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Science Process Skills and Critical Thinking Ability Assessed from Students' Gender

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Abstract

Science process skills and critical thinking are skills that are very important and must be possessed by students in the 21st century. The purpose of this study is to determine the scientific process and critical thinking skills in terms of gender and see whether there is a relationship between science process skills and critical thinking skills. student. This is because the researcher wants to see a comparison of the abilities of male and female students. This research is a type of quantitative research with a research design. The population of this study were students of SMAN 6 Batanghari and the samples used were students of class A and class B, totaling 80 students with a ratio of 50 female students and 30 male students. The sampling technique used is simple random sampling with the criteria of students who are in Accredited Schools A and Class XII students who have studied the latest direct material. The search instrument used was an observation sheet and a critical reflectance test sheet. The data analysis used is descriptive statistical analysis and deductive analysis. Based on the results obtained, it can be concluded that the science process skills and critical thinking skills of female students are higher than male students. besides that there is a high and positive relationship between students' critical thinking skills and students' critical thinking skills. Based on these results, this research can be useful for teachers, namely so that teachers can carry out learning that can develop and improve science process skills so that students' critical thinking skills can also increase. In addition, the benefits for students themselves are so that students are accustomed to using skills in the learning process and can provide critical solutions in solving problems.

Keywords: Critical thinking skills; Gender; Physics; Science process skills

INTRODUCTION

Education is a path which everyone should master. Because education is also a vehicle for improving and developing better human resources (Diansyah, Wiyono & Maisyaroh, 2016 ; Kimianti & Prasetyo, 2019). Qualified human resources have the potential to improve a country (Asrial, Syahrial, Maison & Kurniawan, 2020). Education in Indonesia demands that students are capable of understanding a meaningful learning process. As a result, with education, students can add ideas or scientific knowledge.

Science based on the purpose of understanding and exploring nature through the activities of observing, classifying, hypothesizing and concluding is the science of physics (Yanti,Kuswanto, Habibi & Kinasih, 2020). Physics is a science that deals with nature and its symptoms, often from real concepts to abstracts (Setiawan, Sutarto & Indrawati, 2012; Subali, Lu & Sumpono, 2019). Physics is a must-have science for students because the main goal of physics learning is to prepare students for the better in the 21st century (Karelina & Etkina, 2007; Rokhmah, Sunarno & Masykuri, 2017). Furthermore, in the 21st century, students are expected to possess a core skill, critical thinking (Wahyudi, Verawati, Ayub & Prayogi, 2019; Haniah, Aman & Setiawan, 2020; Sholihah & Lastariwati, 2020). Thus, in physical learning, students are expected to develop critical thinking skills.

Critical thinking skills are a survival skill because they tend to allow students to engage with the world and others in a sensitive, reliable, and predictable way (Johanson, 2010 ; Hohmann & Grillo, 2014; Kleinig, 2016). Critical thinking skills are able to seek, understand, and make reflective decisions, including interpretation, inference, self-regulation, analysis of explanation and evaluation of information, open thinking, and communicating effectively with others(Rahmawati & Harun, 2019; Shaw,et al., 2019; Sumardiana,Hidayat & Parno, 2019). Critical thinking requires conceptual clarity because critical thinking assesses an object to make decisions (Straus, 2016 ; Araabi, 2017; Lundstedt & Sinander, 2020). Critical thinking skills include cognitive, rational, logical processes, and invite students to think reflectively on problems so that critical thinking skills are the main goal in learning (Espey, 2017;

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Syahrial, Asrial, Kurniawan, Pratama & Perdana, 2019). Critical thinking skills can be developed over the course of the internship process. Because on an internship, students are required to better understand the theory to be tested. In addition to being able to cultivate critical thinking skills, practical activities can also foster science process skills. In addition to being able to cultivate critical thinking skills, practicum activities can also foster science process skills.

Scientific process competencies are competencies which refer to cognitive activation (Ambross, Meiring & Blignaut, 2014). Scientific process skills are common skills used in scientific work or experiments (Pujani,2014). Science process competences are divided into core science process competences and integrated science process competences (Florencia, Mauro & Furman, 2016). Basic process skills are skills that understand the process of observation, communication, classification, measurement, conclusion and prediction. Basic process skills are skills that include the process of observing, communicating, classifying, measuring, concluding and predicting. Integrated process skills are defined as: Identifying variables, compiling data tables, drawing graphs, describing relationships between variables, acquiring and processing your own data, analyzing investigations, building hypotheses, defining variables operationally, designing investigations, and experimenting (Durmaz & Mutlu, 2016; Wallace & Coffey, 2019 ; Mutlu, 2020). In education, differences among students include racial/ethnic, gender, and gender differences.

Gender differences in student competencies have been discussed in previous research. There are differences in scientific process skills between male and female students (Abungu, Okere & Wachanga, 2014; Yuliskurniawati, Noviyanti & Mukti, 2019). Students are more knowledgeable about scientific processes than men (Mawarsari, Subali & Wibowo, 2016; Hamdani, 2017; Yuliskurniawati, et al., 2019).This is because students prefer practical activities to male students (Baker, 1985 ; Hadi & Ibnu, 2015). This is because the curiosity of women is much higher than that of men. So there is a connection between the skills of the scientific process and the critical thinking skills of the students.

The relationship between scientific process skills and students' critical thinking skills is that, through scientific process skills, students can develop critical thinking skills. Thus, with the expertise of the scientific process, students will have the ability to find a problem, ask questions, gather data and make critical decisions to solve a problem. Students with high scientific process skills cendrung to have high critical thinking skills as well. This is because students can think deep and constantly about solving problems (Kristianingsih & Khotimah, 2019). If students do not have the skills of the scientific process, then they cannot develop critical thinking skills that cause poor learning outcomes in the learning process. Based on the background that has been described, the objectives of this research are:

1. To find out how the science process skills of students are seen from the female and male gender.
2. To find out how students' critical thinking skills are viewed from the female and male genders
3. To find out how the relationship between science process skills and students' thinking skills

METHOD

This research is a type of quantitative research with experimental research design. Quantitative research is a type of research that produces data that can be generalized using a description of the phenomenon studied (Astuti & Mustadi, 2014). Quantitative research is a research that is often used because it is relatively easy based on the study of philosophy of positivism used to conduct research on a population, samples, data collection instruments, and quantitative data statistics (Groeneveld, Tummers, Bronkhorst, Ashikali & Thiel, 2015; Kurniawan, Anwar, Kurniawan & Lumbantoruan, 2019).The data used in this study is quantitative data. The data was obtained from the assessment of the science process skills observation sheet and the test sheet of students' critical thinking ability.

The instruments used in this study are observation sheets and test sheets. The observation sheet is an instrument used to observe students in order to obtain data on students' science process skills during practical activities (Astuti & Mustadi, 2014; Rahmawati & Mahmudi, 2014 ; Israel et al., 2016). Test instruments used in the form of critical thinking essays to find out the results of students' learning (Sukerni, 2014; Ayuni, Kusmariyatni & Japa, 2017; Istiyono, 2020). The test instrument used is five questions with direct current electrical material. This test instrument is given when the student has practiced.

