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Relationship of Science Process Skills and Critical Thinking of Students in Physics Subject

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Abstract The purpose of this study was to show how the relationship between the scientific process and the critical thinking skills of Al-Falah Islamic High School Jambi students on the pure harmonic motion material. This research method is a mixed methods research with the research design being the embedded design. The subjects of this study were 100 students of class XII MIPA at Al-Falah Islamic High School Jambi. The sampling technique used was purposive sampling. The data collection instruments were the science process skills observation sheet, the critical thinking ability test, and the interview sheet, which were analyzed using descriptive statistics and inferential statistics. The science process skills observed in this study are integrated science process skills with indicators of planning experiments, obtaining and processing data, and describing the relationship between variables. Meanwhile, the sign of critical thinking ability is to provide further explanation and formulate strategies and tactics. The results of the analyzed data showed that the sig value was 0.000 < 0.05, so it could be concluded that there was a relationship between the science process skills and the students' critical thinking skills with a Pearson correlation value of 0.848 and it was positive. This research shows that the students of class XII MIPA at Al-Falah Islamic High School Jambi have excellent science process skills and good enough critical thinking skills.

Keywords Physics, Science Process Skills, Critical Thinking

1. Introduction

Education has a very strategic role in improving the quality and potential of human resources. School intends to help students empower their potential or develop their human potential [1] [2]. According to [3], education is a conscious and planned effort to create an atmosphere of learning and learning process so that students actively develop their potential. States that school has a critical role in shaping and preparing human resources to compete in the development of Science and Technology [4].

Education in Indonesia is well integrated and needs further development [5]. Education is a process to influence students to adapt to their environment [6]. Education is an activity that aims to prepare students to become people who have a positive contribution to society [7]. In education in Indonesia itself, there are several levels, one of which is the high school level [8]. High School is a level of knowledge that must be taken by students before continuing to higher education. In high school, students will study natural sciences, one of which is physics.

Physics is one of the compulsory subjects for students at the Senior High School level. Physics has become one of the questions related to scientific concepts [9]. Physics learning that is based on ideas requires high understanding. Physics learning is a science that discusses the symptoms and properties of objects in nature [10]. Physics is part of science [11]. States weaker natural science closer to science learning and thinking scientists to physics please rephrase this sentence [12].

The purpose of science education is to educate students who can have skills and be able to think critically [13]. In science, learning students are required to have a scientific attitude. With a scientific approach, students will be skilled and think critically in solving problems by the main objectives of the education system [14]. The developed scientific attitude includes honesty, purpose, open, resilient, critical, and can work together with others. This is in line with Rinsiyah (2016) opinion that physics develops aspects of scientific attitudes [15]. Experimental approaches of students can be acquired through practical activities. According to [16], the implementation of a physics practicum is critical to supporting learning and emphasizing aspects of the process. One of the physics materials that can be done with practicum-based education is simple harmonic motion. Simple Harmonic Motion is regularly moving back and forth through the point of balance with the number of vibrations of the object in every second is always the same or constant. Any motion that repeatedly occurs in the same time interval is called a periodic motion [17]. To find out and maximize the concept of simple harmonic motion in students, practicum activities are needed, namely in the form of experiments on a simple pendulum so that students gain direct experience in making discoveries based on existing concepts and facts. Practicum is carried out so that students can connect theory with relevant experiments following everyday life so that it can be understood [10] [18] [19].

Practical activities will shape science process skills and critical thinking skills in students. The Science process skills is a complex ability device commonly used by scientists to conduct scientific investigations into a series the learning process [20] [21]. Science process skills thinking skills that are used to create knowledge, solve problems, and formulate results [22]. Science process skills are tools used by students to investigate the world und them and to develop science concepts [23] [24]. Science process skills are students' ability to apply scientific methods in understanding, developing & discovering science [25]. Science process skills are critical because they help science learning and the generation of scientific knowledge [26] [27]. So the definition of science process skills implies that every student who passes through the formal education system must know sc e process skills.

