JPII 8 (4) (2019) 464-474

Jurnal Pendidikan IPA Indonesia

http://journal.unnes.ac.id/index.php/jpii

THE 7E LEARNING CYCLE APPROACH TO UNDERSTAND THERMAL PHENOMENA

R. Maskur*[1], S. Latifah[2], A. Pricilia[3], A. Walid[4], K. Ravanis[5]

[1,2,3]Faculty of Teacher and Training, Universitas Islam Negeri Raden Intan Lampung, Indonesia
[4]Faculty of Tarbiyah and Tadris, Institut Agama Islam Negeri Bengkulu, Indonesia
[5]Department of Educational Sciences and Early Childhood Education, University of Patras, Greece
LetKol Endro SuratminStreet. No.1, Sukarame, Bandar Lampung, 35131, Indonesia

DOI: 10.15294/jpii.v8i4.20425

Accepted: August 9th, 2019. Approved: December 27th, 2019. Published: December 31st, 2019

ABSTRACT

Conceptual understanding is often a problem in science learning, and this issue has become the point of science education experts, including in Indonesia. Lately, ten articles in Indonesia and six articles in other countries have discussed the model of the 7E Learning Cycle. It was mentioned that this model is able to increase learners' conceptual understanding. This research intended to reveal the effectivity of physics learning using the 7E Learning Cycle in improving students' understanding of temperature and heat concepts. The research design is quasi-experimental with a non-equivalent control group design. The sample was senior high school students. Objective test in the form of multiple choices equipped with reason was employed as the data collection instrument. Based on the data analysis, the value of Effect Size was 0.5 and belonged to the medium category. In other words, the use of the 7E Learning Cycle model is sufficient to improve the learners' understanding of temperature and heat concepts. This could be seen from the success of the learning process that integrates the whole seven stages with the seven indicators of conceptual understanding in detail. Thus, the 7E Learning Cycle could be effectively applied and can increase the students' conceptual understanding.

Keywords: conceptual understanding in physics, direct learning, 7E learning cycle model

INTRODUCTION

The outcome of the physics learning process, among others, is to enable students to comprehend the relevance of physics concepts to be applied in their daily life (Husein et al., 2017; Latifah et al., 2019; Pratiwi & Supardi, 2014). The students' inability to connect one concept to another is a common problem occurring in physics classes (Sagala et al., 2019b; Tanti et al., 2017) non-equivalent control group design with samples were senior high school students grade XI at SMAN 1 Jambi City. The research used the Colorado Learning Atttudes About Science Survey (CLASS). They are more likely to memorize than to understand the concepts (Maharani et al., 2019).

In this case, physics teachers should emphasize the students' understanding of the concepts based on the knowledge acquired in the previous level to the next (Widayanti et al., 2018; Yulianti & Gunawan, 2019; Lestari et al., 2017; Wahyuningsih, 2014). The use of varied learning model is needed (Saregar et al., 2018) in order to

***Correspondence Address**
E-mail: ruhbanmaskur@radenintan.ac.id

be an intermediary so that the material taught could be understood by students (Pitan & Atiku, 2017; Sagala et al.,2019a; Widayanti & Yuberti, 2018; Yıldırım & Akamca, 2017) it is crucial for undergraduates to be more pro-active about their future careers. This study investigates the structural influence of career guidance activities on university students' employability in Nigeria. Data was collected from 600 final-year undergraduates from four universities in the South-West geopolitical zone, with the use of an adapted questionnaire. The quantitative data were subjected to exploratory and confirmatory factor analysis to ensure factorial validity of the research instrument, and subsequently Structural Equation Modelling (SEM). Furthermore, at the final stage, it is expected to increase the students' mastery of the concepts (Saregar, 2016).

Some of the research results showed that conceptual understanding is fundamental in learning since concept mastery is the key to solve even the hardest problem (Alan & Afriansyah, 2017; Surosos, 2016). Many learners do not attain favorable learning outtakes. They are not aware of efficient and effective ways of learning because they only try to memorize lessons while Physics does not mean to be memorized as it requires reasoning and understanding of the concept (Lestari et al., 2017; Yuberti et al., 2019). As a result, if they are given a test, the learners will have difficulties (Yolanda et al., 2016). Therefore, conceptual understanding is highly required for the learners to get proper learning outcomes.