The samples of this study is students class XII IPA of SMA Negeri 6 Batanghari. The samples in this study were students of class XII IPA which amounted to 80 people. Where the sample from this study consists of 50 female

students and 30 male students from two classes that were taken to be used as research samples. The sample itself is a group of small groups representing the population as objects to be studied (Ayuni, et al., 2017; Dewi,Wibawa & Devi, 2017; Made, Lestari, Suniasih & Darsana, 2017; Paramiti,Rati & Tristantari, 2019).So in determining the research sample, techniques or ways are needed in sampling to be studied.

Sampling techniques using simple random sampling techniques. Simple random technique is a sampling technique that is done by random or random sample selection..Simple random sampling technique is a type of basic sample technique that is often used in data retrieval (Arieska & Herdiani, 2018). Samples were taken based on the criteria of students in A-accredited schools and grade XII students who had studied current materials in the same direction and students who had good grades. Simple random sampling technique is commonly used if the population of the sample to be taken is homogeneous (Harahap, Sulardiono & Suprapto, 2018).

Once the data is obtained from the sample studied, the next step is to analyze the data obtained. Data analysis techniques used are descriptive analysis techniques and inferential statistical analysis. Descriptive statistics are statistics used to analyze data taken from each experiment used to get an idea of one and two or more variables and used to describe students' science process skills and critical thinking skills (Anindyta & Suwarjo, 2014; Quintela-del-río & Francisco-fernández, 2016; Wyatt, Velamakuri, & Myers, 2017). Descriptive statistics include mean, median, standard deviation, mode, maximum value, minimum value, and range analysis (Mariana & Zubaida, 2015 ; Marquezin et al., 2016). Descriptive tests are conducted to determine the mean, median, standard deviation, mode, maximum value and minimum value of a data obtained.

Next to see the relationship between the variables of science process skills to the critical thinking abilities of students, used inferial statistical analysis. Inferential analysis is an analysis used to analyze the relationship of science process skills to students' critical thinking skills. Inferential statistical analysis is an analysis that includes two tests, namely prerequisite tests and hypothesis tests. Prerequisite tests are linearity tests and normality tests and then followed by hypothetical tests with correlation tests (Arisantiani, Putra, & Ganing, 2017; Darmaji, et al., 2020). Prerequisite tests are performed to determine if the data obtained is normally distributed and has linear properties of the data distribution obtained. Normality test is part of the assumption test conducted with the aim of knowing if the sample used is a sample that actually comes from the same population that is normally distributed (Noughabi, 2016: Suryani, Rendaa dan Wibawa, 2019). The normality test used is kolmogorov-smirnov normality test. Data requirements are said to be normal if the significant value of the data is greater than 0.05.Linearity test is a test used to see if the model built has linear relationships or not and is a prerequisite test for analyzing a relationship between variables (Ferdiansyah, 2018; Duli, 2019). The rare steps that should be done in this study are shown in Figure 1.

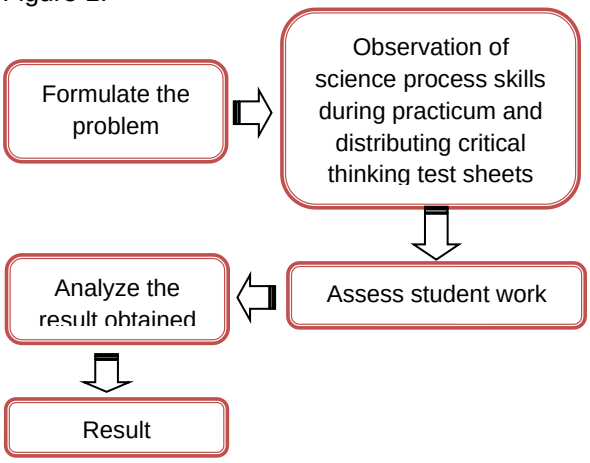

Figure 1. Research flowchart

The following is an interval table for the categories of science process skills and students' critical thinking skills.

Table 1. Interval and Category of SPS Indicator

Science Process Skills		
Indicator	Interval	Category
Observing	18.00 – 31.50	Not Very Good
	31.51 – 45.00	Not Good
	45.01 – 58.50	Good
	58.51 – 72.00	Very Good
Classifying	07.00 – 12.25	Not Very Good
	12.26 – 17.50	Not Good
	17.51 – 22.75	Good
	22.76 – 28.00	Very Good
Communication	12.00 – 21.00	Not Very Good
	21.01 – 30.00	Not Good
	30.01 – 39.00	Good
	39.01 – 48.00	Very Good
Measuring	15.00 – 26.25	Not Very Good
	26.26 – 37.50	Not Good
	37.51 – 48.75	Good
	48.76 – 60.00	Very Good
Inferring	12.00 – 21.00	Not Very Good
	21.01 – 30.00	Not Good
	30.01 – 39.00	Good
	39.01 – 48.00	Very Good
Predicting	03.00 – 05.25	Not Very Good
	05.26 – 07.50	Not Good
	07.51 – 09.75	Good
	09.76 – 12.00	Very Good

Table 2. Critical Thinking Intervals and Indicators

Interval	Category
00.00 – 05.00	Not Very Good
05.50 – 10.00	Not Good
10.50 – 15.00	Good
15.50 – 20.00	Very Good

RESULT AND DISCUSSION

The novelty of this research is the existence of gender differences in terms of science process skills and students' critical thinking skills. Gender differences cause male students and female students to have different learning experiences (Wiranata & Pramesti, 2019).This is what causes female students to be superior to male students. This is because female students have better achievement in science process skills than male students (Mawarsari, et al., 2016; Hamdani, 2017; Yuliskurniawati, et al., 2019).

Science process skills are skills that must be mastered by students with the aim of being able to develop students' critical thinking skills. The instrument of measured science process skills consists of 6 indicators, namely, observing, classifying, predicting, measuring, communicating, concluding. The result of descriptive statistics for science process skills for class A and class B is shown in Table 3.

Table 3. Description of Science Process Skills for lasses A and B

Class A				
Gender	Indicator	Mean	Median	Modus
Female	Observing	53.96	58.00	58.00
	Classifying	20.24	20.00	20.00
	Predicting	29.88	30.00	28.00
	Measuring	39.92	40.00	44.00
	Communication	31.92	34.00	34.00
	Inferring	07.32	08.00	03.00
Male	Observing	50.80	52.00	25.00
	Classifying	21.80	21.00	18.00
	Predicting	31.60	34.00	34.00
	Measuring	31.40	32.00	22.00
	Communication	26.20	27.00	13.00
	Inferring	07.40	07.00	05.00
Class B				
Gender	Indicator	Mean	median	Modus
Female	Observing	57.48	56.00	45.00
	Classifying	20.56	22.00	22.00
	Predicting	38.64	39.00	33.00
	Measuring	44.80	46.00	48.00
	Communication	34.48	34.00	34.00
	Inferring	06.68	07.00	07.00
Male	Observing	41.80	36.00	54.00
	Classifying	19.40	18.00	10.00
	Communication	35.20	35.00	23.00
	Inferring	07.40	07.00	05.00

Science Process Indicator Observing Skills

The following is a descriptive table of the science skills process on the indicators presented in Table 4.