Science process skills fall into two types: necessary science process and integrated science process skills [28] [29]. Necessary science process skills include observation, classification, measurement, prediction, communication, and inferring [30] [31] [32]. Whereas integrated science process skills include Variable Identification, Arranging data tables, Making graphs, Obtaining and processing data, Describing relationships between variables, Identifying variables operationally, Making hypotheses, Experimental analysis, Designing investigations, and Conducting experiments [33] [34] [35]. Integrated Science Process Skills are skills for solving problems or conducting science experiments [36]. From the above understanding shows that with process skills, students try to find and develop cognitive and psychomotor abilities. So that science process skills can support students in developing cr l thinking skills.

Critical thinking is part of high order thinking [37] [38]. Thinking skills are developed through active learning activities, namely, critical thinking skills. Critical thinking is reflective in-depth in decision making and problem-solving to analyze situations, evaluate arguments, and draw appropriate conclusions [39]. Critical thinking is an activity of thinking carried out by operating the intellectual potential to investigate, make judgments, correct de ions, and implement them correctly [40] [41]. Therefore students must be able to think critically after the demands of education at this time. The purpose of critical thinking is to broaden students' views as support of their ideals. Critical thinkers can search for, understand, and evaluate statements that are logically and rationally relevant d g problem-solving or decision making [42] [43]. So the ability to think critically is a method of learning or the right way that we must instill in the process of learning physics.

Critical thinking means being able to think logically and profoundly and be able to systematically seek and evaluate as a result of learning [44] [45]. The purpose of critical thinking has a broader view of critical thinking, which is almost the same as the ideal ideality [46]. Critical thinking includes the necessary intellectual skills, but these skills can be used to serve two purposes: self-centered or other thoughts [47]. Critical thinking is a process that depends, develops a variety of skills and qualities of self [48]. Critical thinking involves more than just possessing and applying specific skills in terms of logic [49]. Critical thinking as a process of assessing and lyzing one's thoughts to improve them [50]. The ability to think critically is the ability to practice, evaluate, carefully [51]. Five indicators of critical thinking ability are often used, provide simple explanations, build necessary skills, make conclusions, make further explanations, and set strategies and tactics [52].

Based the literature review, critical thinking can develop students' science process skills, so research was conducted on the relationship between science process skills and critical thinking skills of students at Al-Falah

Islamic High School Jambi on pure harmonic motion material. Based on the description above, the researcher will analyze the relationship between science process skills and students' critical thinking skills in learning Physics at Al-Falah Islamic High School Jambi. The purpose of this study was to see the relationship between science process skills and critical thinking skills of students at Al-Falah Islamic High School Jambi in simple harmonic motion.

2. Materials and Methods

This research method uses a mixed research method. A mixed research method is a research method that combines quantitative and qualitative methods to be used together in research activity, to obtain more comprehensive, valid, reliable, and objective data [53]. The research design used in this study is the embedded design, a mixed research design that collects quantitative and qualitative data together, where one of the data supports other data [54].

The research was conducted in SMA Islam Al-Falah Jambi, with this research subject is 100 class XII students Mathematics. To determine the research sample, researchers used a purposive sampling technique. Mechanical purposive sampling is a sampling technique used by researchers if the researchers have specific criteria in taking samples [55]. The instruments used in this study are observation sheets of science process skills, tests of critical thinking skills, and interview sheets. The science process skills observed in this study are integrated science process skills with indicators planning experiments, obtaining and processing data, and describing the relationships between variables. In contrast, the ability to think at a higher level is focused on critical thinking skills, with indicators of critical thinking skills that provide further explanation and develop strategies and tactics.

Data analysis was performed on quantitative and qualitative data. This quantitative data analysis technique uses statistical analysis, namely, descriptive statistical analysis and inferential statistical analysis. The descriptive statistical analysis describes data from the average value, maximum and minimum values, standard deviations, and range so that it can quickly get an idea of the characteristics of objects from the data. While inferential analysis for testing hypotheses, namely using the Pearson product-moment correlation test with the SPSS 25 program. Also, interviews were conducted to obtain qualitative data to strengthen quantitative data. Discussions were aimed at teachers and students by asking questions about science process skills and critical thinking skills.

3. Results

3.1. Integrated Science Process Skills

The following are the results of the descriptive statistical analysis of integrated science process skills in the planning experimentation using the SPSS 25 program, which can be seen in Table 1 below.

