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Development of *Problem Solving* Teaching Materials Using *Decision Making Problem* to Improve Students Critical Thinking Skills on Temperature and Heat Materials

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ABSTRACT. The purpose of this study is to find out whether the use of Problem Solving based teaching materials using Decision Making Problem can affect students critical thinking on temperature and heat materials. In the process of developing teaching materials, the researcher uses the ADDIE method and the quasi-experimental research method with a Posttest Only design. During the development using the ADDIE method, the analysis was carried out on 3 aspects (needs analysis, curriculum analysis, and material analysis) and found results that showed that material experts with a percentage of 89.55%, linguists with a percentage of 98% and media experts with a percentage of 93.13% and are categorized as "Very Feasible". In this study, the selected population is all class VII. Then this research will be carried out in class VII C as a control class and class VII D as an experimental class. Based on the results obtained from the Independent Sample T-Test, it was shown that the average score in the control class was 48.59 and the average score in the experimental class was 81.83 with the sign value obtained was (2-tailed) of 0.000 ($\alpha < 0.05$). Based on the acquisition of these data, it can be stated that the application of Problem Solving-based teaching materials using Decision Making Problem has a significant effect on students' critical thinking skills on temperature and heat materials.

Keywords: teaching materials, problem solving, decision making, critical thinking

INTRODUCTION

The 21st century is known as the era of knowledge age, covering various fields such as economics, industry, technology, and education (Ethistika, Y., W., et al., 2018). Technology, especially artificial intelligence (AI), has developed rapidly, this is due to the number of scientists who create the latest technologies by implementing artificial intelligence that is used to help and facilitate human activities called Artificial Intelligence (AI) (Siahan Mangapul et al., 2020). However, this raises concerns because it can replace the role of humans and create fierce competition in the world of work. Therefore, a special effort is needed that is a balancer, differentiator and an advantage of human beings compared to technology. One of the skills that is in great demand in this century is critical thinking skills. Critical thinking skills are essential to distinguish humans from technology. Critical thinking skills are an activity that functions human organs (brains) to analyze situations or problems in a logical, objective, and structured manner (Hidayah, N., 2010). These skills include the ability to make strong arguments, find weaknesses in reasoning or thinking, and use available information to make informed decisions.

In essence, one of the activities that can foster critical thinking skills is learning (Facione, Peter A., 2016). Based on the reality in the field, critical thinking skills are still categorized as low (Yusal, Y., 2021). In Indonesia, students' critical thinking skills are still low, as evidenced by the results of PISA which placed Indonesia at the bottom for several periods (Rani and Trisha, 2023).

One of the causes is the use of conventional learning methods that do not actively involve students. This is in accordance with the results of an interview conducted by the researcher to one of the science teachers who teaches at a school located in the Lamongan area, East Java, who said that in the school, one of the schools that shows critical thinking skills at the school is still low. This is because the learning system in this school still uses the conventional learning system and demonstrations. So that the learning process at school still uses (Teacher Centered Learning) or it can be said that learning still focuses on the elaboration of materials, theories and concepts conveyed by teachers (Emaliana, I., 2017). So that learning in the school has not involved students to play an active role in the learning process, such as students are involved in discussions, questions and answers, experiments, and observations. In fact, student involvement in learning is one of the efforts to improve their abilities and practice critical thinking skills (Lita Ariani F., 2019).

In science learning, especially the concepts of temperature and heat, critical thinking skills can be improved through a problem-solving approach (Elizabeth & W. Alan, 2011). When students learn about the concepts of temperature and heat, they not only understand the underlying principles of physics, but are also trained to apply that knowledge to real-world situations. As part of problem solving, students are challenged to analyze the phenomenon of temperature change and heat/heat transfer, solve problems related to heat conduction, and find the right solution based on their understanding of temperature and heat. This process allows students to develop problem-solving skills that are essential in everyday life and the world of work. In addition, learning about temperature and heat transfer also plays an important role in shaping students' decision-making skills. This learning model allows students to be active in the learning process, analyze problems, and make decisions based on their knowledge. Problem-solving-based learning not only helps students in understanding the material, but also trains them in decision-making and critical thinking (Brenda R., & Robert T., 2008). Therefore, learning about temperature and heat not only hone students' physics skills but also train them in making good decisions based on their knowledge (L. J. Russel, 2013).