Table 4. Description of science Process Indicator Observing Skills for Classes A and B

Class A				
Gender	Interval	F	%	Category
Female	18.00-31.50	1	4	Not Very Good
	31.51-45.00	2	8	Not Good
	45.01-58.50	12	48	Good
	58.51-72.00	10	40	Very Good
Male	18.00-31.50	1	6.7	Not Very Good
	31.51-45.00	0	0	Not Good
	45.01-58.50	9	60.0	Good
	58.51-72.00	5	33.3	Very Good
Class B				
Gender	Interval	F	%	Categori
Female	18.00-31.50	0	0	Not Very Good
	31.51-45.00	5	20	Not Good
	45.01-58.50	8	32	Good
	58.51-72.00	12	48	Very Good
Male	18.00-31.50	1	6.7	Not Very Good
	31.51-45.00	3	0	Not Good
	45.01-58.50	10	66.7	Good
	58.51-72.00	1	6.7	Very Good

Based on the Table 4, it can be seen that the female gender in class A gets a good category by 48% and the female gender in class B is in the very good category with a percentage of 48% on the observing indicator. While the

male gender in class A is also in the good category with a percentage of 60% and the male gender in class B is in the good category with a percentage of 66.7%.

The Students' Science Process Skills are Classifying Indicators

The description of the science process skills of students at SMA N 6 Batanghari is presented on the classification indicator can be seen in Table 5.

Table 5. Description of science process skill intervals on classifying indicators

Class A				
Gender	Interval	F	%	Category
Female	07.00-12.25	2	8	Not Very Good
	12.26-17.50	4	16	Not Good
	17.51-22.75	19	76	Good
	22.76-28.00	0	0	Very Good
Male	07.00-12.25	0	0	Not Very Good
	12.26-17.50	2	13.3	Not Good
	17.51-22.75	8	53.3	Good
	22.76-28.00	5	33.3	Very Good
Class B				
Gender	Interval	F	%	Category
Female	07.00-12.25	2	8	Not Very Good
	12.26-17.50	6	24	Not Good
	17.51-22.75	16	64	Good
	22.76-28.00	1	4	Very Good
Male	07.00-12.25	1	6.7	Not Very Good
	12.26-17.50	1	6.7	Not Good
	17.51-22.75	8	53.3	Good
	22.76-28.00	5	33.3	Very Good

Based in Table 5, the results show that for the indicator classifying gander women in class A and B are in the good category with a percentage of class A 76% and class B 64%. For male gender, it is in the good category with the percentage of class A 53.3 %% and class B 53.3%.

Indicate Science Process Skills To Communicate

The description of the intervals of science process skills of class XII A and XII B students on communicating indicators are presented in Table 6.

Table 6. Description of science process skills on communicating indicators

Class A				
Gender	Interval	F	%	Category
Female	12.00-21.00	4	16	Not Very Good
	21.01-30.00	10	40	Not Good
	30.01-39.00	7	28	Good
	39.01-48.00	4	16	Very Good
Male	12.00-21.00	3	20	Not Very Good
	21.01-30.00	3	20	Not Good
	30.01-39.00	4	26.7	Good
	39.01-48.00	5	33.3	Very Good
Class B				
Gender	Interval	F	%	Category
Female	12.00-21.00	0	0	Not Very Good
	21.01-30.00	1	4	Not Good
	30.01-39.00	12	64	Good
	39.01-48.00	4	32	Very Good
Male	12.00-21.00	1	6.7	Not Very Good
	21.01-30.00	4	26.7	Not Good
	30.01-39.00	7	46.7	Good
	39.01-48.00	3	20.0	Very Good

Based in Table 5, 6, it is known that in the communicating indicator, female gander from class A and class B are in the very bad category for class A with a percentage of 40% and good for class B with a percentage of 64%. Whereas for male gender in class A and class B are in the good category with the percentage of class A 26.7% and the percentage of class B 46.7%

Measuring Science Process Skills Indicators

Table 7 is a description of the science process skills of students in class XII A and XII B on measuring indicators.

Table 7. Description of The Indicator Measuring Science Process Skills

Class A				
Gender	Interval	F	%	Category
Female	15.00-26.25	0	0	Not Very Good
	26.26-37.50	10	40	Not Good
	37.51-48.75	13	52	Good
	48.76-60.00	2	8	Very Good
Male	15.00-26.25	2	13.3	Not Very Good
	26.26-37.50	4	26.7	Not Good
	37.51-48.75	4	26.7	Good
	48.76-60.00	5	33.3	Very Good
Class B				
Gender	Interval	F	%	Category
Female	15.00-26.25	1	4	Not Very Good
	26.26-37.50	4	16	Not Good
	37.51-48.75	14	56	Good
	48.76-60.00	6	24	Very Good
Male	15.00-26.25	4	26.7	Not Very Good
	26.26-37.50	1	6.7	Not Good
	37.51-48.75	8	53.3	Good
	48.76-60.00	2	13.3	Very Good

Based on Table 7 that has been presented, the results show that for measuring indicators, the gender of women from class A and class B gets good results, with the percentage of class A 52% and class B 56%. Male gender from class A obtained very good category with a percentage of A 33.3% and class B categorized as good with a percentage of 53.3%.

The Indicator Science Process Skills Concluded

The descriptions of science process skills on the concluded indicators are presented in Table 8.

Table 8. Description of Science Process Skills Indicators Concludes

Class A				
Gender	Interval	F	%	Category
Female	12.00-21.00	2	8	Not Very Good
	21.01-30.00	7	28	Not Good
	30.01-39.00	16	64	Good
	39.01-48.00	0	0	Very Good
Male	12.00-21.00	9	60	Not Very Good
	21.01-30.00	0	0	Not Good
	30.01-39.00	4	26.7	Good
	39.01-48.00	2	13.3	Very Good
Class B				
Gender	Interval	F	%	Category
Female	12.00-21.00	1	4	Not Very Good
	21.01-30.00	6	24	Not Good
	30.01-39.00	10	40	Good
	39.01-48.00	8	32	Very Good
Male	12.00-21.00	7	43.7	Not Very Good
	21.01-30.00	2	13.3	Not Good
	30.01-39.00	5	36.3	Good
	39.01-48.00	1	6.7	Very Good

Based on Table 8 which has been presented, it is known that for female gender in class A is good with a percentage of 64% and in class B is in the good category with a percentage of 40%. Male gender is in a very bad position for class A with a percentage of 60% and very bad for class B with a percentage of 43.7%.

Predicting Science Process Skills Indicators

The description of the science process skill interval of class XII A and XII B students on predicting indicator are presented in Table 9.

Table 9. Description of Science Process Skills on Predictive Indicators

Class A				
Gender	Interval	F	%	Category
Female	03.00-05.25	6	24	Not Very Good
	05.26-07.50	5	20	Not Good
	07.51-09.75	9	34	Good
	09.76-12.00	5	20	Very Good
Male	03.00-05.25	6	40	Not Very Good
	05.26-07.50	4	26.7	Not Good
	07.51-09.75	3	20.0	Good
	09.76-12.00	2	13.3	Very Good
Class B				
Gender	Interval	F	%	Category
Female	03.00-05.25	10	42	Not Very Good
	05.26-07.50	7	28	Not Good
	07.51-09.75	6	22	Good
	09.76-12.00	2	8	Very Good
Male	03.00-05.25	9	60	Not Very Good
	05.26-07.50	2	13.3	Not Good
	07.51-09.75	3	20.0	Good
	09.76-12.00	1	6.7	Very Good

From the Table 9, it is known that in the predicting indicator, female gander from class A is in the good category with a percentage of 34% and class B is in the very bad category with a percentage of 42%. Meanwhile, male gender in class A is in the very bad category with a percentage of 40% and class B is in the very bad category with a percentage of 60%.