Based on Table 1, there are four categories of integrated science process skills in the indicators of planning an experiment. In contrast, the very not right and not suitable types are included in the not good category. While good and very good are included in both classes. Based on Table 1, there were 37 students out of 100 students in the wrong type, with a 37% percentage. Students categorized as useful have a higher rate of 63%, with a total of 63 out of 100 students. Also obtained is a standard deviation of 3.27, a mean value of 11.72, a maximum value of 16, and a minimum value of 4.

Table 1. Results of Indicators for Experimental Planning

Characteristics			Mean	Std. Deviation	Max	Min	Range	%
Interval	Category	Total						
4.00 – 7.00	Very Not Good	11	11.72	3.27	16.00	4.00	12.00	11
7.01 – 10.00	Not Good	26						26
10.01 – 13.00	Good	26						26
13.01 – 16.00	Very Good	37						37
Total		100						100

Table 2. Results from Indicators of Gaining and Processing Data

Characteristics			Mean	Std. Deviation	Max	Min	Range	%
Interval	Category	Total						
4.00 – 7.00	Very Not Good	14	11.38	3.44	16.00	4.00	12.00	14
7.01 – 10.00	Not Good	27						27
10.01 – 13.00	Good	24						24
13.01 – 16.00	Very Good	35						35
Total		100						100

Based on Table 2. There are four categories of integrated science process skills in the indicators of obtaining and processing data. In contrast, the types that are not very good and not good are included in the wrong category. While good and very good are included in both classes. Based on Table 2, there were 41 students out of 100 students who were classified as not useful, with a 41% percentage. Students who are categorized as useful have a higher rate of 59%, with a total of 59 out of 100 students. Also obtained is a standard deviation of 3.44, a mean value of 11.38, a maximum value of 16, and a minimum value of 4.

Based on Table 3. There are four categories of integrated science process skills in the indicator describing the relationship between variables. In contrast, the classes are not very good and not good included in the wrong category. While good and very good are included in both types. Based on Table 3, there are 50 students out of 100 students in the lousy class, with a percentage of 50%. Students who are categorized as useful have a higher rate of 50%, with a total of 59 out of 100 students. A standard deviation of 5.61 is also obtained, a mean value of 14.44 is a maximum value of 24 and a minimum value of 6.

3.2. Critical Thinking Skills

The results of the descriptive statistical data analysis of Critical Thinking Skills using the SPSS 25 application are shown in Table 4.

Based on Table 4. There are four categories of critical thinking skills in the indicator member further explanation. In contrast, the class that are not very good and not good are included in the group of not excellent. While good and very good are included in both categories. Based on Table 4, there are 54 students out of 100 students in the lousy class, with a percentage of 54%. Students who are categorized as useful have a higher rate of 46%, with a total of 46 out of 100 students. A standard deviation of 2.39 is also obtained, a mean value of 5.03 is a maximum of 8 and a minimum amount of 2.

Table 3. Results of the Indicator Describe the Relationship between Variables

Characteristics			Mean	Std. Deviation	Max	Min	Range	%
Interval	Category	Total						
6.00 – 10.50	Very Not Good	33	14.44	5.61	24.00	6.00	18.00	33
10.51 – 15.00	Not Good	17						17
15.01 – 19.50	Good	23						23
19.51 – 24.00	Very Good	27						27
Total		100						100

Table 4. Results of Indicators Provide Further Explanation

Characteristics			Mean	Std. Deviation	Max	Min	Range	%
Interval	Category	Total						
2.00 – 3.50	Very Not Good	34	5.03	2.39	8.00	2.00	6.00	34
3.51 –5.00	Not Good	20						20
5.01 – 6.50	Good	10						10
6.51 – 8.00	Very Good	36						36
Total		100						100

Table 5. Results of Indicators Developing Strategies and Tactics

Characteristics			Mean	Std. Deviation	Max	Min	Range	%
Interval	Category	Total						
1.00 – 1.75	**Very Not Good**	**21**	2.66	1.10	4.00	1.00	3.00	21
1.76 – 2.50	Not Good	20						20
2.51 – 3.25	Good	31						31
3.26 – 4.00	Very Good	28						28
Total		100						100

Based on Table 5, there are four categories of critical thinking skills in the indicators compiling strategies and tactics. In contrast, the classes that are not very good and not good are included in the group of not excellent. While good and very good are included in both categories. Based on Table 5, there were 41 students out of 100 students who were classified as not useful, with a percentage of 41%. Students who are categorized as useful have a higher rate of 59%, with a total of 59 out of 100 students. A standard deviation of 1.10 is also obtained, a mean value of 2.66 is a maximum of 4 and a minimum amount of 1.

