indicator assessment items developed from Regulation of the minister of education and culture Number 103 In 2014, each subject matter in the student book was analyzed. The completion stage: processing the research data to obtain the percentage of the scientific approach of each student book analyzed, interpreting the research data by determining the scientific approach category for each student book analyzed, concluding and reporting the results of the analysis obtained.

Data collection techniques for research carried out through the method of documentation. The documentation method is to collect data about variables from books, magazines, newspapers, notes, transcripts, agendas, meeting minutes, and others[19]. The documents for this study were five books of class X Physics students used in 20 State Senior High Schools in Padang Pariaman Regency. The data obtained through this documentation method is data on the application of the components of the scientific approach in the presentation of the Physics class X Semester 2 student books.

The data analysis technique to be carried out is the content analysis technique with the following stages:

1. Adding up the appearance of the components of the scientific approach at each presentation of the student book that is analyzed.
2. Calculating the average score of the component of the scientific approach of all aspects analyzed.
3. Calculating the percentage of components of the scientific approach in each student book analyzed.

$$P = \frac{\sum q}{\sum r} \times 100\%$$

P is the percentage of each indicator of the scientific approach, and is the number of occurrences present on each indicator item is the total number of each indicator item^[20].

4. Determining the criteria for implementing the components of the scientific approach in the Physics student books of Class X Semester 2.
5. Drawing conclusions based on the results of the analysis of the application of the components of the scientific approach to each indicator analyzed.

III. RESULTS AND DISCUSSION

1. Data Description

The analysis of the application of the component of the scientific approach was carried out on five high school physics student books for class X used by students in Padang Pariaman Regency, namely student books with code Book A, student books with code Book B, student books with code Book C, student books with code Book D, and the student book coded Book E. The analysis of the application of this scientific approach includes five components, namely observing, asking questions, gathering information, reasoning, and communicating which are translated into 28 assessment items. The analysis was carried out on five main subjects of physics class X Semester 2, namely particle dynamics, Newton's law of gravity, energy work, momentum impulses, and harmonic vibrations. The results of the analysis reveal that the five student books are still categorized as low in the facilitation of the implementation of the scientific approach components with an average percentage below 50% of the implementation of the components of the scientific approach is shown in Table1.

Table 1. Percentage of Application of Scientific Components in High School Physics Student Books Class X Semester 2.

Components of the Scientific Approach	Book A	Book B	Book C	Book D	Book E
Observe	52.1	49.2	38.8	39.2	30.8
Asking	62.5	44.2	30.8	38.3	25
Gathering Information	27.7	27, 2	24.7	28.3	32
Reasoning	60.4	63.3	42.9	54.6	45.8
Communicating	26.5	24.2	24.2	13.7	34.4
Average	45.8	41.6	32 , 3	35.5	33.6
Category	Enough according	Enough accordance	Less By	Less accordance	Less Match

Table 1 shows that the student book code Book A obtained the highest average percentage of 45.8% with sufficiently appropriate criteria, meaning that the student book simply facilitates the components of the Scientific approach in learning and this student book is categorized as a student book with a very high interpretation of fulfillment of the components of the Scientific approach. Book A has implemented the five stages of learning using the scientific approach as a whole, starting from the components of observing, asking questions, gathering information, reasoning, to communicating. The stages are related to one another. However, there is a weakness of this Book A, namely the lack of directing students to the components of gathering information and communicating.

Student books with the code Book B obtained an average percentage of 41.6% with sufficient criteria, meaning that the student books were sufficient to facilitate the components of the Scientific approach in their learning. Book B has found several main subjects that apply the scientific approach in its entirety. However, there are still weaknesses in this Book B, namely the lack of facilitating the components of gathering information and communicating. Student books with the code Book C obtained an average percentage of 32.3% with inappropriate criteria, meaning that student books could not facilitate the components of the Scientific approach in their learning. The weakness of this Book C is that no stage of the Physics material is analyzed by implementing the five components of the scientific approach as a whole. The five stages of the scientific approach in Book C are seen as separate stages from one another. This means that in using student books as a guide for learning activities, students do not get the opportunity to experience the whole scientific approach process as well.

Student books with the code Book D obtained an average percentage of 34.8% with inappropriate criteria, meaning that student books could not facilitate the components of the Scientific approach in their learning. The weakness of this Book D is that it does not facilitate students in reasoning activities to solve various problems related to learning materials. Student books with the code Book E obtained an average percentage of 33.6% with inappropriate criteria, meaning that student books could not facilitate the scientific

approach component in their learning. Book E includes several sub-topics that contain the stages of the scientific approach as a whole. However, it does not facilitate students in questioning activities. The observations made do not encourage students to ask various questions about the object or phenomenon being observed.