After knowing all the categories of intervals for students' science process skills, then a description of the critical thinking skills of students at SMA N 6 Batanghari is presented.

Table 10. Description of critical thinking skills

Class A				
Gender	Interval	F	%	Category
Female	00.00-05.00	0	0	Not Very Good
	05.50-10.00	6	24.0	Not Good
	10.50-15.00	19	76.0	Good
	15.50-20.00	0	0	Very Good
Male	00.00-05.00	0	0	Not Very Good
	05.50-10.00	11	73.3	Not Good
	10.50-15.00	4	26.7	Good
	15.50-20.00	0	0	Very Good
Class B				
Gender	Interval	F	%	Category
Female	00.00-05.00	0	0	Not Very Good
	05.50-10.00	0	0	Not Good
	10.50-15.00	20	80	Good
	15.50-20.00	5	20	Very Good
Male	00.00-05.00	0	0	Not Very Good
	05.50-10.00	8	53.3	Not Good
	10.50-15.00	7	46.7	Good
	15.50-20.00	0	0	Very Good

Based on Table 10 presented, it can be seen that for female gender in class A, the good category is obtained with a percentage of 76% and for class B the good category is obtained with a percentage of 80%. For male gender, the results show that men are in the bad category with a percentage of A 76.3% and a percentage of B 53.3%.

After the descriptive test was carried out, the normality and linearity of the data were tested. Table 11 is the output of the normality test of science process skills data and data normality of students' critical thinking abilities.

Table 11. Normality Test

		SPS	CT
N		80	80
Normal Parameters	Mean	73.19	85.50
	Std.Deviation	9.87	12.74
MostExtremedifferences	Absolute	.133	.133
	Positive	.084	.095
	Negative	.-133	.-133
Kolmogorocv-smirnov Z		1.187	1.011
Asymp.Sig(2-tailed)		.199	.259

Based on Table 11, the results show that the data used are normally distributed data. Because in the table, the significant value for the science process skills is 0.199 which means greater than 0.05, and for the significant value for critical thinking skills is 0.259 which means that the data is normally distributed.

Furthermore, Table 12 is the output of the linearity test of data on science process skills and students' critical thinking skills.

Table 12. Linearity Test

			Sum of squares	Df	Mean square	F	Sig
SPS*CT	Between groups	(combided	664.92	11	60.44	.584	.835
		Linearity	215.66	1	215.66	2.08	.153
		Deviation from linearity	449.25	10	44.92	.434	.925
	Within groups		7039.12	68	103.51		
	Total		7704.04	79			

Based on Table 12, when viewed from the significance value (sig) of the output, the deviation from linearity value is 0.925 and greater than 0.05. So it can be said that there is a significant linear relationship between the variables of science process skills and critical thinking skills. Furthermore, after conducting the prerequisite test, namely the normality test and linearity test, the next step is to test the hypothesis. The hypothesis test used in this study is the correlation test. Correlation test is a test used to see the relationship between variables. Table 13 is the output of the correlation test.

Table 13. Correlation Test

		SPS	CT
SPS	Person Correlation	1	.633
	Sig. (2-tailed)		.002
	N	80	80
CT	Person Correlation	.633	1
	Sig (2-tailed)	.002	
	N	80	80

Based on table.13, there is a relationship between science process skills and critical thinking skills because of the known value of Gis. (2-tailed) between science process skills and critical thinking skills is 0.002<0.05 which means there is a significant correlation between the variables of science process skills and critical thinking skills and their relationships fall into the strong category because the correlation value is 0.633(falls in the range of 0.6-0.8).

Based on the results of the description of science process skills almost all indicators with good categories dominated by female gender. In addition it can be known that the science process skills of male and female students in each aspect or indicator have different percentage numbers, but there are some aspects that have the same category between male and female genders. In the indicators of observing, classifying, measuring and communicating, both male and female genders fall into good categories. While concluding and predicting to be in the moderate category.

For the indicators observed, the gender of women and men fall into either category. Observation is the activity of identifying the characteristics of a specific object with the help of sensory tools. Observational techniques are carried out using five senses, namely vision, weavers, tasters, tasters and listeners (Mahmudah, 2017). Observation is one of the most basic aspects or indicators of kps. Observation activities may provide more meaningful learning because students are directly involved in observing events in their environment. So the skill of observing is a point of tumpuh or a basic point to be able to develop other science process skills. In this study, observation skills manifested themselves in the driving skills of observations of various resistors, observations of multimeter parts and observations of parts of the power supply.

On the indicators classifying female gender and male gender is in the category both with a percentage of 70% for women and 53.3% for men. Classifying skills are skills performed in the process of classifying objects based on observable properties. According to (Mahmudah, 2017) classification skills are useful to train learners to be able to show similarities, differences, and reciprocal relationships. Based on the data that has been obtained, it is known that the classifying skills possessed by students are already classified as good categories. This means learners can already classify objects to be observed based on the same properties. Classification skills in this study are realized in conducting classification of test data on current, resistance, and voltage measurement. Based on the observations of students have been able to group the data obtained and have been able to record the data separately.

Furthermore, for the indicator measure, female gender and male gender are also in the category of both with a percentage of 54% for women and 43.3% for male gender. Measuring skills are also one of the basic skills of process science skills. Measuring skills need to be mastered well in order to master other skills.

Measuring skills are used to find out how well learners understand the use of tools in the laboratory (Mutmainnah, Padmawati, Puspitasari, & Prayitno, 2019)

For indicators communicating female gender and male gender are in the good category. Based on the observations, it can be known that the communication skills of all students fall into the good category. Communication skills are basic skills that also have a very important role in conducting observation activities. Because if the learner is able to apply communication skills well then the learner is able to communicate the results of the experiment that has been done using good language and correct. Communication skills mean skills used to convey the results of other process skills both verbally and in writing (Mahmudah, 2017).

The indicator concludes that the gender of men and women falls into the category quite well. Concluding skills are basic skills that must be possessed by learners. Because with the skill of concluding learners can know what they get from the experiments or observations they do. In addition, the conclusion is also a new knowledge that they found.

For indicators predicting both men and women fall into the category is quite good as well. Predicting skills are basic skills that students must have in order to be able to experiment. The skill of predicting or hypothesizing includes the skill of proposing an estimate of something that has not yet occurred based on an existing tendency or pattern (Mahmudah, 2017). So the skill of making hypotheses is not easy, because to make a hypothesis learners must have a basic knowledge of what will be tested.

The average percentage of science process skills of male and female students is 50.5% for female students and 48.09% for male students, respectively. So that the more dominant gender has a high science process skills that is female gender. This is because women are more master of the skills of the science process. For the results of the description of critical thinking ability is also dominated by female gender where 78% of female gender belongs to the good category and male gender belongs to the category of bad with a percentage of 64.8%.

