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The Effect of Cosheet Strategy-Based on Collaborative Creativity Learning on Energy Literation Ability and Physics Learning Outcome

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ABSTRACT

The purpose of this study was to find out how the energy literacy abilities of high school students while using Cosheet Strategy based on the Collaborative Creativity (CC) learning model and to determine the effect Cosheet Strategy based on the Collaborative Creativity (CC) learning model on physics learning outcomes in high school students. This type of research is experimental research with post-test only control group design. The study population was all students in Mumbulsari 1 Senior High School. The determination of the study sample used was cluster random sampling which was then obtained in class X Mathematics and Natural Science 3 as the experimental class and class X Mathematics and Natural Science 2 as the control class. The research instruments were observation, interviews, tests, and documentation. Analysis of research data for energy literacy skills is by using the energy literacy formula, while for physics learning outcomes use statistical tests on the SPSS application program. Based on the results of the analysis it can be said that students' energy literacy abilities while using the Cosheet Strategy based on Collaborative Creativity (CC) learning model are good, and the Cosheet Strategy based on Collaborative Creativity (CC) model has a significant effect on physics learning outcomes in high school students.

INTRODUCTION

Energy literacy as a basic ability that includes knowledge, attitudes, and behaviors about the complexities associated with energy use. Based on the preliminary study, the energy literacy of junior high school students is still low. One's energy literacy can be trained in a learning process. Indonesia must have students with graduates who have the ability to be able to think critically, creatively in the fields of literacy, engineering, science, art and mathematics (Soeyono, 2013). The results of the 2015 PISA (Program for International Student Assessment) research show that student learning outcomes in Indonesia in the field of reading literacy are still very low and are ranked lower. The results of the data clearly show that education in Indonesia is still far behind compared to other countries, especially in ASEAN such as Thailand and Singapore (OECD, 2016). The meaning of literacy which at first was just literacy developed very rapidly, wider, and complex. The word literacy many juxtaposed with other words, such as computer literacy, media literacy, information literacy, scientific literacy which includes energy literacy.

Physics is a branch of a Natural Science that emphasizes students to have the ability to understand concepts and so that students are able to solve problems that have been given by the teacher. The problem that often occurs today in learning physics is the passivity of students in learning activities in the classroom (Agustin et al., 2017). On the results of the analysis of research student learning outcomes these problems occur because it is caused by the way teaching in the classroom still often uses traditional

learning methods (Mahmudah, 2014). Teacher-centered learning activities result in students becoming passive, because students do not play a role in learning activities (Supeno et al., 2019).

Based on the results of interviews with high school physics teachers known that in physics teaching in these schools are still many problems. The problem that often occurs is the low student learning outcomes accompanied by low student activity caused by the students' low understanding of the material that has been taught. Based on observations made known that the learning model used is still often use learning model (direct learning), these models are often implemented using lecture method which accompanied the assignment method, resulting in learning activities of students in the classroom are heard, write what is described teachers, and work on problem training. This causes students to tend to be passive and make students inferior in the ability of their science process skills (Zubaidah, 2015).

Based on the problems that occur in high school there should be a solution so that these problems can be solved. Therefore, so that learning objectives can be achieved, it is necessary to apply a learning model that is able to make active students in the class and able to make students focus when the teacher explains so that the material taught can be understood by students and activities in the classroom are not only teacher-centered. The appropriate learning model is expected to be able to overcome all problems in physics learning (Jatmiko et al., 2018), including improving students' energy literacy skills (Astutik et al., 2018).

One learning model that can be used is Collaborative Creativity (CC) learning model is Cosheet Strategy. Cosheet is a learning strategy that uses the steps of the Collaborative Creativity Model as a reference in carrying out learning activities (Astutik et al., 2017; Sutarto & Indrawati, 2013). Cosheet is expressed in the form of a worksheet that students must work on in a collaborative way with other students. Student activities are carried out based on individual groups and collaborative groups whose number of members is a multiple of 2 and a maximum of 6 people.