From the description above, teachers need to apply learning methods that actively involve students, such as Problem Solving which directs students to analyze and solve problems independently. There are several steps in using Problem Solving: (a) Creating a problem, b) Analyzing the problem, c) Creating a hypothesis, d) Collecting data, e) Testing a hypothesis, f) Creating suggestions to solve the problem (Izzatunnisa', E., 2015). Previous research conducted by Ikhwan, et al. in 2020 showed that the use of Problem Solving-based teaching materials can improve students' critical thinking and decision-making skills (Putra, I. R., et al., 2020). Therefore, further research is needed to develop these teaching materials to support learning and improve critical thinking skills.

METHOD

This study uses the research and development method (RnD), with the ADDIE development model, and the quasi-experimental research method with a Posttest Only design. During the development using the ADDIE method, the analysis part was carried out on 3 aspects (needs analysis, curriculum analysis, and material analysis). Research and development (RnD) is a research method that is systematically used to find, formulate, improve, develop, produce, and test superior products, models, methods, strategies, methods, services, or procedures. The ADDIE development model is a learning approach that prioritizes individuality, has direct and long-term phases, is systematic (ongoing), and uses a systems approach to human knowledge and learning. ADDIE's effective learning design focuses on the application of authentic tasks, complex knowledge, and real-world problems (Hidayat et al, 2021). This research aims to create and test

new teaching materials that are expected to improve students' critical thinking skills. The RnD method is used because it allows for a systematic research process to produce a new superior product.

In the process of using the ADDIE research and development model, it is carried out in 5 stages:

1. Analysis

   In this stage, the researcher conducts an analysis to identify and classify various problems that exist in schools and the needs of students during learning. At this stage, there are 3 things that are analyzed that include the needs of students, including needs analysis, curriculum analysis, and material analysis. Needs analysis is carried out by conducting interviews with teachers to be able to analyze the needs of teachers, students and school needs. Curriculum analysis was carried out by means of observation and interviews with the results that said that the teaching materials used were not in accordance with the criteria and demands of the independent curriculum. Meanwhile, material analysis is carried out by identifying, detailing and collecting the main materials learned by students.
2. Design

   At the design stage, the researcher designs starting from designing teaching materials both materially and designally, creating a concept of teaching materials that can encourage students to think critically, and designing the learning process.
3. Development

   The development stage is the stage where the researcher realizes the arrangement of the plan/design that has been made, where the design that has been made is processed and developed to become a complete unit to form a product. At this stage, the researcher validated two material experts, two linguists, and two media experts on the teaching materials that had been made. Then make improvements and refinements of teaching materials made from the analysis conducted by researchers on the results of expert reviews.
4. Implementation

   At this stage, it is a trial stage that has been made by conducting a trial in a school that has been observed before. This stage is carried out as during daily learning activities and in accordance with the design of the learning activity process that has been designed at the design stage.
5. Evaluation

   This evaluation stage is the final stage that is carried out to get the best quality from the product developed. At this stage, an evaluation of the results is carried out ranging from criticism to input obtained by the researcher regarding the teaching materials made, then revision activities are carried out to improve the quality of teaching materials.

Teaching materials that have been prepared and made must pass the trial stage. The purpose of the trial procurement is to find out more about the feasibility of a teaching material made and how far the impact of the teaching material on students' critical thinking skills. The trial in this study was carried out using a quasi-experimental method with a quantitative approach. In this study, 2 classes were used, namely the control class and the experimental class. The control class is a class that receives treatment in the form of learning using conventional methods and teaching materials used in the school that is researched and the experimental class is a class that receives treatment using Problem Solving based teaching materials using Desicion Making Problem.

Table 1. Research Design

Eksperimen	XP	O1
Control	XE	O2

Information:
O1 : Posttest critical thinking skills in the experimental class
O2 : Posttest critical thinking skills in the control class
XP : Treatment of learning with problem-based teaching materials solving using Decision Making Problem
XE: Treatment of learning with conventional methods using available teaching materials

The test subjects used in this study are grade VII D students at one of the junior high schools in Lamongan, East Java, totaling 30 people in the 2023/2024 school year. The selection of this subject was selected based on the results obtained during observation activities in which the implementation of learning is more dominant using conventional methods and has not used teaching materials that are able to encourage students to carry out critical thinking activities. This is one of the reasons why students are not trained in critical thinking skills in students.