Many researchers have conducted many ways to improve students' conceptual understanding. One of which is through learning models and one of the learning models that has been proven in improving students' conceptual understanding is the constructivism (Balta & Sarac, 2016). There are various types of constructivism learning models, such as problem-solving, mind mapping, and 7E learning cycle. In this research, the 7E Learning Cycle model was selected since it provides chances for learners to build their knowledge (Febriana et al., 2014).

7E Learning Cycle model is the improvement of the 5E Learning Cycle model (Ghaliyah et al., 2015). The cycles of the applied learning model are emphasized in the understanding of the scientific physics concepts and misconception correction. Furthermore, it is also expected to be able to ameliorate the students' memorization process that is focused on the knowledge and knowledge transfer (Balta & Sarac, 2016). The learning cycle Approach (LCA) is a model that is deemed adequate for physics students (Olaoluwa & Olufunke, 2015) as it can help them to elaborate their understanding of certain aspects of scientific research (Hodson, 2014; Putra et al., 2018). One of the physics materials that is considered quite difficult for students to understand is temperature and heat (Sayyadi et al., 2016).

The constructivism basis of the 7E Learning Cycle possesses some weaknesses and strengths. One of the notable strengths of the 7E Learning Cycle is its ability to encourage the students to be active and think maximally to acquire the knowledge. On the other hand, the weakness of the 7E Learning Cycle is the length of time needed as the students are trained to explore their knowledge, and they are also given enough freedom to express their ideas. In order to minimize the weakness of this model, proper preparation is certainly required by the teacher acting as a facilitator (Rawa et al., 2016).

The previous researchers showed that the learning cycle could be used to enhance learners' understanding (Nurmalasari et al., 2014) and learning achievement (Sumiyati et al., 2016). Conceptual understanding means expressing the materials learned into a simplified version to overcome the problems of the interconnected concept. The cognitive process of conceptual understanding consists of interpreting, modeling, classifying, summarizing, predicting, comparing, and explaining (Setyawati et al., 2014). One of the factors that determine the learning process outcome is the students' achievements measured by how much they can master the learning material (Parasamya et al., 2017).

There are some distinctions between this research and the previous ones. Firstly, there is an elaboration of each of the seven prescribed stages of the 7E Learning Cycle model implementation, exposing the pupils' level of understanding presented in the discussion. Besides, this study uses different learning materials, namely temperature and heat, which is very suitable for the object of measuring concept understanding (Damar, 2013). Then, the learning circumstances of this research are also relatively different.

The learning cycle is a learning model centered on learners (Balta & Sarac, 2016). It comprises a series of activities arranged in such a way that learners could master the established competencies in learning with an active role (Ngalimun, 2014; Ratiyani et al., 2014). The 5E Learning Cycle as five stages that consist of Engagement, Exploration, Explanation, Elaboration, and Evaluation. Besides the teaching Model, teaching Material is also required. Teaching Material is a material of learning that is constructed systema-

tically and used by teacher in learning process. The teaching Material could be combined with Technology Information and Communication in order to be a digital teaching Material. The aim of the research is to understand the digital teaching material development and also to check the improvement of students' study result and the result of study after using digital teaching material and its application in Learning Cycle 5E. The Result of the research shows that the validation test result which uses three validators, shows that 51.6% is in Very Good Category. The students' result study activity average was 71% in the first meeting and 79.5% in the second meeting. While the average score of the study result of student was 78.13 in the first meeting and 82,00 in the second meeting. The learning cycle in the classroom practice focuses on the experience and knowledge of the early learners (Ghaliyah et al., 2015). Is sum, in attaining well-organized students' concept, an organized procedure is needed.