After describing the students' science process skills and critical thinking skills, the next step is to test the two variables using a simple linear regression test to see if there is a relationship between science process skills variables and critical thinking skills. The result of the correlation test is obtained results that there is a relationship between the variables of science process skills to the variables of critical thinking ability of students. The relationship between the variables of science process skills to the critical thinking abilities of students is worth 0.633. This means there is a positive relationship between the variables of the science process skills and the critical thinking abilities of the students. So it is very good to improve the skills of the science process and critical thinking skills of students.

To improve the skills of the science process and critical thinking skills to be better, practical learning is needed. Practicum is hands-on experience-based learning that can develop students' skills (Hayati, Rosana, & Sukardiyono, 2019). Practicum is a factor that influences students' learning outcomes and is a very important activity in supporting the success of the physics teaching and learning process (Poniman, 2016). The importance of practicum is to support learning and emphasize the aspects of the process and to improve the reflection of theories (Siswanto, 2016; Stenberg, Rajala, & Hilppo, 2016). The advantage of learning through practicum is that with practicum students can develop the nature of thinking scientifically. In addition, with practicum students can cultivate scientific traits such as being able to work together, honestly and critically. So practicum is an activity that can cultivate the skills of the science process as well as the critical thinking skills of students.

But in fact there are still many schools that do not implement practicum-based learning. So students do not respond well to practical-based learning. If students do not respond well to precritical then it will have an impact on the students' low science process skills. This is related to the results of research from (Sukarno, Permanasari, dan Hamidah, 2013) which suggests that the science process skills of junior high school students in Jambi city in the category of skills to make conclusions, observe, predict, measure and classify are still relatively low. In addition, Anam's research (2014) also showed that there are four types of science process skills, namely observing skills, planning experiments, classifying and creating tables, which are still in the less advanced category, as well as the category of not proficient in concluding skills. If the skills of the science process are low then it will have an impact on the critical thinking ability of the student.

Science process skills are a must-have skill for students in the 21st century. Science process skills aim to build the knowledge that exists in students through activities involving cognitive, psychomotor and affective knowledge (social)(Siswono, 2017). Science process skills are the skills of developing a scientific attitude to discover new concepts, principles, or theories

found in science process skills used to refute previous findings and to develop students' cognitive skills (Nurhudayah & Lesmono, 2016; Pratiwi, Hudha, Asri, & Ahmad, 2019).So that the skills of the science process can foster the critical thinking skills of students.

Critical thinking ability is an important ability possessed by every student (Onsee & Nuangchalerm, 2019).Because critical thinking skills can develop the way students think to solve a problem and also analyze and evaluate information carefully and precisely (Mulyono, 2018 ; Gandi, Haryani & Setiawan, 2021). According to(Umam,Suparmi & Sukarmin, 2020) critical thinking skills are a much-needed ability to face the challenges of life in the era of globalization. Thinking ability is one of the high levels of thinking that should required in social life (Dahliana, Khaldun & Saminan, 2018). A critically minded person is able to raise vital questions and problems and formulate them clearly and appropriately (Rachmantika & Wardono, 2019). This is what makes critical thinking skills very necessary for every student to be able to face problems, especially math problems so that critical thinking skills are something that must be owned by every student.

Low science process skills will result in low critical thinking skills of students. Low critical thinking ability will have an impact on students' learning outcomes. Students who have high critical thinking skills then the learning outcomes are also high. This is because students who have a high level of thinking ability can analyze and solve the given problems. While students who have low critical thinking ability then the learning outcomes may also be low. In addition, the long impact of low critical thinking ability is the difficulty of competing in the world of education in the 21st century. The causes of low critical thinking ability include teachers still applying the learning process that is only centered on teachers. So students cannot develop critical thinking skills in more depth. It is therefore very important that we can improve students' science process skills and critical thinking skills.

So the result of this study is, there is a positive relationship between the variables of science process skills and critical thinking skills of students. In addition, there are significant differences in science process skills and critical thinking skills between female and male genders. This is because women are more mastered of science process skills and critical thinking skills.

CONCLUSION

Based on the results of the analysis and discussion that has been presented, it can be concluded that, the science process skills of students at SMAN 6 Batanghari are included in the category both with the average value of science process skills possessed by female students is 50.5% and male students are 48.9%. For critical thinking skills possessed by students at SMAN 6 Batanghari categorized well with an average female gender percentage of 78% good and male gender more dominant 64.8% with a bad category. Furthermore there is a significant relationship between the variables of science process skills and critical thinking skills of 0.633.

REFERENCES

Abungu, H., Okere, M., & Wachanga, S. (2014). The Effect of Science Process Skills Teaching Approch on Secondary School Student's Achievement in Chimestry in Nyando District,Kenya. *Journal of Educational and Social Research*, *4*, 359–372.

Ambross, J., Meiring, L., & Blignaut, S. (2014). *The Implementation and Development of science Process Skills in the Natural Sciences : A Case Study of Teachers ' Perceptions*. *11*(3), 459–474.https://doi.org/10.1080/18146627.2014.934998.

Anindyta, P., & Suwarjo. (2014). The Effect Of Applaying Problem-Based Learning To Critical Thinking Skill And Self-Regulation. *Jurnal Prima Edukasia*, *2*(1), 209–222. https://doi.org/10.21831/jpe.v2i2.2720.

Araabi, H. F. (2017). Schools and Skills of Critical Thinking for Urban Design. *Journal of Urban Design*, *4809* (September), 1–17. https://doi.org/10.1080/13574809.2017.1369874.

Arieska, P. K. N. H. (2018). Pemilihan Teknik Sampling Berdasarkan Perhitungan Efisiensi Relatif. *Jurnal Statistika*, *6*(2), 166–171. http://dx.doi.org/10.23887/jet.v1i2.11774.

Arisantiani, N. ., Putra, M., & Ganing, N. . (2017). Pengaruh Model Pembelajaran Childrens Learning In Science (CLIS) Berbantu Media Lingkungan Terhadap Kompetensi Pengetahuan IPA. *Journal of Education Technology*, *1*(2), 125–132.

Asrial, A., Syahrial, S., Maison, M., Kurniawan, D. A., & Piyana, S. O. (2020). Ethnoconstructivism E-Module to Improve Perception, Interest, and Motivation of Students in Class V Elementary School. *JPI (Jurnal Pendidikan Indonesia)*, *9*(1), 30.https://doi.org/10.23887/jpiundiksha.v9i1.19222

Astiti, N. P. ., Ardana, I. ., & Wiarta, I. . (2017). Pengaruh Model Pembelajaran Children Learning in Science Berbasis Budaya Penyelidikan Terhadap Kompetensi Pengetahuan IPA. *Journal of Eduvation*

Technology, *1*(7), 86–93. http://dx.doi.org/10.23887/jet.v1i2.11744.

Astuti, Y. W., & Mustadi, A. (2014). Pengaruh Penggunaan Media Film Animasi Terhadap Keterampilan Menulis Karangan Narasi Siswa Kelas V SD. *Jurnal Prima Edukasia*, *2*(2), 250–262. https://doi.org/10.21831/jpe.v2i2.2723.