2. Discussion

The discussion of the results of the analysis of the scientific approach for each component in the five student books is described as follows.

a. Observing

The results of the analysis show that the observing component of the five student books analyzed is still categorized as quite appropriate. This is because the observing indicators are not yet fully contained in every student book analyzed, there are still some indicator items that have not been fulfilled. The observing component encourages students to take advantage of all their senses in observing a phenomenon[21]. The observing component in this study is divided into several indicators developed from Regulation of the minister of education and culture Number 103 of 2014 including reading, observing, seeing, and finding various objects/phenomena related to learning material. The observing indicator in the analyzed student book invites students to make observations of a phenomenon/object directly or only through the images presented in the analyzed student book. Images that are loaded are in the form of phenomena/objects related to the subject matter being studied.

The observing component on the indicator observes events in everyday life invites students to see the original object so that students can use their various senses. An example of observing this indicator can be seen in Book B on the subject matter of Particle Dynamics on page 119, namely "try to observe your body position while riding the bus". The subject matter of Newton's Law of Gravity on page 150 is "observe the motion of the moon as a natural satellite of the earth". The main topic of Business and Energy on page 172 is "try to observe hydropower plants in various regions of Indonesia". Indicators of observing images of phenomena or events related to the subject matter being studied can be seen in Book B on the subject matter of motion dynamics on page 124 and Impulse Momentum on page 189, which invites students to observe various images of phenomena and events related to the subject matter being studied. The presentation of the picture makes students more interested in learning the material. Through the observing component, students get the fact that there is a relationship between the object under study and the material being studied. The observing indicators in the analyzed student books are dominated by activities that encourage students to see pictures of phenomena or events related to the subject matter being studied, meaning that the student books instruct students to use their sense organs. Even though the observing component is categorized as quite appropriate, other objects must be added to be observed because there are still sub-subjects that have not included observing activities.

b. Question

The results of the analysis show that the questioning components in the five student books analyzed are still in the. This is because it is considered that the indicators for asking questions are not fully contained in every student book analyzed, there are still some indicator items that have not been fulfilled. The questioning component is a continuation of the observing component that has been done at the beginning of the lesson using a scientific approach. Asking is the ability to exchange ideas and ask questions to obtain various information[22]. The questions posed by students aim to increase knowledge, thinking skills, and develop their curiosity about the learning material.

Components propose in this study were divided into several indicators which encourage students to do the debriefing, ask questions, discuss the information that is not understood, or additional wanting to be known. The questioning indicator in the analyzed student book instructs students to ask questions if there is something that is not understood and cannot be resolved in a group discussion. Examples of questioning activities in Book A on Particle Dynamics material are on page 165 which invites students to ask questions, namely "ask the teacher about efforts to increase your understanding", and on the subject matter of Newton's Law of Gravity on page 178 there is an invitation "ask a question to your group of friends. or your teacher, if there is something you don't understand about the content above".

Physics material is material that has a lot to do with everyday life, so without realizing it, everything that is seen and done has something to do with physics. Therefore, the student book must present a variety of questions that are shown in everyday life to stimulate student knowledge to be more active in asking questions, so that students become more aware of physics lessons and their application in everyday life. Based on this explanation, it is necessary to increase the activity of asking questions in the analyzed student books so that students are more active and get the answers they want to know more fully.

c. *Gathering Information*

The results of the analysis show that the components of collecting information in the five student books analyzed are still in the inappropriate category. This is because the indicators of collecting information are not yet fully contained in every student book analyzed, there are still some indicator items that have not been fulfilled. The information-gathering component is a continuation of the question component. Information gathering activities are conducted through the collection of information from various sources through *Berba gaisway*[23]. The component of collecting information in research consists of several indicators developed from Regulation of the minister of education and culture Number 103 of 2014, including inviting students to try, explore, discuss, demonstrate, imitate a movement and form, carry out experiments, read sources other than student books, and collect data through resource persons with questionnaire or interview.

An example of the components of collecting information in Book E on indicators of conducting experiments on the subject matter of Particle Dynamics page 139 teaches students to collect information by conducting experiments, seen from the existence of the instruction "let's experiment". Through experiments, students are encouraged to discover a learning concept for themselves. The indicator reads other sources besides student books on the subject matter of Newton's Law of Gravity on page 184 which invites students to collect information through reading sources other than student books, "you can find information on these satellites from the internet, encyclopedia books, or other reference books".