The learning cycle model has been developed from 3E (Exploration, Explanation, Elaboration), 5E (Engagement, Exploration, Explanation, Elaboration, and Evaluation), and 7E (Elicit, Engage, Explore, Explain, Elaborate, Extend, and Evaluate). Some studies suggest that the 7E learning cycle can foster motivation and learning achievement (Febriana et al., 2014; Sumiyati et al., 2016), improve language comprehension (Balta & Sarac, 2016), is sufficient to achieve goals quickly (Bozorgpouri, 2016), improve the ability of mathematical connections (Rawa et al., 2016), and foster conceptual understanding (Nurmalasari et al., 2014). Thus, the researchers consider it is necessary to conduct research to see the effectivity of the 7E Learning Cycle in improving the students' conceptual understanding of the temperature and heat topic.

The results of the earlier quantitative and qualitative research on the understanding of the thermal concepts and phenomena showed that the majority of children do not master the concepts and the related phenomena even after receiving formal instruction on these subjects (Karabulut & Bayraktar, 2018). There is a confusion between the concepts "heat" and "temperature," and often they think that temperature is a measure of the heat.

Temperature is an intrinsic property of matter; it is hot and cold objects by nature. The warm and the cold are two separate entities, all materials if placed protractedly in an environment will reach the same temperature. Confusion with the meaning of words like 'heat', 'heat flow' or 'heat capacity', mixing hot and cold water has led to correct qualitative judgments but incorrect quantitative judgements, and difficulty in explaining how a thermometer works (Gönen & Kocakaya, 2009; Kampeza et al., 2016; Ravanis, 2013).

METHODS

Design of Study

The design used in this research was Quasi-experimental with *Non-equivalent Control Class Design* (Suharsimi, 2010; Sugiyono, 2010; Tanti et al., 2017). The research was conducted at the X IPA 1 and X IPA 2 class of SMAN 1 Kotabumi, North Lampung. The study was implemented in three phases (pre-test, teaching interventions in an experimental group and a control group, and post-test). The data of the study consisted of student responses to objective tests in the form of reasoned-multiple choices, which are able to show the characteristics of students' conceptual understanding (Pratiwi, 2016) and the ability of students to answer the question. Before the instruments were used, the questions were tested to find out the validity level, reliability, difficulty level, discriminating power, and destruction functions.

The subject of this research was learners of grade X IPA in SMA Negeri 1 Kotabumi (amounted to 240 students). Employing the cluster random sampling technique, the researchers chose 80 students from class X IPA 1 and X IPA 2.

The samples of this research were male and female students (age range 15-16 years old). The chosen students had similar socio-economic characteristics and were randomly split into two groups, thus forming the experimental class (hereafter E.C.) and control class (hereafter C.C.), respectively.

Teaching Interventions (The Experimental Class)

The learning stage of 7E Learning Cycle can be seen in Figure 1.

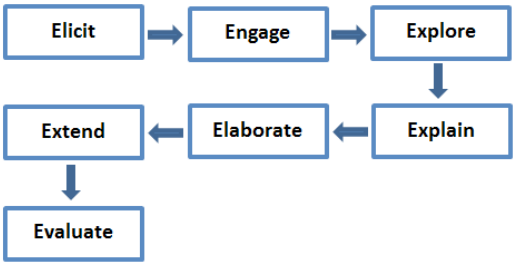


Figure 1. The Stages of the 7E Learning Cycle

Researchers applied the seven stages of the 7E Learning Cycle model during the teaching and learning activity. The first stage was Elicit to raise the student's initial knowledge by asking questions as displayed in Figure 2.

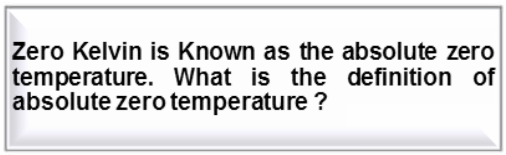


Figure 2. The First Stage: Elicit.

The second stage was to Engage. It was involving the students with the surrounding events related to the temperature material by carrying out the demonstration, as displayed in Figure 3.