Ayuni, I. G. A. P. A. S., Kusmariyatni, N., & Japa, I. G. N. (2017). Pengaruh Model Pembelajaran Talking Stick Berbantuan Media Question Box Terhadap Hasil Belajar Ipa Kelas V. *Journal of Education Technology*, *1*(3), 183. https://doi.org/10.23887/ jet.v1i3.12503.

Dahliana, P., Khaldun, I., & Saminan, S. (2018). Pengaruh Model Guided Discovery Terhadap Kemampuan Berpikir Kritis Peserta didik. *Jurnal Pendidikan Sains Indonesia*, *6*(2), 101–106. https://doi.org/10.24815/jpsi.v6i2.12477.

Darmaji, D., Astalini, A., Kurniawan, D. A., Ningsi, A. P., Romadona, D. D., & Dari, R. W. (2020). Regression of Science Process Skills On Critical Thinking Skills In Two Junior High Schools In Jambi City. *JIPF (Jurnal Ilmu Pendidikan Fisika)*, *5*(3), 177. https://doi.org/10.26737/jipf.v5i3.1788.

Dewi, N. P. S. R., Wibawa, I. M. C., & Devi, N. L. P. L. (2017). Kemampuan Berpikir Kritis Dan Keterampilan Proses Dalam Pembelajaran Siklus Belajar 7E Berbasis Kearifan Lokal. *JPI (Jurnal Pendidikan Indonesia)*, *6*(1), 125–133. https://doi.org/10.23887/jpi-undiksha.v6i1.9476.

Diansyah, Aziz, S, N., Wiyono, B., & Maisyaroh, M. (2016). Implementasi Total Quality Management pada Program Pendidikan Kejar Paket (Studi Multi Situs di PKBM Bintang Bangsa Kab Malang dan Ki Hajar Dewantara Kota Malang). *Jurnal Pendidikan : Teori, Penelitian, Dan Pengembangan*, *1*(3), 369–376. http://dx.doi.org/10.17977/jp.v1i3.6163

Duli, N. (2019). *Metodologi Penelitian Kuantitatif: Beberapa Konsep Dasar Untuk Penulisan Skripsi & Analisis Data Dengan SPSS.* Yogyakarta : DEEPUBLISH.

Durmaz, H., & Mutlu, S. (2016). The effect of an instructional intervention on elementary students ' science process skills. *The Journal of Educational Research*, *0*(0), 1–13. https://doi.org/10.1080/00220671.2015.1118003.

Espey, M. (2017). Enhancing Critical Thinking Using Team-Based Learning Enhancing Critical Thinking Using Team-Based Learning. *Higher Education Research & Development*, *0*(0), 1–15.https://doi.org/10.1080/07294360.2017.1344196.

Ferdiansyah. (2018). Pengaruh Komunikasi terhadap Efektivitas Organisasi (Studi Kasus pada Pihak Struktural SMK Letris Indonesia 2 Pamulang). *Jurnal Kreatif : Pemasaran, Sumberdaya Manusia Dan Keuangan*, *6*(2), 132–142. http://dx.doi.org/10.32493/jk.v6i2.y2018.p132-142.

Florencia, M., Mauro, D., & Furman, M. (2016). Impact of an Inquiry Unit on Grade 4 Students' Science Learning. *International Journal of Science Education*, *0693*(14), 2239–2258. https://doi.org/10.1080/09500693.2016.1234085.

Gandi, A. S. K., Haryani, S., & Setiawan, D. (2021). The Effect of Project-Based Learning Integrated STEM Toward Critical Thinking Skill. *Journal of Primary Education*, *10*(1), 18–23. https://journal.unnes.ac.id/sju/index.php/jpe/article/view/33825/14147.

Groeneveld, S., Tummers, L., Bronkhorst, B., Ashikali, T., & van Thiel, S. (2015). Quantitative Methods in Public Administration: Their Use and Development Through Time. *International Public Management Journal*, *18*(1), 61–86. https://doi.org/10.1080/10967494.2014.972484.

Hadi, M. S., & Ibnu, S. (2015). Pengaruh Kelompok Peminatan Mata Pelajaran dan Gender terhadap Hasil Belajar dan Keterampilan Proses Ilmiah Siswa pada Materi Laju Reaksi. *Jurnal PendidikanSains. 3*(1), 31–41. http://dx.doi.org/10.17977/jps.v3i1.4836

Hamdani. (2017). Deskripsi Keterampilan Proses Sains Mahasiswa Calon Guru Fisika. *Jurnal Pendidikan Matematika Dan IPA*, *8*, 43–51. http://dx.doi.org/10.26418/jpmipa.v8i1.18423

Haniah, A. R., Aman, A., & Setiawan, R. (2020). Integration of strengthening of character education and higher order thinking skills in history learning. *Journal of Education and Learning (EduLearn)*, *14*(2), 183–190. https://doi.org/10.11591/edulearn.v14i2.15010.

Harahap, M., Sulardiono, B., & Suprapto, D. (2018). Analisis Tingkat Kematangan Gonad Teripang Keling (HOLthuria Autra) di Perairan Menjangan Kecil, Karimunjawa. *Journal of Maquares*, *7*(3), 263–269. https://doi.org/10.14710/marj.v7i3.22550

Hayati, I. A., Rosana, D., & Sukardiyono, S. (2019). Pengembangan Modul Potensi Lokal Berbasis SETS untuk Meningkatkan Keterampilan Proses IPA Development of SETS Based Local Potential Modules to Improve Science Process Skills. *Jurnal Inovasi Pendidikan IPA*, *5*(2), 248–257. https://doi.org/10.21831/jipi.v5i2.27519.

Hohmann, J. W., & Grillo, M. C. (2014). Using Critical Thinking Rubrics To Increase Academic Performance. *Journal of College Reading and Learning*, *45*(1), 37–41. https://doi.org/10.1080/10790195.2014.949551

Israel, M., Wherfel, Q. M., Shehab, S., Ramos, E. A., Adam, M., & Reese, G. C. (2016). Assessing Collaborative Computing : Development of the Collaborative-Computing Observation Instrument (C-COI). *Computer Science Education*, *3408*, 1–26. https://doi.org/10.1080/08993408.2016.1231784

Istiyono, E. (2020). Developing Instrument of Essay

Test to Measure the Problem-Solving Skill in Physics. *Jurnal Pendidikan Fisika Indonesia*, *16*(2), 72–82. https://doi.org/10.15294/jpfi.v16i2.24249.

Johanson, J. (2010). Cultivating Critical Thinking : an interview with Stephen Brookfield. *Journal of Developmental Education*, *33*(3), 26–30.

Karelina, A., & Etkina, E. (2007). acting like a physicst : student approach study to experimental design. *Physics Education Research*, *94*(5), 810–824. https://doi.org/10.1103/PhysRevSTPER.3.020106.

Kimianti, F., & Prasetyo, Z. K. (2019). Pengembangan E-Modul IPA Berbasis Problem Based Learning untuk Meningkatkan Literasi Sains Siswa. *Jurnal Teknologi Pendidikan*, *07*(02), 91–103. https://doi.org/10.31800/jtp.kw.v7n2.p91-103.