The collaborative creativity model (CC) is a learning model in which it trains scientific creativity skills and scientific collaboration in accordance with systematic procedures a Collaborative Creativity to guide teachers in helping students identify problems, explore creative ideas, collaborative creativity, elaborate creative ideas and evaluation processes and the results of creativity scientific (Astutik & Prahani, 2018; Mahaux et al., 2013; Puspitaningrum et al., 2018). Collaborative creativity also shows how the potential and balance of participation can increase the contribution of scientific creativity. Thus collaborative creativity plays an important role in determining student learning success and increasing the contribution of scientific creativity skills (Partlow in Astutik, et al., 2019; Puspitasari et al., 2018; Hariani et al., 2014). Based on the description above, the researcher intends to conduct research with Cosheet strategy based on the Collaborative Creativity (CC) learning model in the hope that it can improve energy literacy skills and student physics learning outcomes. So the researcher took a study entitled "The Effect of Cosheet Strategy based on Collaborative Creativity Learning Model (CC) on The Energy Literation Ability and The Results of Learning Physics in High School Students".

The main problem in this research was to describe students' energy literacy skills while using the Cosheet strategy based on Collaborative Creativity (CC) learning

model and assess the effect of Cosheet strategy based on Collaborative Creativity (CC) learning models on student physics learning outcomes. (1) Students' energy literacy abilities are measured using test questions about energy literacy. The final score on student energy literacy uses the energy literacy score guidelines which will then be interpreted based on energy literacy criteria; (2) The effect of the Cosheet strategy based on Collaborative Creativity (CC) model on student physics learning outcomes is measured using post-test questions which will be analyzed using the SPPS 23 application program.

RESEARCH METHOD

General background of research

This research was conducted on X grade high school students at Mumbulsari Jember. The research design used is the Post-test Only Control Design. The first class is given a treatment called the experimental class and the second class is not given treatment called the control class, after that at the end of the learning each class is given a post-test with the aim to determine the effect of the treatment.

Participants

This type of research is quasi-experimental research. The population used in this study was all students of grade X at High School 1 Mumbulsari in Jember. After determining the population of the study, the study sample consisted of the experimental class and the control class. In sample selection is done by conducting a homogeneity test of a predetermined population. The data used is the value of the previous test. Based on the homogeneity test results obtained, if the test results are homogeneous sample selection is done randomly or commonly referred to as cluster rundom sampling whereas if the homogeneity test results state the tested class is not homogeneous then the sample is selected based on the average test value approaching or almost the same which was then drawn to determine the experimental class and the control class. The class used in this study was class X Mathematics and Natural Sciences 3 as the experimental class and class X Mathematics and Natural Sciences 2 as the control class.

Instrument and Procedure

Data collection technique is a series of ways to get a data result carried out by researchers in an effort to obtain the information needed in accordance with the objectives of the researcher . This observation technique is used to see student learning activities during the learning process using the Collaborative Creativity (CC) learning model (Astutik et al., 2019). Data collection using energy literacy test instruments and learning outcomes.The Energy literacy test instruments and learning outcomes have been tested for validity and reliability. The test results stated that the test instrument was valid and reliable.

The interview is a method carried out by researchers to obtain a data in the form of information. Interview done by asking questions that needed to the informant. The results of the interview are then used as supporting data which is then discussed in the discussion. Technic data collection in the form of tests. The test given is in the form of a *post-test* . This test is given after the learning process . Tests of physics learning outcomes are given in the form of a collection of description questions which is five

questions. The questions in the post-test are taken from the bank questions, which means that the questions are taken from the physics package book, so that in making this post-test question there searcher does not need to do validation and relability tests. The learning outcomes measured in this study are in the cognitive domain (Nugroho et al., 2017; Nurazizah et al., 2017; Susilowati & Ramli, 2017). Tests for energy literacy skills are also in the form of descriptions or essays which number 10 questions. Test questions given to students are scored for each problem (DeWaters, 2013). Different competencies will be given different scores. The distribution of scores in each category of questions is:

a. Energy understanding and concept categories, easy categories given a score of 1, categories being given a score of 2, difficult categories given a score of 3.
b. Categories of energy utilization in everyday life, easy categories given a score of 4, categories being given a score of 5, difficult categories given a score of 6.
c. Energy saving categories, easy categories given a score of 7, categories being given a score of 8, difficult categories given a score of 9.
d. Categories about energy conservation and global warming, easy categories were given a score of 10, categories were given a score of 11, score categories were given a score of 12.

In this study the data obtained from techniques documentation the form of a picture or a photograph of during the learning activities take place. In addition, the data obtained through this documentary activity is in the form of student physics scores in the previous material, a list of names of students from the experimental class and the control class, as well as student learning outcomes. The research procedure is given by the following flowchart in Figure 1.

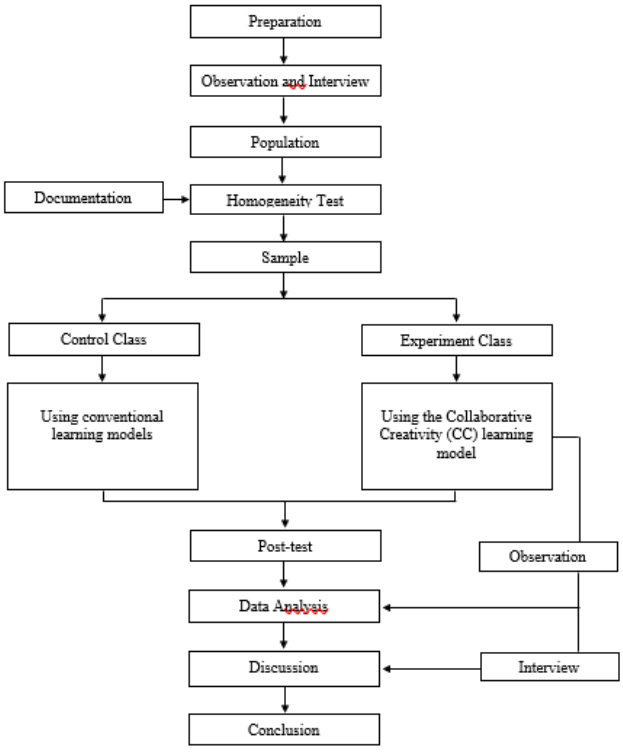

Figure 1. Research procedure.

Data Analysis

Data analysis used to determine literacy skills in students is as equation (1):

$$N_{energy\ literacy} = \frac{R}{SM} x100 \quad (1)$$

Information:

$N_{energy\ literacy}$ = final score on energy literacy

R = raw score obtained by students

SM = maximum test score

(Ali, 2013)

The final test scores of students will be interpreted using the **Table 1** guidelines:

Table 1. Interpretation of student's final values**.**

No.	Value (N)	Information
1.	95.00> N ≤ 100	Special
2.	80.00> N ≤ 95.00	Very good
3.	65.00> N ≤ 80.00	Well
4.	55.00> N ≤ 65.00	Enough
5.	40.00> N ≤ 55.00	Less
6.	00.00> N ≤ 40.00	Very lacking

(Purwanto & Winarto, 2019)

The final formula, then obtained the score category (N) that has qualifications comparable to the interpretation of energy literacy abilities. The way to analyze the learning outcomes data that has been obtained is by using a manual method, and can also be analyzed using the independent sample t-test t on the SPSS 23 application. The manual method used to find out the improvement in student learning outcomes is to use T-test The formula used is as equation (2):

$$t_{tes} = \frac{M_X - M_Y}{\sqrt{\left(\frac{\Sigma X^2 - \Sigma Y^2}{N_X - N_Y}\right)\frac{1}{N_X} + \frac{1}{N_Y}}} \quad (2)$$

Information:

M_X = the average value of the experimental group

M_Y = average value of the control group

ΣX^2 = deviation of individual values from the experimental class

ΣY^2 = deviation of individual values from the control class

N_X = the number of samples in the experimental class

N_Y = the number of samples in the control class

(Sugiyono, 2015)

RESULTS AND DISCUSSION

Data on energy literacy capabilities in this study were obtained based on techniques in the form of tests of energy literacy. The test is conducted after learning about the subject

matter of Business and Energy. This test consists of 10 essay questions where each question contains an indicator of energy literacy.The second technique is the documentation technique obtained based on the results of the answers on the test sheet assessed by the researcher. The percentage value of energy literacy skills is obtained at the end of the meeting.The following is the data on the average value of energy literacy skills in the experimental class and the control class shown in the **Table 2.**

Table 2. Description of average value of energy literacy ability tests in experimental classes and control classes.

Class	Amount of Value	Average	Criteria
Experiment	2,275	66.91	Well
Control	2,089	59.68	Enough

Table 2 shows the average value of the experimental class energy literacy ability is 66.91 and in the control class is 59.68 this indicates that the average experimental class is greater than the control class. Based on the data on the average energy literacy ability that has been obtained from the experimental class and the control class, it can be graphed in Figure 2.

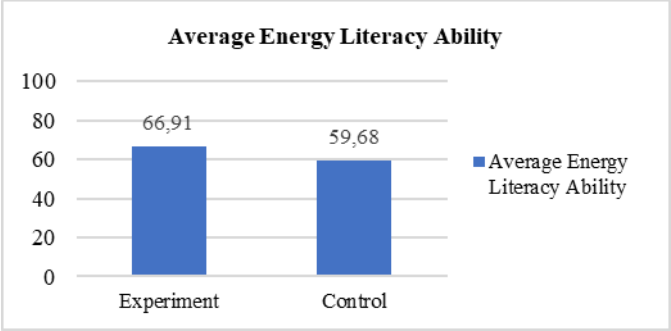

Figure 2. Average graph of energy literacy ability.

Figure 2 shows that the average value of the experimental class's energy literacy ability is greater than the control class. The experimental class has an average value of 66.91 which is included in the good category, while the control class has an average value of 59.68 which is included in the sufficient category. Energy literacy skills of the two classes are different, in the experimental class the energy literacy ability is good while in the control class the energy literacy ability is sufficient. Based on the results of the research conducted on the tests of energy literacy skills in the two classes, the average values of the experimental class and the control class were different. The average value in the experimental class was 66.91 while in the control class it was 59.68. From these values it can be seen that the average value of the experimental class is greater than the control class. The experimental class has good criteria while the control class has sufficient criteria. This is because learning activities using the Collaborative Creativity (CC) model make students support students to be more active in learning activities, besides being able to express their own creative ideas so that the results of tests of energy literacy skills in the experimental class are well compared to the adequate control class (Purwanto and Winarti, 2019).

Learning outcomes observed in this study are learning outcomes in the realm of cognition (Putri, et al., 2017; Zahro et al., 2018) . Data on student physics learning outcomes were obtained based on post-test scores. Post-test implementation for the experimental class. To determine the effect of the Collaborative Creativity (CC) learning model on the experimental class, statistical tests need to be conducted using the t test with the Independent Sample T Test. Before conducting the t test the data must be tested by a normality test to determine the data obtained is normal. This normality test uses Kolmogorov Smirnov. Results of data normality test cognitive results can be seen in the following Table 3.

Table 3. Normality test results of learning outcomes data.