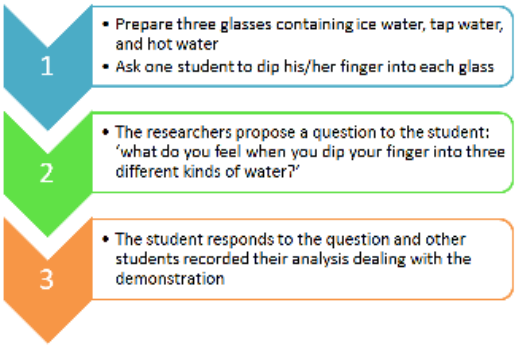


Figure 3. The Second Stage: Engage

The third stage was to Explore. This was the stage of collecting information. The procedure can be observed in the following Figure 4.

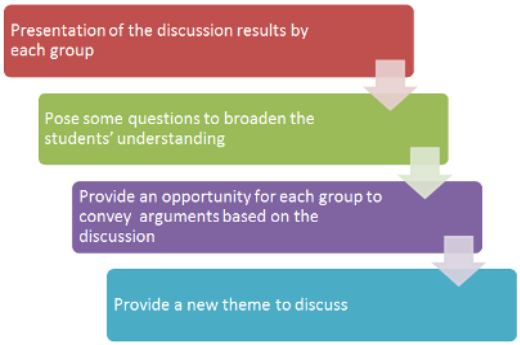


Figure 4. The Third Stage: Explore

It was expected that based on the information-gathering stage, the students were able to grasp the materials in detail.

The fourth stage was to Explain. The students were required to explain the results of the discussion by using their way to understand the material indicating the level of student' understanding, has appeared in the following Figure 5.

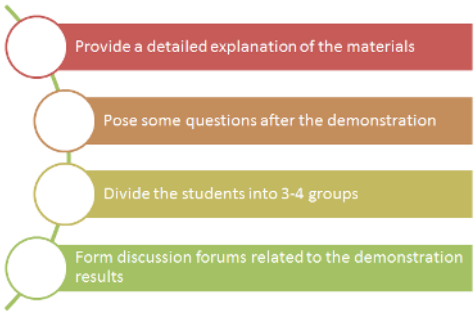


Figure 5. The Fourth Stage: Explain

The fifth stage was Elaborate. Elaborate was the proficiency stage for the researchers and the students to connect previously learned concepts with daily life. It can be seen in Figure 6.

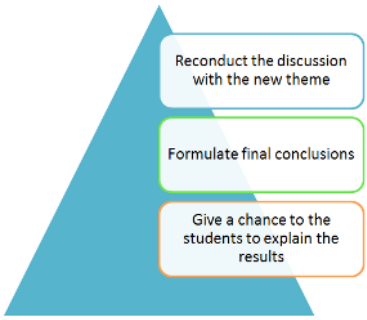


Figure 6. The Fifth Stage: Elaborate

In this stage, the students re-conducted the discussion to acquire new findings in order to overcome different problems and concepts and to produce the correct and clear conclusion.

The sixth stage was to Extend. The students' findings was extended to enable them to be more active and interested in searching for new concepts, as displayed in Figure 7.

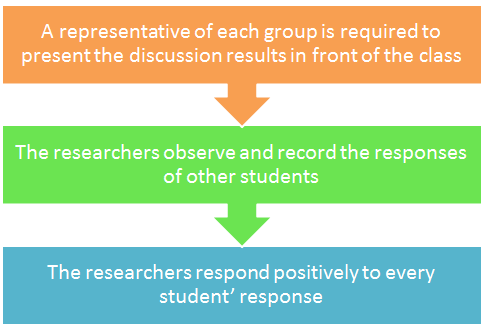


Figure 7. The Sixth Stage: Extend

The seventh stage was to Evaluate. The students were given opportunities to conclude everything related to the materials that had been studied. Then, an evaluation was carried out to obtain a profound understanding of the con-

cept of the temperature by giving the task to the students. One of the conceptual understanding problems can be viewed in the following Figure 8.

