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Science Processing Skill and Critical Thinking: Reviewed Based on the Gender

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ABSTRAK

Keterampilan merupakan aspek penting yang harus dimiliki setiap individu. Kemampuan berpikir kritis siswa di Indonesia masih dalam kategori rendah. Berdasarkan fakta pembelajaran IPA yang dilakukan oleh guru di sekolah cenderung menggunakan metode ceramah dalam pembelajaran. Hal ini yang menyebabkan siswa kurang memiliki kemampuan berpikir kritis. Penelitian ini bertujuan untuk menganalisis pengaruh keterampilan proses sains terhadap keterampilan berpikir kritis. Jenis penelitian ini adalah penelitian deskriptif kuantitatif melalui metode eksperimen. Teknik pengambilan sampel yang digunakan adalah total sampling, dengan jumlah sampel 60 praktisi. Metode yang digunakan untuk mengumpulkan data yaitu observasi dan tes. Instrumen yang digunakan dalam mengumpulkan data yaitu lembar observasi dan tes esai. Teknik analisis data yang digunakan yaitu statistik deskriptif dan statistik inferensial. Analisis data diperoleh keterampilan proses sains siswa sudah dikategorikan baik, namun lebih dominan pada siswa perempuan. Sementara itu, kemampuan berpikir kritis juga tergolong kritis dan dominan pada mahasiswi dalam kategori sangat kritis. Berdasarkan hasil penelitian disimpulkan terdapat pengaruh keterampilan proses sains terhadap keterampilan berpikir kritis siswa. Diharapkan penelitian ini dapat memberikan kontribusi bagi sekolah-sekolah di Indonesia.

ABSTRACT

Skills are an essential aspect that every individual should have. Students' critical thinking ability in Indonesia is still in the low category. Based on the fact that science learning carried out by teachers in schools tends to use the lecture method in learning. It causes students to lack critical thinking skills. This study aims to analyze the effect of science process skills on critical thinking skills. This type of research is descriptive quantitative research through experimental methods. The sampling technique used is total sampling, with a sample of 60 practitioners. The methods used to collect data are observation and tests. The instruments used in collecting data are observation sheets and essay tests. Data analysis techniques used are descriptive statistics and inferential statistics. Data analysis obtained that the students' science process skills were considered good, but female students were more dominant. Meanwhile, critical thinking skills are also classified as critical and dominant in female students in the very critical category. Based on the study results, it was concluded that there was an influence of science process skills on students' critical thinking skills. It is hoped that this research can contribute to schools in Indonesia..

1. INTRODUCTION

Skills are an essential aspect that every individual should have. One of the critical skills essential in making education and employment successful in the 21st century is critical thinking skills (Rahmatika et al., 2020; Shaw et al., 2020). A person with critical thinking skills can search for understand, and evaluate a statement by analyzing logical and rational relevant matters in problem-solving or decision-making processes (Kavenuke et al., 2020; Kembara et al., 2018; Shaw et al., 2020). When the student can understand the concept, they can apply the concept to solve the problem then indirectly, the student can already think critically (Dewi et al., 2017; McCormick et al., 2015). The indicators of critical thinking ability, according to other research are as follows; provide a elementary clarification, basic support, inference, advanced

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clarification, strategy and tactic (Aminudin et al., 2019; Tanti et al., 2020). In addition to critical thinking skills, the skills required in the 21st century are science process skills.

Science process skills are one of the skills required by a learner to be able to develop his or her potential since science process skills refer to cognitive and psychomotor aspects that can create meaningful learning based on the student experience (Ambross et al., 2014; Saidaturrahmi et al., 2019; Darmaji et al., 2020). Science process skills are divided into two kinds of basic science process skills and integrated science process skills. Basic science process skills include; observing, communicating, classification, measuring, inference, predicting (Darmaji, Kurniawan, & Irdianti, 2019a; Mutlu, 2020; Solé-Llussà et al., 2019). Science process skills are essential skills needed in practicum activities (Astalini et al., 2019; Rahmawati et al., 2020). Students' science process skills and critical thinking skills can be seen, improved, and shaped through practicum activities (Sari et al., 2017; Servitri & Trisnawaty, 2018; Maison et al., 2019; Darmaji et al., 2020).

Practicum activities are one of the scientific investigation processes in science learning, and practicum activities allow students to engage in several processes such as: observing, comparing, compiling hypotheses, and preparing several experiments (Darmaji, Kurniawan, & Irdianti, 2019b; Nuswowati et al., 2020). Learning science is essentially scientifically learning the environment and providing a learning experience to develop thinking skills, process skills, and scientific attitudes (Citrawathi et al., 2016). Because science learning, especially physics, is not only aimed at encouraging students to have satisfactory learning outcomes with 100 percent learning completion criteria, but rather to encourage students to understand, knowledge, skills, meaningful theory, and also experience (Jufrida et al., 2019; D. A. Kurniawan et al., 2018; Rosdianto & Teeka, 2019).