The five student books analyzed have facilitated students to collect information through various sources. The component of collecting information in the analyzed student book is done not only to answer questions that students have made but to dominate instructions for collecting information in the book. Based on this explanation, it is necessary to increase the activities of collecting information in the analyzed student books to facilitate students when they are going to conduct experiments and other activities to obtain good information.

d. *Reasoning*

The results of the analysis show that the component of reasoning in the five student books analyzed is still categorized as quite appropriate. This is because it is considered that the reasoning indicators are not fully contained in every student book analyzed, there are still some indicator items that have not been fulfilled. The reasoning is the ability to connect questions, problems, and information to generate new ideas[22]. The component of reasoning in this study is divided into several indicators developed from Regulation of the minister of education and culture Number 103 of 2014, including students being able to process information, analyze data, connect various information, and make conclusions. Information gleaned from observations and experiments that have been done must be processed to obtain Keter linkages between various information, obtain patterns of relatedness of information, as well as the conclusion of as pattern is obtained.

Examples of reasoning components in Book A on indicators collect data on the subject matter of Newton's Law of Gravity on page 193 is an example of reasoning components on indicators of processing information, where student books invite students to tabulate and calculate various gravitational accelerations of various celestial bodies, and indicators to analyze on the subject matter Impulse Momentum page 231 is an example of the reasoning component of the analyzing indicator, where the student book invites students to investigate various questions to find a concept. Reasoning activities in the student books that he analyzes have led students to link observations with relevant concepts. However, reasoning activities in student books need to be improved so that students' thinking or reasoning abilities are even better and students can conclude the material from the learning activities carried out.

e. *Communicating*

The results of the analysis show that the communicating component in the five student books analyzed is still in the inappropriate category. This is because there are not yet fully communicating indicators contained in every student book analyzed, there are still some indicator items that have not been fulfilled. Communicating is an activity in summarizing various facts that have been observed and tried[24]. Students communicate ideas or findings obtained based on evidence so that through this communicating component students practice to express facts, not just opinions without evidence.

The communicating component in this study is divided into several indicators developed from Regulation of the minister of education and culture Number 103 of 2014, including inviting students to present experimental data through graphs, diagrams, compiling reports in writing and electronic media, and submitting reports on the results of learning activities orally. Communication skills help students transfer and convey knowledge consistently and correctly so that there are no misunderstandings in understanding the information obtained. Examples of communicating components in Book E on the subject matter of Newton's Law of Gravity

on page 192 are examples of communicating components on indicators presenting reports on the results of learning activities on electronic media, where student books invite students to simulate the motion of objects based on flash, and on the subject matter, Simple harmonic vibrations found on page 253 are an example of communicating activities on indicators of delivering reports on the results of learning activities orally and in writing, where student books invite students to make reports on the results of experiments from discussion activities carried out and convey the results of these discussions in front of the class.

The communicating component in the student book has invited students to compile reports both in writing and orally. According to Daryanto "the learning process will run effectively if there is the direct interaction between teachers and students"[19]. Through this communicating component, students practice interacting with teachers and other students. The results of the analysis regarding the indicators of communicating in the analyzed student books are still many that have not presented reports in the form of graphs, charts, diagrams, and writing, for that it is necessary to increase the indicators of communicating to facilitate good communication skills.

The five components of the scientific approach are very important to be presented in the Physics student book used by students at school. Through this scientific approach, students will better understand the learning material because they discover the learning concept through scientific activities. As in the observing component, it invites students to observe various objects or events related to the subject matter they learn with daily activities, so that students will better understand the material they are learning. After observing students are invited to ask questions about material that has not been understood, through questioning activities stimulates students to be more active in learning activities. Then students are invited to gather information through several sources or experimental activities. Information gathering activities are not only carried out individually but to create a fun learning process the student book instructs students to carry out each of these learning activities in groups so that students can discuss and from these discussions can indirectly help them to correct the knowledge and concepts they find. . Following the trial would be nice books students are presented with reasoning component in which students are encouraged to solve problems related experiments have been conducted or the various problems that exist in the subject matter, so that motivate students to thinks critically. Then for the last component students are encouraged to communicate their findings at the observing, asking, questioning stage. gather information, reason, and communicate. The five components of the scientific approach direct students towards fun and meaningful learning activities in achieving graduate competencies following the provisions of the 2013 Curriculum.

IV. CONCLUSION

The application of the components of the scientific approach from the five student books analyzed was categorized as quite appropriate. Physics student books that get the highest percentage of the fulfillment of the components of the Scientific approach are in Book A with an average percentage of 45.8%, meaning that Book A is the best quality student book among the five student books analyzed. Book B gets an average percentage of 41.6%. Book C gets an average percentage of 32.3%. Book D gets an average percentage of 34.8%. Book E obtained an average percentage of 33.6%. Overall, the five student books analyzed have not fully facilitated each component of the scientific approach optimally in describing the learning material. The lowest percentage of occurrences of scientific approaches is in the components of gathering information and communicating. Therefore, it is necessary to add five steps of a scientific approach in discussing each learning material so that it is in line with the standard process of the 2013 Curriculum which uses a scientific approach in the learning process.

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