Look at the following Images:

The three containers are filled with liquid and heated with the same amount of heat. If the volume of each liquid is the same, and the density is different, namely $\rho_1 < \rho_2 < \rho_3$. Then the correct statement regarding the temperature rise is ...

a. Figure 1 has the most significant temperature rise
b. Figure 2 has the most significant temperature rise
c. Figure 3 has the most significant temperature rise
d. Figure 1 has the lowest temperature rise
e. Figure 2 has the lowest temperature rise

Figure 8. The Seventh Stage: Evaluate

In the final step of the seventh stage, the researcher conveyed information about the next materials that will be studied so the students should learn before the materials are delivered.

The learning process through the 7E Learning Cycle requires time accuracy considering its numerous stages. Time is one of the key factors in implementing this learning model. Furthermore, to achieve the learning objectives, this learning model should be done in complete seven stages. If only two stages were done or a stage is skipped, then the implementation of this learning model will not be optimum.

Teaching Interventions (The Control Class)

The learning process in the control class was conducted using Direct Learning Model, which is commonly used by physics teachers. The researcher only delivered the lesson by writing the materials on the whiteboard. The whole process of learning was focused on the teacher/researcher (teacher center). The students responded passively and only listened to the researcher explained. It resulted in a lack of conceptual understanding; consequently, the students faced difficulty in solving some of the physics problems on the topic.

Based on the research design presented, we formulated two research problems: (1) how is the experimental class students' understanding of the thermal concept compared to the control class students'?; and (2) how is both groups' progress after the two educational interventions are performed?

The students' understanding of the concepts were measured through pre-test and post-test using objective test in the form of reasoned-multiple choices. Each test consisted of 15 items. Since the original version of the tests was the only multiple-choice format, then modification was carried out by asking the students to provide a reason for choosing the answer.

To go into the effectiveness of learning toward the learners' mastery of the concepts, the Effect Size test was used. It is a measurement to determine the effect of one variable on another. The effect Size can be counted using a particular formula (Cohen, 1998), and further explanation of it is also available (Anwar et al., 2019; Hake, 1998).

$$d = \frac{m_A - m_B}{\left[\frac{sd_A^2 + sd_0^2}{2}\right]^{1/2}}$$

Definition:

d = *effect size*
m_A = mean gain of the experimental class
m_B = mean gain of the control class
sd_A = standard deviation of experimental class
sd_B = standard deviation of the control class

The value of Effect Size can be seen in Table 1, as follows.

Table 1. Effect Size Criteria

Effect Size	Category
$d < 0.2$	Low
$0.2 \leq d < 0.8$	Average
$d \geq 0.8$	High

RESULTS AND DISCUSSION

The data display of pre-test and post-test score recapitulation of the control and experimental class can be seen in Table 2.

The pretest and posttest shown in Table 2 were measured through a multiple-choice test (example figure 8). The scores measured in this study included cognitive scores according to the blooms' taxonomy comprising cognitive 2, 3, 4, and 5 (C2, C3, C4, C5). There were seven indicators of conceptual understanding applied in this

study. Table 2 indicates the outcomes of conceptual understanding tests in each indicator change. On the Interpreting, the highest and lowest scores in the experimental and the control class experienced an elevation, both as a result of pretest and posttest. Nonetheless, the highest and lowest scores in the experimental class were higher compared to the scores in the control class.

Table 2. The Pre-Test and Post-Test Score of the Control and Experimental Class

Indicator of Conceptual Understanding	Pretest				Posttest			
	Experimental Class*		Control Class**		Experimental Class*		Control Class**	
	Highest Score	Lowest Score	Highest Score	Lowest Score	Highest Score	Lowest Score	Highest Score	Lowest Score
Interpreting	71	41	70	40	95	72	83	62
Modeling	72	40	70	38	94	70	80	63
Predicting	70	35	69	32	89	65	82	60
Explaining	70	32	68	30	90	66	80	61
Classifying	65	31	64	29	97	62	79	58
Comparing	64	30	62	28	94	68	78	59
Summarizing	62	31	60	30	92	66	78	57
The Highest and Lowest Total Score	474	240	463	227	651	469	560	420
The Highest and Lowest Average Score	68	34	66	32	93	67	80	60
Total Score	1.986,4		1.880		3.113,2		2.820	
Number of Students	40		40		40		40	
Total Average Score	49.66		47		77.83		70.5	