In a study, there must be data that can support the truth of the research. To get the data needed, usually what a researcher does is make an instrument. The validation instruments of material, language, and media of teaching materials in this study used the Likert scale used in the feasibility test of teaching materials.

Table 2. Criteria for Material Ahli Validation Sheet, Linguist, Media Expert

Criterion	Value
Strongly Agree	4
Agree	3
Disagree	2
Strongly Disagree	1

In the analysis of validation data, the researcher distributed 6 questionnaires to each expert whose results will then be processed using the following formula:

$$\text{Presentase} = \frac{Sum\ of\ scores\ from\ validators}{Maximum\ score} \text{x } 100\ \%$$

The calculation is carried out on each question that has been presented in the form of a questionnaire. To find out the criteria of the product can be expressed in the table:

Table 3. Product Validity Criteria

Valuation	Category
0% - 20%	Invalid
21% - 40%	Less Valid
41% - 60%	Quite Valid
61% - 80%	Valid
81% - 100%	Highly Valid

In this study, the researcher conducted a prerequisite test, namely a normality test using SPSS software version 22.0 for windows to test a hypothesis that shows the distribution of data is normally distributed or not. The normality test was carried out on the control class and the experimental class with the condition that if the significance level used was 5%, the criteria used to make the decision were as follows: H0 will be assumed to be accepted if the sig value ≥ 0.05, meaning that the data is normally distributed, Ha will be assumed to be accepted if the ≥ value of sig is 0.05, meaning that the data is abnormally distributed.

After that, the researcher conducted a homogeneity test which also used SPSS version 22.0 for windows software which was used to test two or more groups of data samples from the population with the same variance as the provision: if there are 2 or more groups of population that have a sign value. (p) ≥ 0.05, can be assumed to be homogeneous (equal) and if there are 2 or more groups of populations that have a sign value. (p) < 0.05, can be assumed to be non-homogeneous (not the same).

The researcher's hypothesis test uses the Independent sample t test at the sign level. α = 0,05. The formula that can be used to calculate the t-test is as follows:

$$t = \frac{x_1 - x_2}{s\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}}$$

Information:
t : Hypothesis test
x1 : Average of the experimental class
x2 : Average control class
S : Combined variant value
n1 : Number of samples of the experimental group
n2 : Number of samples of the control group

In analyzing the data of this study, the following criteria were used: The analysis of the research data was based on the significance value (sign). If the sign value > 0.05, then the zero hypothesis (H_0) is accepted, which means that there is no significant influence of the use of problem-solving-based teaching materials with the decision making Problem method on students critical thinking skills. On the other hand, if the sign value < 0.05, then the zero hypothesis (H_0) is rejected and the alternative hypothesis (H_a) is accepted, which shows that the use of these teaching materials has a significant effect on students critical thinking skills.

A practicality test was also carried out to find out the extent of the development of teaching materials. These data will be obtained from the results of the questionnaire widely distributed to users of teaching materials which will then be processed by the following formula:

$$TP = \frac{Sum\ of\ scores\ obtained\ for\ each\ item}{Sum\ of\ scores\ obtained\ for\ all\ items}\ X\ 100\%$$

Here are the categories that will determine the approval level data:

Table 4. Criteria for Questionnaire Interpretation

sponse percentage	erpretation
0% ≤ Response ≤ 20%	Very impractical
21% ≤ Response ≤ 40%	Impractical
41% ≤ Response ≤ 60%	Enough
61% ≤ Response ≤ 80%	Practical
81% ≤ Response ≤100%	Impractical

RESULT AND DISCUSSION

Critical thinking is an important skill in the 21st century due to technological developments that have shifted many human roles. One of the advantages of humans over technology is the ability to reason and solve problems, so critical thinking needs to be trained. One way to practice these skills is through learning activities that involve analysis, problem-solving, and desicion-making. In education, the development of media that supports critical thinking is very important. This research presents new innovations by inserting problems and encouragement for desicion-making in teaching materials. The stages of research and development are as follows:

Development of Problem Solving-Based Teaching Materials Using Decision making Problem to Improve Students Critical Thinking Skills

Before taking the next step, in this study, the researcher conducted an analysis activity first. There are 3 analysis activities carried out by researchers, namely needs analysis, curriculum analysis and material analysis. Needs analysis, this activity aims to find out the needs of schools, teachers and students. In this study, the researcher conducted a study in one of the schools in Lamongan, East Java. When conducting analysis activities in the school, it can be found that in terms of schools, teachers and students need a teaching material that is able to encourage students to be active in learning and be able to train students' critical thinking skills. Curriculum analysis is carried out to ensure the use of the curriculum in the school so that at the time of development of teaching materials in accordance with the curriculum used. Meanwhile, material analysis is carried out to find out what material is less interested in students and the causes of students lacking interest in the material.