Experiences involving students directly are much better in the process of absorption of long-term memory. Based on experience, students have trained in thinking and understanding concepts. When the student can understand the concept, he can apply the concept to solve the problem. The student can already think critically and impact the results of his learning (Dewi et al., 2017; Polat & Aydın, 2020). Not only useful in the field of education but also on job prospects and application in daily life, if students have good critical thinking skills means students also have intellectual abilities that are believed to be able to solve problems and make decisions through practical cooperation and communication processes (Changwong et al., 2018; Jufri et al., 2018).

Students' critical thinking skills in Indonesia are still low in category (Pradana et al., 2020). Based on the facts contained in the field through observations, science learning conducted by teachers in schools tends to use lecture methods in their daily learning (Budiyono & Hartini, 2016). Still, students' science is not fully understood because the material presented memorizes a lot of theories (Arissantianti et al., 2017; Hariadi et al., 2019). Thus, the student's skills in finding and connecting concepts taught by teachers are rarely developed to influence their critical thinking skills (Kumala, 2015; Sasono et al., 2017). If students do not have good science process skills and critical thinking skills, then students tend to be hampered in the learning process. This study aimed to analyze the effect of science process skills and critical thinking skills at SMPN 8 Batanghari. The importance of science process skills and critical thinking skills, so this research is expected to contribute to schools in Indonesia to create more exciting learning activities and media to develop students' critical thinking skills and skills in science subjects.

2. METHOD

This type of research is descriptive quantitative research through experimental methods. Quantitative research is a study based on the philosophy of positivism studies to conduct studies and experimental methods are one of the research methods that use an experiment or experiment (Mauliza & Nurhafidhah, 2018). The type of experiment used is quasi-experimental research with a post-test-only control design. Called quasi-experimentation because in this type of experimental research used are many variables that can not be controlled, and the design of post-test only control design is a research design conducted only using the final test, which is then analyzed to see the success of the research (Payadnya & Jayantika, 2018). This type of research was chosen because it follows the researcher's goal of knowing the influence between science process skills and students' critical thinking skills on measurement materials.

The data for this study were collected through data collection instruments. This study's quantifiable data collection techniques through essay test instruments totaling 5 points of measurement questions and observation sheets of students. Ten observers assisted this research in assessing the observation sheet of students' science process skills. The experiment was conducted in several sessions and ended with a post-test of essay questions that included indicators of critical thinking ability. The grid of science process skills and critical thinking ability instruments are lots in Table 1.

Table 1. The Grid of Science Process Skills and Critical Thinking

Science Process Skills		Critical Thinking	
Indicator	**Total Statemant**	**Indicator**	**Total Question**
Observation	7	Provide a elementary	1
Classification	8	Basic Support	1
Measure	7	Inference	1
Predict	2	Advanced Clarification	1
Communication	4	Strategy and Tactic	1
Infering	6		
Total	**34**		**5**

The science process skill instrument is equipped with a Likert scale where Very Not Good is given a score of (1), Not Good (2), Good (3), Very Good (4). Meanwhile, for the assessment of critical thinking skills through the scoring rubric. And then, the interval category of science process skills and critical thinking skills is attached to Table 2. Categories of basic science process skills are presented in Table 3.

Table 2. Category of Science Process Skills and Critical Thinking Ability

Science Process Skills		Critical Thinking		Gender
Interval	**Category**	**Interval**	**Category**	
34 – 59,5	Very Not Good	0.0 – 5.0	Very Not Critical	Male & Female
59,6 – 85,1	Not Good	5.5 – 10.5	Not Critical	
85,2 – 110,7	Good	11.0 – 16.0	Critical	
110,8 – 136,3	Very Good	16.5 – 21.5	Very Critical	

Table 3. Category of Basic Science Process Skills

Interval	Basic Science Process Skills			
	Category			
	Very Not Good	**Not Good**	**Good**	**Very Good**
Observation	7.0 – 12.3	12.4 – 17.7	17.8 – 23.1	23.2 – 28.5
Classification	8.0 – 14.0	14.1 – 20.1	20.2 – 26.2	26.3 – 32.3
Measure	7.0 – 12.3	12.4 – 17.7	17.8 – 23.1	23.2 – 28.5
Predict	2.0– 3.5	3.6 – 5.1	5.2 – 6.7	6.8 – 8.3
Communication	3.0 – 7.0	7.1 – 11.1	11.2 – 15.2	15.3 – 19.3
Infering	6.0 – 10.5	10.6 – 15.1	15.2 – 19.7	19.8 – 14.3