Kleinig, J. (2016). Trust and Critical Thinking. *Educational Philosophy and Theory*, *1857*, 1–11.https://doi.org/10.1080/00131857.2016.1144167.

Kristianingsih, R., & Khotimah, R. (2019). Keterkaitan Antara Kemampuan Critical Thinking Dengan Keterampilan Proses Dasar pada Pembelajaran IPA Sekolah Dasar. *Seminar Nasional Pendidikan Dasar*, 102–112. https://202.91.10.50/prosiding/index.php/semnaspgsd/article/view/1006.

Kurniawan, D. A., Kurniawan, W., Anwar, K., & Lumbantoruan, A. (2019). Students' Perceptions of Electronic's Modulein Physics Practicum. *Journal of Educatio and Learning*, 13(2), 288-294. https://doi.org/10.11591/edulearn.v13i2.1305.

Lundstedt, L., & Sinander, E. (2020). Enhancing Critical Thinking in Private International Law Enhancing Critical Thinking in Private International Law. *The Law Teacher*, *00*(00), 1–14. https://doi.org/10.1080/03069400.2019.170035.

Made, N., Lestari, D., Suniasih, N. W., & Darsana, I. W. (2017). Pengaruh Model Pembelajaran Snowball Throwing Berbasis Lagu-lagu Anak Terhadap Kompetensi Pengetahuan PKN. *Jurnal of Education Technology*, 1(3), 163–168. http://dx.doi.org/10.23887/jet.v1i3.12500.

Mahmudah, L. (2017). Pentingnya Pendekatan Keterampilan Proses pada Pembelajaran IPA di Madrasah. *ELEMENTARY: Islamic Teacher Journal*, 4(1). https://doi.org/10.21043/elementary.v4i1.2047.

Mariana, S., & Zubaida, E. (2015). Pengaruh Penggunaan Media Boneka Tangan Terhadao Keterampilan Bercerita Siswa Kelas V SD Se-Gugus 4 Kecamatan Bantul. *Jurnal Prima Edukasia*, *3*(2), 166–176. https://doi.org/10.21831/jpe.v3i2.6538.

Marquezin, M. C. ., Pedroni-pereira, A., Santos, D., Rosar, J. V., Barbosa, T. S., & Castelo, P. M. (2016). Descriptive Analysis of The Masticatory and Salivary Functions and Gustatory Sensitivity in Healthy Children. *Acta Odontologica Scandinsvica*, *6357* (June), 1–6. https://doi.org/10.1080/00016357.2016.119085.

Mawarsari, O., Subali, B., & Wibowo, Y. (2016). Kreativitas Keterampilan Proses Sains Aspek Kehidupan Siswa SD Berdasarkan Aspek Gender. *Jurnal Pendidikan Biologi*, *5*(3).

Mulyono, Y. (2018). Critical Thinking Skills of Physics Education Students Through CTL-Based Fundamental Biology. *Science, Engineering, Education, and Development Studies (SEEDS): Conference Series*, *2*(1), 65–76. https://doi.org/10.20961/seeds.v2i1.24646.

Mutlu, A. (2020). International and Multidisciplinary Perspectives Evaluation of students ' scientific process skills through reflective worksheets in the inquiry-based learning environments. *Reflective Practice*, *00*(00), 1–16.https://doi.org/10.1080/14623943.2020.1736999.

Mutmainnah, S. N., Padmawati, K., Puspitasari, N., & Prayitno, B. A. (2019). Profil Keterampilan Proses Sains (KPS) Mahasiswa Pendidikan Biologi Ditinjau Dari Kemampuan Akademik Profile of Science Process Skills in Biology Education (Case Study At a University in Surakarta). *Didaktika Biologi: Jurnal Penelitian Pendidikan Biologi*, *3*, 49–56. https://doi.org/10.32502/dikbio.v3i1.1687.

Noughabi, H. A. (2016). Efficiency of ranked set sampling in tests for normality. *Journal of Statistical Computation and Simulation*, *0*(0), 1–10. https://doi.org/10.1080/00949655.2016.123090.

Nurhudayah, M., & Lesmono,A, D. (2016). Penerapan Model Inkuiri Terbimbing (Guided Inquiry) dalam Pembelajaran Fisika SMA di Jember (Studi pada Keterampilan Proses Sains Dan Keterampilan Berpikir Kritis). *Jurnal Pembelajaran Fisika*, *5*(1), 82–88. Retrieved from https://jurnal.unej.ac.id/index.php/JPF/article/view/3568/2772.

Onsee, P., & Nuangchalerm, P. (2019). Developing Critical Thinking of Grade 10 Students through Inquiry-Based STEM Learning. *Jurnal Penelitian Dan Pembelajaran IPA*, *5*(2), 132. https://doi.org/10.30870/jppi.v5i2.5486.

Paramiti.N.M.A.S, Rati, N. & Tristiantari, N.K. (2019). Pengaruh Model Pembelajaran Picture And Picture Berorientasi Pendidikan Karakter. *Jurnal of Education Technology*, *3*(87), 1–8. http://dx.doi.org/10.23887/jet.v3i1.17957.

Poniman, P. (2016). Upaya Peningkatan Aktivitas dan Hasil Belajar Fisika dengan Metode Praktikum pada Siswa Kelas XI IPA MAN 1 Kalianda Lampung Selatan. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, *5*(2), 257–264. https://doi.org/10.24042/jpifalbiruni.v5i2.125.

Pratiwi, H. Y., Hudha, M. N., Asri, M., & Ahmad, N. J. (2019). The Impact of Guided Inquiry Model Integrated with Peer Instruction towards Science Process Skill and Physics Learning Achievement. *Momentum: Physics Education*

Journal, *3*(2), 78–85. https://doi.org/10.21067/mpej.v3i2.2768.

Pujani, N. . (2014). Pengembangan Perangkat Praktikum Ilmu Pengetahuan Bumi dan Antariksa Berbasis Kemampuan Generik Sains untuk Meningkatkan Keterampilan Laboratorium Calon Guru Fisika. *Jurnal Pendidikan Indonesia*, *3*(2), 471–484 http://dx.doi.org/10.23887/jpi-undiksha.v3i2.4463..

Quintela-del-río, A., & Francisco-fernández, M. (2016). Excel Templates : A Helpful Tool for Teaching Statistics. *Journal The American Statistician*, *1305*, 1–23. https://doi.org/10.1080/00031305.2016.1186115.

Rachmantika, A. R., & Wardono. (2019). Peran Kemampuan Berpikir Kritis Siswa pada Pembelajaran Matematika dengan Pemecahan Masalah. *Prosiding Seminar Nasional Matematika*, *2*, 439–443. Retrieved from https://journal.unnes.ac.id/sju/index.php/prisma/article/view/29029.

Rahmawati, E., & Harun, H. (2019). Developing Instruments of Teacher's Perception of Critical Thinking in Elementary School. *Journal of Education and Learning (EduLearn)*, *13*(4), 559–566.https://doi.org/10.11591/edulearn.v13i4.13232

Rahmawati, R. & Mahmudi, A. (2014). Keefektifan Pembelajaran Kooperatif STAD dan TAI Ditinjau dari Aktivitas dan Prestasi Belajar Matematika Siswa. *Jurnal Prima Edukasia*, *2*(1), 102–115. https://doi.org/10.21831/jpe.v2i1.2648.