The second stage is the design of teaching materials. At this stage it is in accordance with what is written in chapter 3. There are several things that need to be done at this stage such as collecting teaching materials, designing a framework for teaching materials, selecting and determining the format of teaching materials, selecting and implementing teaching material tools, compiling validation sheets that will be given to validators as a means of assessing the teaching materials that are being developed, making a design of the learning process in control classes and experimental classes, making posttest questions, and the last one making a student response sheet. At this stage, it is the most important stage to develop a product so that during the development process the teaching materials are more structured and in accordance with what is desired so that the results of the developed product can have good quality.

The third stage is the development stage, at this stage the design that has been designed is processed and realized so that it becomes a form of teaching materials based on Problem Solving using the decision making problem. After the teaching materials are ready, then the materials will be given to experts to be asked for assessment, criticism and input. There are 3 types of expert assessments, namely material expert assessment, language assessment and media expert assessment. Criticism and input obtained from experts will be used as material for consideration and improvement of teaching materials. With these improvements, it will make the teaching materials that have been developed worthy of being tested on students.

The fourth stage is the trial stage of teaching materials. This trial was given to 2 classes with different treatments. This is in accordance with the principle of quasi-experimental research methods. In class VII C, a treatment was given in the form of learning temperature and heat without using teaching materials based on Temperature and Heat Problem Solving using the decision making problem, while in class VII D a learning was carried out by implementing the teaching materials that had been developed, namely temperature and heat teaching materials based

on Problem Solving using the Decision Making Problem. After giving treatment, the next step is to give a posttest to the 2 classes. The different treatments were carried out to find out the differences in the different treatments given to students' critical thinking skills in grades VII C and VII D on temperature and heat materials. The implementation was carried out in class VII C which amounted to 27 students while in class VII D there were 30 students with 3 meetings, at the first meeting in the control class and the experiment discussed temperature material. The second meeting discussed heat and its transfer. The difference that occurred in these two meetings was that in the experimental class, the teaching materials used had several problems that needed to be solved and made a decision in each subchapter in the teaching material. Meanwhile, at the third meeting, students were given a test (posttest) which aimed to measure the thinking skills of the two classes. The last stage is the evaluation stage, this stage is carried out to find out whether the teaching materials developed can have an impact on students or not. The scores obtained from the results of the posttest given to the two classes were calculated using an independent sample t-test with the aim of finding out the difference in critical thinking skills of students who used the developed teaching materials and students who did not use the teaching materials. The questions given to the two classes amounted to 8 questions in the form of essays.

The use of the ADDIE development model in this study is in accordance with the opinions of Yuli Chasanah, Fatchur Rohman, Siti Zubaidah who use the ADDIE model in developing the teaching materials they make (Chasanah, Y., et al., 2019).

Feasibility of Problem Solving-Based Teaching Materials Desicion Making Problem to Improve Students Critical Thinking Skills

The test conducted by the researcher is a validation test conducted by 3 experts, namely material, language and design experts. The subject matter expert test was carried out by 2 experts. The two material experts gave an assessment of the material used in the teaching materials. The assessment given by the experts was in accordance with the instrument made by the researcher with a total of 12 questions. Based on the assessment data of the validation of teaching material experts based on problem solving using the decision making problem which obtained an average score of 43 and a validity percentage of 89.55% and was categorized as "Very Feasible". The existence of this assessment can be concluded that problem solving based teaching materials using decision making problems in terms of material can be tested on grade VII junior high school students. The criticism and input provided by experts, including qualitative data. The revision activities carried out by the researcher are in accordance with the criticism and suggestions given by the material experts so that problem solving based teaching materials using the decision making problem are worthy of being tested in class VII D in one of the junior high schools in Lamongan, East Java, which is an experimental class.