The data are then analyzed to determine the relationship between two variables, namely, the relationship between integrated science process skills and the critical thinking abilities of students using the Pearson product-moment correlation test.

Table 5. Outcomes of the Relationship between Science Process Skills and Critical Thinking Skills

Variable	Mean	Science Process Skills		Critical Thinking Skills	
		r	Sig. (2-tailed)	r	Sig. (2-tailed)
SPS	64.14		1	.848	.000
CTS	66.95	.848	.000		1

From table 5, obtain sig value 0,000 <0.05. It can be concluded that there is a relationship between science process skills with students' critical thinking skills with a person correlation value of 0.848 and positive value. If the value of sig. <0.05, then there is a relationship [56].

4. Discussion

The data that have been analyzed produce that in the integrated science process skills on pure harmonic motion material on the indicators of planning an experiment, students have the most significant percentage of 63%, which is in a proper category. This means that on this indicator, students can determine the tools and materials for the experiment. On the symbol of obtaining and processing, students have the most significant percentage of 59%, which is in a proper category. In this indicator, students are also able to display data in the form of experimental table results. The index describing the relationship between student variables has the most significant percentage of 50%, which is in the proper category. This means that on this indicator, students can criticize the use of equations in experiments. From this explanation, it appears that students have mastered integrated science process skills. Students who master integrated process skills also master necessary science process skills.

Observation skills are the essential skills that can support the subsequent mastery of skills, namely, integration process skills. When students are skilled in necessary science process skills, their integrated science process skills will also be useful. Through practicum activities that lead to student activity in discovering new things, it can improve students' science process skills. However, the problem is that learning is currently only centered on the teacher. This is in line with the interviews that have been conducted.

Researchers also conducted interviews with students and teachers to see students' science process skills. From the results of the modeling, it can be seen that through practicum activities, it can be seen that the science process skills of Al-Falah Islamic High School Jambi are classified as useful. In general, teaching and learning activities occur during practicum activities, so that students can explore science process skills and students can understand concepts; students do not just memorize formulas without paying attention to understanding the idea or understanding the physical meaning of the method correctly. Science process skills and critical thinking skills are closely related, because students who do not have science process skills will not have critical thinking.

Based on the study results, it was found that the Al-Falah Islamic High School students in Jambi were in the critical category. The increase in students 'critical thinking skills is due to learning that applies the 2013 Curriculum, where learning is centered on students so that it can train students' critical thinking skills. The high ability of students to think critically is because students are accustomed to getting questions with cognitive level C4-C6 on the simple harmonic motion. This is in line with the results of interviews conducted by researchers with teachers and students that students have given optimal responses to problems raised by the teacher, students have been able to describe the conditions in the issue being discussed, and students have an intense curiosity so that the ability students have high critical thinking.

From the results of the Pearson correlation analysis that has been done, it is found that there is a relationship between science process skills and students' critical thinking abilities. Students who have high science process skills will tend to have high analytical thinking abilities. This happens because the indicators of science process skills already contain signs of critical thinking skills. If students master science process skills, students also have critical thinking. So that science process skills have a strong relationship with critical thinking, if students have low science process skills, then their critical thinking skills are also little.

The importance of science process skills for students is that students experience meaningful learning and be actively involved in discovering concepts from phenomena in the environment. Meaningful learning is learning that engages students directly, and knowledge will be easy to remember. Students who have excellent science process skills can master the next skill. Students who have science process skills can think critically. Critical thinking skills are needed to understand physics

concepts well.

5. Conclusions

Science process skills can be related to developing students' critical thinking skills. Students' necessary science process skills are categorized as useful and have analytical thinking skills, which are also classified as useful. So there is a significant relationship between science process skills and high-level thinking skills of students with a relationship value of 0.848 and positive value. This study shows that the students of the XII MIPA grade at Al-Falah Islamic High School have excellent science process skills, as well as critical thinking skills that are also quite good. Suggestions from researchers are that teachers and schools to improve the science process skills and higher-order thinking abilities possessed by students because these two things support student success.

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