The sample comprises the population members taken using specific characteristics representing the population. The sampling technique used by researchers is total sampling, where total sampling is sampling by taking a total sample of the existing population. The samples in this study were grade VII A and VII B students at SMPN 8 Batanghari, with a total sampling of 60 practices. All data obtained is then analyzed and calculated through IBM SPSS Statistic 23 analysis with descriptive statistics and parametric inferential statistics in the form of assumption tests and hypothesis tests (simple linear regression test) (Syahrial, Asrial, Kurniawan, & Pratama, 2019). Descriptive statistics are used to calculate minimum values, maximum values, mode, mean, median, and frequency (Syahrial, Asrial, Kurniawan, Nugroho, et al., 2019). Meanwhile, hypothetical tests (simple linear regression tests) are used to see the influence between two variables. However, before the hypothesis test should be tested for assumptions first. Assumption test in this study includes normality test and linearity test (Tentama & Abdussalam, 2020).

3. RESULT AND DISCUSSION

Result

Based on the research data, the novelty of this study is to look at the influence of science process skills on critical thinking skills reviewed based on the gender of students. Meanwhile, the analysis of descriptive statistical data on basic science process skills and critical thinking skills of grade VII students at SMPN 8 Batanghari. Based on data analysis, They explain that grade VII students' science process skills at SMPN 18 Batanghari are relatively good. Seen from the percentage of science process skills of male students that is 81% well category, and the second most significant percentage is 19% with excellent category. Similarly, in female students, the highest percentage is 79.5% in good categories and 20.5% in very good

categories. For the average science process skills, male students gained 108.14 with mode 108, and for the average science process skills, female students gained 108.38 with mode 108.

Based on analysis data, the percentage of science process skills based on fundamental science process skills indicators, which include observation, classification, measuring, predicting, communication, and concluding. Of all the indicators, observation and communication indicators got the highest percentage of scores. The observation skills of male and female students were 100%, and male students' communication skills were 90.5% and female students' 94.9% with good categories. Then, the percentage of the second-highest science process skills score was on the classification indicator and concluded that the classification skills in male students were 84.6%, and female students were 82.1% with good categories and the summing skills of male students were 71.4% and female students were 66.7% very good category. The measuring skills of male students were 76.9%, and female students were 69.2% well-categorized. Furthermore, there is a striking comparison between men and women, i.e., on the predicting indicator, the male students on the indicator are 81%, with an excellent category. In contrast, in female students, the predicting skills are 82.1% of the bad category.

Based on analysis data, While critical thinking skills are more dominant in female students, 46.2% are highly critical, while male students are only 9.5% highly critical. The average thinking ability of male students is 14.19, and the mode is 14. In female students, the average rating of critical thinking ability is 16.13, and the mode obtained is 16. To conduct a simple linear regression test, the first step that researchers must do is conduct an assumption test in the form of a normality test and linearity test. Based on data analysis, the data obtained by researchers have qualified. Namely, data on science process skills and critical thinking ability has a significance value more excellent than 0.05, i.e., the value of science process skills is 0.094, and critical thinking ability is 0.066. A data is normally distributed when the value of significance greater than 0.05 means that the data obtained by researchers has been distributed normally.

Science process skills have a significant linear relationship to critical thinking ability because the value of significance obtained is 0.869, which means more than 0.05, so that data critical thinking ability and science process skills have linear relationships. Once the data were distributed normally and linearly, the researchers continued the hypothesis test using a simple linear regression test. Based on data analysis, the variant results are 0.000, which means 0.000 < 0.05, so that there is an influence of science process skills on students' critical thinking skills.

Based on data analysis, shows that the value of the coefficient of determination or R Square is 0.931. The magnitude of the coefficient of determination (R Square) is 0.931 x 100% = 93.1%. That is, the variables of science process skills and critical thinking skills simultaneously affected 93.1%. Regression equations can be obtained using the common equation Y= a + b X and obtained the equation Y = -70.736 + 0.796X. And after analyzed obtained t count = 27,963, while p-value = 0.000/2 = 0.000. Where, 0.000 < 0.05 which means science process skills affect students' critical thinking skills.