The subject language expert test was carried out by 2 experts. The two linguists gave an assessment of the language, grammar and writing used in the teaching materials. The assessment given by the experts was adjusted to the instrument made by the researcher with a total of 13 questions. Based on the assessment data of the validation of teaching language experts based on problem solving using the Decision Making Problem, the average score was 10.2 and the validity percentage was 98% and was categorized as "Very Feasible". The existence of this distinction can be concluded that problem-solving-based teaching materials using Decision Making Problems in terms of language can be tested on grade VII junior high school students. The assessment given by linguists is accompanied by criticism and suggestions from linguists. Criticism and suggestions have been revised by the researcher in accordance with the criticism and suggestions given by

linguists so that problem-solving-based teaching materials using Desicion Making Problem are worthy of being tested in class VII D which is an experimental class.

The subject media expert test was carried out by 2 experts. The two media gave an assessment of the layout and design used in the teaching materials. The assessment given by the experts was adjusted to the instrument made by the researcher with a total of 18 questions. Based on the assessment data of the validation of teaching materials experts based on problem solving using the Decision Making Problem, the average score was 68.5 and the validity percentage was 93.13% and was categorized as "Very Feasible". The existence of this distinction can be concluded that problem solving based teaching materials using Decision Making Problems in terms of media can be tested on grade VII junior high school students. The assessment given by media experts is accompanied by criticism and suggestions from media experts. Criticism and suggestions have been revised by the researcher in accordance with the criticism and suggestions given by media experts so that problem solving based teaching materials using Decision Making Problem are worthy of being tested in class VII D which is an experimental class.

Of the three experts' assessments, it is in accordance with the research of Endang Wahyudiana et al., who said that Problem Solving-based teaching materials are very feasible to be used in the learning process (Wahyudiana, E., et al., 2021).

The Effectiveness of Problem Solving-Based Teaching Materials Using Decision Making Problem to Improve Students Critical Thinking Skills

To find out whether a teaching material developed is effective or not can be done by analyzing the data that has been obtained. Likewise, what researchers did in this research and development. Data analysis conducted by researchers in the development of Problem Solving-based teaching materials using Decision Making Problem on temperature and heat materials with the average score obtained from descriptive statistical calculations showed that the average score of the experimental class obtained was 81.83 higher than the average score of the control class of 48.58, meaning that the application of Problem Solving based teaching materials using Desicion Making Problems are effective in improving students' critical thinking skills. The statement is also supported by the results of the t-test which obtained a sign value. 0.000, which means ($\alpha < 0.05$) so that H0 is rejected while Ha is accepted. These results are in accordance with research conducted by Ni Nyoman Rediani, the results of the study show that there is an increase in students' critical thinking influenced by the application of problem-based teaching materials (Rediani, N., 2022). Based on the presentation of the data obtained, the development of problem-solving-based teaching materials using decision making problems in science subjects, especially in temperature and heat materials, was declared "Effective" to improve students' critical thinking skills.

The statement of effectiveness is in accordance with the developments seen at the time of learning. This can be seen that students are able to carry out identification activities for the problems displayed, students also carry out analysis activities and collect some information that is able to be a choice of solutions for students, besides that students in the final stage students are able to carry out decision-making activities. The above statement is supported by student response research which shows that a percentage of 85% of problem-solving-based teaching materials using decision making problem are declared "very practical".

Problem Solving based teaching materials using Decision Making Problem is a very unique innovation where this teaching material combines two different components but has the same final result, namely to improve students' critical thinking. With them, they can solve problems, then dare to give arguments, and be willing to accept other people's opinions. In developing this teaching

material, the researcher uses a concept that adapts to the times, namely using technology as a means for students to access the teaching material so that students can learn anywhere and anytime.

CONCLUSION

Based on the results of research conducted by researchers on "Development of Problem Solving Teaching Materials Using Decision Making Problem Materials to Improve Students' Critical Thinking Skills on Heat Materials", it can be concluded that the results of the development that have been carried out are in the form of "Temperature and Heat Teaching Materials Based on Problem Solving Using Problem Making Materials". Using the ADDIE development model which is carried out in 5 stages, namely the analysis stage (Analyze), the design stage (Design), the development stage (Development), the implementation stage (Implementation), and the evaluation stage (Evaluation). This teaching material is considered very feasible to use as shown by the results of the material validation analysis of 89.5%, linguists 98%, and media experts as well as 95.3%. Problem Solving-based teaching materials using Decision Making Problems on temperature and heat materials are effectively used in improving students' critical thinking skills. This is shown by the results of the average score of the descriptive calculation of the experimental class of 82.83, higher than the average score of the control class, which is 48.59 In addition, the results are also supported by calculations carried out using the t-test which shows the acquisition of sign values. 0.000 which means ($\alpha < 0.05$) so that H0 is rejected while Ha is accepted.