		CONTROL	EXPERIMENT
N		**35**	**34**
Normal Parameters [a, b]	Mean	68,1143	82.7941
	Std. Deviation	9.57562	11,63532
Most Extreme Differences	Absolute	, 135	, 144
	Positive	, 107	, 096
	Negative	-, 135	-, 144
Test Statistic		, 135	, 144
Asymp. Sig. (2-tailed)		, 104 [c]	, 072 [c]

Table 3 shows the value of Sig. in the Asymp table. Sig. (2-tailed) for the control class of 0.104, this indicates that the significance value is > 0.05 or 0.104 > 0.05, in the experimental class the value of Asymp. Sig. (2-tailed) of 0.072, this indicates that the significance > 0.05 or 0.072 > 0.05, based on the decision-making guidelines if the significance value is> 0.05 then the data is said to be normally distributed. The t-test was then carried out with the Independent Sample t-Test. Comparison of the average value of learning outcomes of students in the experimental class and the control class in regular circular motion material can be seen in the Table 4.

Table 4. Average value of student physics learning outcomes.

Class	Amount of Value	Average
Experiment	2,815	82.79
Control	2,384	68.11

Table 4 shows the average value of the experimental class post-test is 82.79 while the average value in the control class is 68.11, indicating that the average experimental class is greater than the control class. Based on the average data on the learning outcomes of the experimental class and the control class, graphs can be made that can be seen in Figure 3.

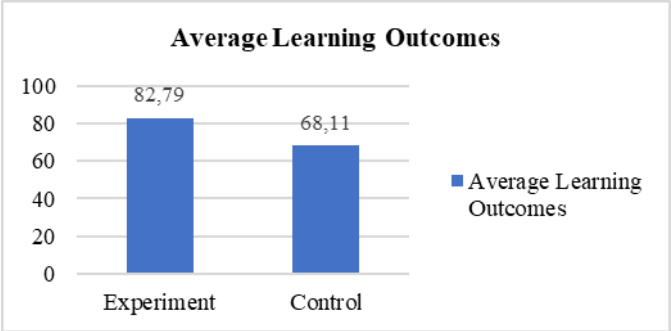

Figure 3. Average graph of learning outcomes.

Figure 3 shows that the average student learning outcomes of the experimental class are greater than the average learning outcomes of the control class. Furthermore, to further examine student physics learning data, it is necessary to do a statistical test using the t-test with the Independent Sample T Test to determine the significant effect of the Cosheet based on Collaborative Creativity (CC) learning model used in the experimental class compared to the conventional learning model (Model Jigsaw) used in the control class.

Table 5. Independent test samples.

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Difference Error	95% Confidence Interval of the Difference	
									Lower	Upper
VALUE	Equal variances assumed	2,404	,126	5,73	67	.000	14,67	2,56	9.56	19,793
	Equal variances not assumed			5,71	63,873	.000	14,67	2,56	9.54	19,812

Table 5 shows that the data on student physics learning outcomes in the cognitive realm has a Sig. (2-tailed) of 0,000, so that the significance value (1-tailed) is 0,000. Based on the guideline for decision making because of the large significance value of 0,000 <0,05, it can be concluded that there is a significant influence between the physics learning outcomes of the experimental class and the control class or it can be said that H_a is accepted and H_0 is rejected. So it can be concluded that the Cosheet based on Collaborative Creativity (CC) learning model has a significant effect on physics learning outcomes in high school students.

Energy Literacy Ability

The first objective of this study was to describe the ability of energy literacy using Cosheet based on the Collaborative Creativity model (CC). Data on energy literacy capabilities are obtained based on two techniques, namely tests and licenses. The test technique is carried out when the learning takes place, while the registration technique is obtained from the results of the energy literacy ability test. This test of energy literacy ability has 4 sub indicators with the number of questions, namely 10 questions or essays.

The score of each student's literacy energy abilities is different. In the control class, the average category of understanding and concept of energy answered correctly. The question category expends energy in everyday life, on average, all of them answer incorrectly. The category of energy-saving action questions on average answer is less precise. While in the category of energy saving and global warming the average answer is less precise. Each question is in a different category so the scales also differ according to weight. The maximum score for students answering all right is 63. Then agreeing on the student score will be divided by the maximum score then multiplied by 100 to get the test score for students' energy literacy abilities (Astutik, et al., 2019).