Discussion

Female students can have better science process skills than male students because female students are more enthusiastic and have a more profound curiosity when conducting practical activities. The expert opinion says that students' interest in learning activities or practicum activities will differ between male and female students (Hadi & Ibnu, 2015; Rosidin et al., 2019; Sari et al., 2020). Based on observations in the field of post-test results that have been implemented, there are still many students who have the same answers as other friends meaning that most students are still reluctant to try to analyze and use their thinking skills and choose to use the ability to copy or cheat other people's work (Akbari & Sahibzada, 2020; Andiwatir & Khakim, 2019). In this case, the behavior exists due to many factors, one of which is because online learning during the pandemic that resulted in students who had just student is still stuttering in adapting to the new learning environment and making learning motivation decrease (Cahyani et al., 2020; Satyawan et al., 2020; Sutarto et al., 2020). There are also other causes that each individual has different abilities and motivations. Some are interested in the practice, and some prefer the theory, which also impacts critical thinking abilities and their learning outcomes.

Science process skills are a complex set of abilities commonly used by scientists in conducting scientific investigations into a series of learning processes (Derlina & Afriyanti, 2016; Zainuddin et al., 2020). Science process skills can be trained by doing practical activities at school. Science process skills are closely related and have a significant influence on students' critical thinking skills. People who have good science process skills tend to have good critical thinking skills (Maison, Darmaji, Astalini, et al., 2019; Maison, Darmaji, Kurniawan, et al., 2019). Critical thinking is the process of being able to make rational decisions about what to do and what to believe (Gunawan & Liliasari, 2012; Kavenuke et al., 2020). Someone with critical thinking ability can search, understand, and evaluate a statement by analyzing relevant things logically and rationally in the process of problem solving or decision making (McCormick et

al., 2015; Polat & Aydın, 2020; Shaw et al., 2020). This critical thinking ability is not present in the individual from birth but exists because of continuous practice.

Based on the findings observer in the field, gender also affects critical thinking skills and science process skills. This is because female students will have different knowledge, enthusiasm, interest, and learning styles from male students. Gender differences can be said to be a differentiating factor in a person's abilities such as student learning abilities (Heeg & Avraamidou, 2021; Ikonen et al., 2019; Sultan et al., 2020). Female students were more active in the learning process than male students (Bhagat & Chang, 2018; Daher et al., 2021; Gulacar et al., 2019). Therefore, gender differences have an influence on students' science process skills and critical thinking.

In this study, science process skills and critical thinking skills based on observations during practicum activities showed that female students dominated science process skills and students' critical thinking skills. The role or impact of science process skills in the teaching and learning process in the classroom and daily life is very significant. Science process skills can grow and train critical and logical thinking skills in solving problems in people's lives (Solé-Llussà et al., 2019; Zainuddin et al., 2020). Experience or science process skills that involve students directly are much better in the absorption of students' long-term memory (Arantika et al., 2019; Haryadi & Pujiastuti, 2020). Students tend to have less possibility of misconceptions with science process skills because direct experience will make students more aware of concepts, trained to think critically and have an impact on good learning outcomes. Students who have low science process skills and critical thinking skills will be different from the learning outcomes of students who have good science process skills and critical thinking skills (Darmaji, et al., 2019; Desnita & Susanti, 2017).

Previous research only examined several indicators of integrated science process skills and did not conduct research on indicators of basic science process skills at the junior high school level and indicators of critical thinking skills which only included indicators of further explanation and strategies & tactics only (Kurniawan et al., 2020). Then in research, 16 indicators have been examined which include basic and integrated science process skills and 5 indicators of critical thinking ability (Darmaji et al., 2020). Then, previous research only explained about the importance of science process skills, relationships, and the influence of science process skills on critical thinking skills without adding gender. The novelty of this research is knowing the effect of science process skills, namely through indicators of basic science process skills of junior high school students on critical thinking skills which include 5 indicators accompanied by modifications to the addition of information on gender differences.

The limitation of this research is that the indicators only cover basic science process skills and this research does not cover integrated science process skills. Suggestions for further researchers are to examine 16 indicators of students' science process skills which include basic process skills and integrated science process skills and their effect on critical thinking skills in terms of students' gender. Thus, all 16 indicators can be explained because in this study the researchers only studied basic science process skills.This study shows that the science process skills and critical thinking skills of students at SMPN 2 Batanghari and SMPN 8 Batanghari are in good and critical category. Then, there is the influence of science process skills on students' science process skills. And this research shows that female students have better science process skills and critical thinking skills than male students.

4. CONCLUSION

The science process skills has a significant effect on student' critical thinking ability. The science process skills of the seventh grade students of SMPN 8 Batanghari were in good category but were more dominant in female students in the good category. Meanwhile, for the critical thinking ability of grade VII students of SMPN 8 Batanghari is classified as critical. However, the ability to think critically is more dominant in female.

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