Rediarta, I. W., Sudarma, I.K., & Murda, I. N. (2014). Pengaruh Model Kooperatif Two Stay Two Stray Terhadap Hasil Belajar IPA Universitas Pendidikan Ganesha. *Jurnal Mimbar PGSD Universitas Pendidikan Ganesha*, *2*(1). Retrieved from https://ejournal-pasca.undiksha.ac.id/index.php/jurnal_ipa/article/view/2933/1564.

Rokhmah, A., Sunarno, W., & Masykuri, M. (2017). Science Literacy Indicators in Optical Insytuments of High School Physics Textbooks Chapter. *Jurnal Pendidikan Fisika Indonesia*, *13*(1), 19–24. https://doi.org/10.15294/jpfi.v13i1.8391.

Setiawan, A., Sutarto, & Indrawati. (2012). Metode Eksperimen dalam Pembelajaran Penghantar Fisika SMA: Studi pada Konsep Besaran dan Satuan Tahun Ajaran 2012-2013. *Jurnal Pembelajaran Fisika*, *1*(3), 285. Retrieved from http://repository.unej.ac.id/handle/123456789/458.

Setyorini, U., Sukiswo, S. E., & Subali, B. (2011). Penerapan Model Problem Based Learning Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Smp. *Jurnal Pendidikan Fisika Indonesia*, *7*(1), 52–56. https://doi.org/10.15294/jpfi.v7i1.1070.

Shaw, A., Liu, O. L., Gu, L., Kardonova, E., Chirikov, I., Li, G., Hu, S., Yu, N., Ma, L., Guo, F., Su, Q., Shi, J., & Loyalka, P. (2019). Studies in Higher Education Thinking Critically about Critical Thinking : Validating The Russian HEIghten ® critical Thinking Assessment Thinking Critically About Critical Thinking : Validating The Russian. *Studies in Higher Education*, *5079*. https://doi.org/10.1080/03075079.2019.167640.

Sholihah, T. M., & Lastariwati, B. (2020). Problem Based Learning to Increase Competence of Critical Thinking and Problem Solving. *Journal of Education and Learning (EduLearn)*, *14*(1), 148–154. https://doi.org/10.11591/edulearn.v14i1.1372.

Siswanto. (2016). Keterampilan Proses Sains dan Kemandirian Belajar Siswa. *Jurnal Ilmiah Penelitian Dan Pembelajaran Fisika*, *2*(2), 190–202.

Siswono, H. (2017). Analisis Pengaruh Keterampilan Proses Sains Terhadap Penguasaan Konsep Fisika Siswa. *Momentum: Physics Education Journal*, *1*(2), 83. https://doi.org/10.21067/mpej.v1i2.1967.

Stenberg, K., Rajala, A., & Hilppo, J. (2016). Fostering Theory Practice Reflection in Teaching Practicums. *Asia-Pacific Journal of Teacher Education*, *2945*(2), 1–16. https://doi.org/10.1080/1359866X.2015.1136406.

Strauss, D. (2016). How Critical is "Critical Thinking"? *South African Journal of Philosophy*, *35*(3), 261–271. https://doi.org/10.1080/02580136.2016.1191853

Subali, B., Lu'aili, Z., & Sumpono, I. (2019). Development of Ultrasonic Sensors Based Mechanical Energy Experiments. *Jurnal Pendidikan Fisika Indonesia*, *15*(1), 29–38. https://doi.org/10.15294/jpfi.v15i1.19308.

Sukarno, Permanasari, A., dan Hamidah, I. (2013). The Profile of Science Process Skills (SPS) Students at Secondary High School (Case Study in Jambi). *International Journal of Scientific Engineering and Research (IJSER).*, *1*(1), 79–83.

Sukerni, P. (2014). Pengembangan Buku Ajar Pendidikan IPA Kelas IV Semester I SD N. 4 Kaliuntu Dengan Model Dick and Carey. *JPI (Jurnal Pendidikan Indonesia)*, *3*(1), 386–396. https://doi.org/10.23887/jpi-undiksha.v3i1.2920.

Sumardiana, S., Hidayat, A., & Parno, P. (2019). Kemampuan Berpikir Kritis pada Model Project Based Learning disertai STEM Siswa SMA pada Suhu dan Kalor. *Jurnal Pendidikan: Teori, Penelitian, Dan Pengembangan*, *4*(7), 874–879. http://dx.doi.org/10.17977/jptpp.v4i7.12618.

Syahrial, S., Asrial, A., Kurniawan, D. A., Pratama, R. A., & Perdana, R. (2019). Towards improving the critical thinking skills of pre-service teachers in Indonesia. *Journal of Education and Learning (EduLearn)*, *13*(4), 575–582. https://doi.org/10.11591/edulearn.v13i4.13613.

Umam, A., Suparmi, & Sukarmin. (2020). Analysis of critical thinking skill profile on the concept of

simple harmonic motion using two tier instrument test. *Journal of Physics: Conference Series*, *1567*(3). https://doi.org/10.1088/1742-6596/1567/3/032085.

Wahyudi, Verawati, N. N. S. P., Ayub, S., & Prayogi, S. (2019). Conceptual Framework of Inquiry-Creative-Process Learning Model to Promote Critical Thinking Skills of Physics Prospective Teachers. *Jurnal Pendidikan Fisika Indonesia*, *15*(1), 5–13. https://doi.org/10.15294/jpfi.v15i1.10693.

Wallace, C. S., & Coffey, D. . (2019). Investigating Elementary Preservice Teachers ' Designs for Integrated Science / Literacy Instruction Highlighting Similar Cognitive Processes. *Journal of Science Teacher Education*, *0*(0), 1-21.https://doi.org/10.1080/1046560X.2019.1587569.

Wiranata, S. P., Pramesti, G., & Pambudi. (2019). Analisis Kemampuan Berpikir Kritis Siswa Kelas VIII A SMP Negeri 8 Surakarta dalam Memecahkan Masalah Lingkaran dari Gender dan Kemampuan Awal. *Jurnal Pendidikan Matematika Dan Matematika*, *III*(1), 172–183.

Wyatt, J. E., Velamakuri, N. S. C., & Myers, O. J. (2017). Statistical analysis conducted during the study on the impact of tool-chip contact time on the shear angle in orthogonal machining. *Advances in Materials and Processing Technologies*, *0698*, 1–19. https://doi.org/10.1080/2374068X.2017.1420289

Yanti, F. A., Kuswanto, H., Habibi, H., & Kinasih, A. (2020). Development of Analogy-Based Material Physics Module to Provide Analogy Ability of Physics Teachers Candidates. *Jurnal Pendidikan Fisika Indonesia*, *16*(1), 34–40. https://doi.org/10.15294/jpfi.v16i1.9122.

Yuliskurniawati, I. D., Noviyanti, N. I., & Mukti, W. R. (2019). Science Process Skills Based on Genders of High School Students. *Journal of Physics: Conference Series*, *1241*(1), 1–10. https://doi.org/10.1088/1742-6596/1241/1/012055.