Based on the results of the research that has been done on the first goal, namely the test of energy literacy skills in the second class, the average values of the experimental class and the control class are obtained. The average value in the experimental class was 66.91 while in the control class it was 59.68. From these values, it can be seen that the average grade of the experimental class is greater than the control class. The experimental class has good criteria in the control class has sufficient criteria. This is related to learning activities using the Collaborative Creativity model (CC) to make students support students to be more active in learning activities, while also being able to provide advice on creativity needed to produce tests of energy literacy skills in the experimental class, both in the control class enough (Astutik, et al., 2020).

The Results of Studying Physics

The second objective of this study was to examine the effect of the Collaborative Creativity (CC) model on physics learning outcomes in high school students. Based on the data analysis of student physics learning outcomes which obtained an average value in the experimental class is 82.79, while in the control class is 68.11. From the average data on the results of learning physics, it can be seen that the average physics learning outcomes in the experimental class are greater than the control class. After knowing the average physics learning outcomes in the next two classes to examine the differences in learning outcomes that were more significant between the experimental class and the control class, it was analyzed using the t-test with the Independent Sample T Test found in the SPSS 23. Application program. -t is a normality test to determine whether the post-test data is normally distributed or not. Based on the normality test that has been done, it was found that the value of Asymp. Sig. (2-tailed) in the control class of 0.104 and in the experimental class the value of Asymp. Sig. (2-tailed) of 0.072. Based on the decision making guidelines if the significance value is> 0.05 then the data is said to be normally distributed. Based on these results, the value of the learning outcomes of the experimental class and the control class are normally distributed. The second test after conducting a normality test is to test the value of physics learning

outcomes of students using the t-test with the Independent Sample t-Test found in the SPSS 23 application program to determine the significant effect after being given treatment in the experimental class. After analyzing the data on student physics learning outcomes in the cognitive domain has a Sig. (2-tailed) of 0,000, so the significance value (1-tailed) is 0,000.

Based on the guidelines for decision making because of the large significance value of 0,000 <0,05, it can be concluded that there is a significant influence between the experimental and class physics learning outcomes. Based on the results of the research that has been done it can be seen that the Collaborative Creativity (CC) learning model applied to the experimental class has a significant effect on students' physics learning outcomes. (Astutik, et al., 2020; Rahayu et al., 2017; Ramadhani et al., 2017; Sari et al., 2016). Whereas in the control class that uses the cooperative learning model used by the teacher (Jigsaw Model) tends to focus on one student only, so that other students tend to depend on their friends during group activities. In contrast to the control class, in the experimental class each student is tried to be able to explore ideas that are owned so students tend to be more active and can collaborate their ideas with other group members. So from that students become more understanding of the material taught through active group activities. Factors that cause differences in physics learning outcomes of students in the experimental class and the control class that use the Collaborative Creativity (CC) learning model and use the models commonly used by teachers are the advantages of the Collaborative Creativity (CC) learning model where this model emphasizes teamwork and collaboration from the creative ideas they have with all students who are encouraged to explore each other's ideas to other group members so that an idea can be formed that can solve the problems given by the teacher. With the Collaborative Creativity (CC) learning model, students will become more active in discussion activities so that students do not depend on just one friend, but all group members are actively involved in conducting learning activities, especially during practicum.

CONCLUSION

Energy literacy ability in high school students while using Cosheet based on Collaborative Creativity (CC) learning model is included in the criteria of good. These results indicate that the Cosshet strategy based on Collaborative Creativity has a positive impact on learning so that students' energy literacy skills increase. Cosheet based on Collaborative Creativity (CC) learning model has a significant effect on physics learning outcomes in high school students. These results indicate that the Cosshet strategy based on Collaborative Creativity has a positive impact on learning so that student learning outcomes increase. The implication of this result is that students will develop good attitudes and character towards energy literacy. This will get better when students do it in a sustainable manner so that energy literacy will become a culture that is attached to students. Future research can be directed at affective, cognitive and psychomotor aspects so that ultimately energy literacy learning makes a positive contribution to the formation of student character.