REFERENCES

Brenda R. Shaw, Robert T. Miller. (2008). Enhancing Decision Making Skills Through Problem Based Learning. *Journal on Excellence in College Teaching*. 19(2).

Chasanah, Yuli, Fatchur Rohman, and Siti Zubaidah. (2019). *Efektivitas Modul Keanekaragaman Hayati Berbasis Project Based Learning Dalam Upaya Peningkatkan Hasil Belajar Kognitif Siswa SMA*.

Elizabeth A. Davis, W. Alan Wright. (2011). The Impact of Science Education on Critical Thinking and Problem Solving. *Journal of Research in Teaching*. 48(3).

Emaliana, Ive. (2017). Teacher-Centered or Student-Centered Learning Approach to Promote Learning ?. *Jurnal Sosial Humaniora 10*.

Etistika Y W, Dwi A S, and Amat N. (2016). Transformasi Pendidikan Abad 21 Sebagai Tuntutan. *Jurnal Pendidikan 1*.

Facione, Peter A. 2016. *Critical Thinking : What It Is and Why It Counts*.

Fitrie, Lita Ariani. (2010). Keterlibatan Siswa (Student Engagement) di Sekolah sebagai Salah Satu Upaya Peningkatan Keberhasilan Siswa di Sekolah. *Prosiding Seminar Nasional & Call Paper Psikologi Pendidikan*.

Hidayah, Nur. (2010). *Mengasah Keterampilan Berpikir Kritis Dan Kreatif*. 2006.

Hidayat, Fitria, Cihanjuang Rahayu, Kabupaten Bandung Barat, Muhamad Nizar, 154 Kecamatan Coblong, and Kota Bandung. (2021). *Model ADDIE (ANALYSIS , DESIGN, DEVELOPMENT, IMPLEMENTATION AND EVALUATION) Dalam Pembelajaran Pendidikan Agama Islam Addie (Analysis, Design, Development, Implementation And Evaluation) Model In Islamic Education Learning*.

Izzatunnisa', Erlita. (2015). Pengembangan Buku Ajar Berorientasi Problem Solving Learning Materi Hereditas Pada Manusia. *BioEdu Berkala Ilmiah Pendidikan Biologi*.4(1).

L. J. Russell. (2013). The Development of Desicion -Making Skills in Physics Education. *European Journal of Physics*. 34(3).

Putra, Ihwan Riskya, Wahyu Sukartiningsih, and Titik Indarti. (2020). Pengembangan Bahan Ajar Menulis Esai Berbasis Lingkungan Menggunakan Model Problem Solving Untuk Meningkatkan Kemampuan Berpikir Kritis Siswa Kelas V Sekolah Dasar. *ELSE (Elementary School Education Journal): Jurnal Pendidikan dan Pembelajaran Sekolah Dasar*. 4(2).

Rediani, Ni Nyoman. (2022). Dampak Pembelajaran Berbasis Masalah Berbasis Aktivitas terhadap Keterampilan Berpikir Kritis dan Hasil Belajar bagi Pengembangan Konsep-Konsep Dasar IPA. *Mimbar Ilmu*. 27(3).

Siahaan, Mangapul, Christopher Harsana Jasa, Kevin Anderson, and Melissa Valentino. (2021). Penerapan Artificial Intelligence (AI) Terhadap Seorang Penyandang Disabilitas Tunanetra. *Information System and Technology*. 1(2).

Wahyudiana, Endang, Julius Sagita, Vina Iasha, Ari Setiantini, and Ari Setiarini. (2021). *Meningkatkan Kemampuan Pemecahan Masalah*. 17(2).

Yusal, Yulianti. (2021). Profil Kemampuan Berpikir Kritis Guru Fisika Prajabatan Terkait Perpindahan Panas. *Journal of Physics*, no. Conferences Series.