REFERENCES

Agustin, P.N., Lesmono, A.D., & Bachtiar, R.W. (2017). Pembelajaran fisika di SMA dengan menggunakan model kooperatif tipe STAD di SMAN 1 tapen bondowoso. *Jurnal Pembelajaran Fisika, 6*(2), 196-202. https://doi.org/10.19184/jpf.v6i2.5021

Ali, M. (2013). *Prosedur dan strategi penelitian pendidikan*. Bandung: Angkasa.

Astutik, S., Endang, S., & Madlazim. (2017). *Model pembelajaran collaborative creativity untuk meningkatkan afektif kolaboratif ilmiah dan kreativitas ilmiah siswa pada pembelajaran IPA*. Surabaya: Universitas Negeri Surabaya.

Astutik, S., & Prahani, B.K. (2018). The practicality and effectiveness of collaborative creativity learning (ccl) model by using phet simulation to increase students' scientific creativity. *International Journal of Instruction, 11*(4), 409-424. https://doi.org/10.12973/iji.2018.11426a

Astutik, S., & Wicaksono, I. (2019). Pengaruh model pembelajaran collaborative creativity terhadap kemampuan literasi energi pada siswa SMA. *Jurnal Pembelajaran Fisika, 8*(2), 87-93. https://doi.org/10.19184/jpf.v8i2.11669

Astutik, S., Mahdiannur, M.A., & Prahani, B.K. (2019). Improving science process skills of junior high school students through the implementation of collaborative creativity learning (CCL) model in physics learning. *Journal of Physics: Conference Series*, *1171*(1), 012006.

Astutik, S., Susantini, E. Madlazim, Nur, M.m & Supeno. (2020). The effectiveness of collaborative creativity learning models (ccl) on secondary schools scientific creativity skills. *International Journal of Instruction, 13*(3), 525-538. https://doi.org/10.29333/iji.2020.13336a

DeWaters, J., & Powers, S. (2013). Designing an energy literacy questionnaire for middle and high school youth. *Environmental Education*, *44*(1), 56-78. https://doi.org/10.1080/00958964.2012.682615

Hariani, F., Sudarti, S., & Astutik, S. (2014). Pengaruh model problem solving laboratory terhadap keterampilan proses sains dan hasil belajar fisika siswa kelas XI di SMA negeri 2 tanggul. *Jurnal Pembelajaran Fisika, 3*(1), 47-52. https://doi.org/10.19184/jpf.v3i1.23238

Mahmudah, L. (2014). P*embelajaran fisika menggunakan metode pictorial riddle dan problem solving ditinjau dari kemampuan berpikir kritis dan kemampuan analisis*. Tesis. Semarang: Universitas Sebelas Maret

Jatmiko, B., Prahani, B.K., Munasir, Supardi, Z.A.I., Wicaksono, I., Erlina, N., Pandiangan, P., Althaf, R., & Zainuddin. (2018). The comparison of OR-IPA teaching model and problem based learning model effectiveness to improve critical thinking skills of pre-service physics teachers. *Journal of Baltic Science Education*, *17*(2), 1-22. https://doi.org/10.33225/jbse/18.17.300

Mahaux, M., Gotel, O., Mavin, A., Nguyen, L., Deakin, M.L., & Schmid, K. (2013). *Collaborative creativity in Requirement Engineering Analysis and Practical Advice.* Valencia: Springer.

Nugroho, P. B. (2017). Scaffolding meningkatkan kemampuan berpikir kritis dalam pembelajaran matematika. *Jurnal Silogisme: Kajian Ilmu Matematika Dan Pembelajarannya,2*(1), 15-21.

Nurazizah, S., Sinaga, P., & Jauhari, A. (2017). Profil kemampuan kognitif dan keterampilan berpikir kritis siswa SMA pada materi usaha dan energi. *Jurnal Penelitian & Pengembangan Pendidikan Fisika*, *3*(2), 197-202. https://doi.org/10.21009/1.03211.

OECD. (2016). *Programme for internasional student assessment (pisa) result from pisa 2015*. PARIS: OECD.

Purwanto, J., & Winarti, W. (2016). Profil Pembelajaran Fisika dan Kemampuan Berpikir Kritis Siswa Madrasah Aliyah se-DIY. *Jurnal Penelitian Pembelajaran Fisika, 7*(1), 9-21. https://doi.org/10.26877/jp2f.v7i1.1148

Puspitaningrum, H.Z., Astutik, S., & Supeno. (2018). Lembar kerja siswa berbasis collaborative creativity untuk melatihkan kemampuan berargumentasi ilmiah siswa SMA. *Seminar Nasional Quantum, 25,* 159-165.

Puspitasari, F., Astutik, S., & Sudarti. (2018). Efektivitas model collaborative creativity untuk meningkatkan kemampuan pemecahan masalah siswa. *Seminar Nasional Pendidikan Fisika 2018, 3*(1), 116-120.

Putri, R.H., Lesmono, A.D., & Aristya, P.D. (2017). Pengaruh model discovery learning terhadap motivasi belajar dan hasil belajar fisika SMA MAN bondowoso. *Jurnal Pembelajaran Fisika, 6*(2), 168-174. https://doi.org/10.19184/jpf.v6i2.5017

Rahayu, T.M., Astutik, S., & Prihandono, T. (2017). Model pembelajaran kooperatif tipe grup investigation berbasis observasi gejala fisis pada pembelajaran IPA-fisika di SMP. *Jurnal Pembelajaran Fisika, 6*(1), 53-59.

Ramadhani, W.S., & Indah, E.N.K. (2016). Penerapan pembelajaran outdoor learning process (olp) melalui pemanfaatan taman sekolah sebagai sumber belajar materi klasifikasi tumbuhan untuk meningkatkan hasil belajar siswa SMP. *Jurnal Pendidikan Sains, 6*(4), 1-7.

Sari, A.L.R., Parno, P., & Taufiq, A. (2016) Kemampuan berfikir kritis dan pemahaman konsep fisika siswa pada materi hukum newton. *Prosiding Seminar Nasional Pendidikan IPA Pascasarjana Universitas Malang, 1,* 88-100.

Soeyono, Y. (2013). Pengembangan bahan ajar matematika dengan pendekatan open-ended untuk meningkatkan kemampuan berpikir kritis dan kreatif siswa SMA. *Jurnal Mathematics Education, 9*(2), 639 – 648. https://doi.org/10.21831/pg.v9i2.9081

Sugiyono. (2015). *Educational research methods (quantitative, qualitative and R&D approaches)*. Bandung: Alfabeta.

Supeno, S., Astutik., S, Bektiarso, A.D., Lesmono, & Nuraini, L. (2019). What can students show about higher order thinking skills in physics learning. *IOP Conference Series: Earth and Environmental Science*, *243*(1).

Susilowati, & Ramli, M. (2017). Analisis keterampilan berpikir kritis siswa madrasah aliyah negeri di kabupaten magetan. *Prosiding Seminar Nasional Pendidikan Sains,* 223-232.

Sutarto, & Indrawati. (2013). *Strategi belajar mengajar sains*. Jember: UPT Penerbitan.

Zahro, Y.F., Sri A., & Mariyani. (2018). Pengaruh model pembelajaran collaborative creativity (cc) disertai teknik probing prompting terhadap hasil belajar fisika siswa SMKN 2 jember. *Prosiding Seminar Nasional Pendidikan Fisika*, *3*(2), 114- 118.

Zubaidah, S. (2016). Keterampilan abad ke-21: Keterampilan yang diajarkan melalui pembelajaran. *Seminar Nasional Pendidikan Isu-Isu Strategis Pembelajaran MIPA Abad 21*, *10*, 145-153.

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