*Learning cycle 7e model **Conventional model

On the Modeling, the highest and lowest scores in the experimental and the control class experienced an increase, both the results of the pretest and posttest. However, the highest and lowest scores in the experimental class were higher than the scores in the control class. This significant increase was obtained from the results of Independent-Sample T-test that is shown in Table 3.

Table 3. The Independent-Sample T-Test Results

Independent-Sample T-Test	Pretest	Posttest
Criteria	Sig.(2-tailed) > 0.05	Sig.(2-tailed) < 0.05
Sig. (2-tailed)	0.229	0.000
Decision	H_o is accepted	H_a is accepted

Table 3 informs that in the pretest, we got Sig. (2-tailed) of 0,229. It means Sig. (2-tailed) > 0,05; thus, the average pretest scores in the experimental class was equal to the average pretest scores in the control class. Furthermore, based on posttest results, we got Sig. (2-tailed) of 0,000, it means the average pretest scores in the experimental class was not equal to the average pretest scores in the control class.

On the Predicting, the highest and lowest scores in the experimental and the control class experienced an enhancement at both the results of the pretest and posttest. However, the highest and lowest scores in the experimental class were greater than the scores in the control class.

On the Explaining, the highest and lowest scores in the experimental class and the control class experienced an increase, both the results of the pretest and posttest. Nevertheless, the highest and lowest scores in the experimental class are higher than the scores in the control class.

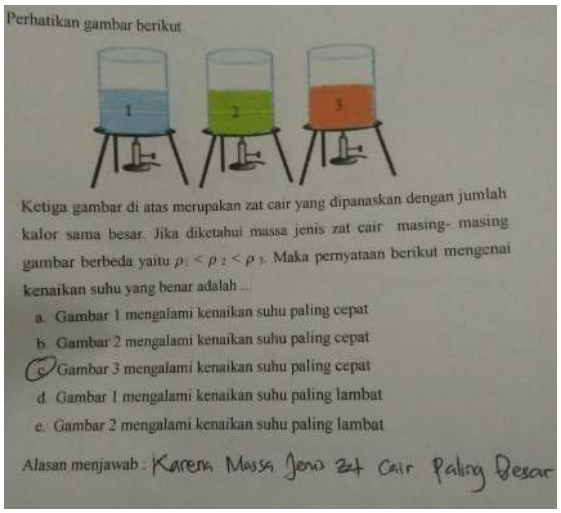
On the Classifying, the highest and lowest scores in the experimental cand the control class experienced an upswing, both the results of the pretest and posttest. However, the highest and lowest scores in the experimental class were higher than the scores in the control class.

On the Comparing, the highest and lowest scores in the experimental class and the control class experienced an increase, both the results of the pretest and posttest. Nevertheless, the highest and lowest scores in the experimental class were higher than the scores in the control class.

On the Summarizing, the highest and lowest scores in the experimental class and the control class experienced an increase, both the

results of the pretest and posttest. However, the highest and lowest scores in the experimental class were more significant than the scores in the control class.

In general, the results of concept understanding tests on each indicator experienced an increase in both the experimental class and the control class. Yet, before applying the 7E Learning Cycle, there was no notable difference of the experimental class learners' understanding of the concepts. Nonetheless, after the implementation of the 7E Learning Cycle model, the scores of the experimental class students were significantly improved. Based on the analysis result of each student's answers, their conceptual understanding had not been trained when answering the conceptual questions in the form of multiple choices when they chose the answer (Figure 9). The results changed after applying the 7E Learning Cycle and the conventional model, as there were significant differences between the conceptual understanding of the experimental and the control class. The answer of experimental class students was more appropriate than the control class students (Figure 10).

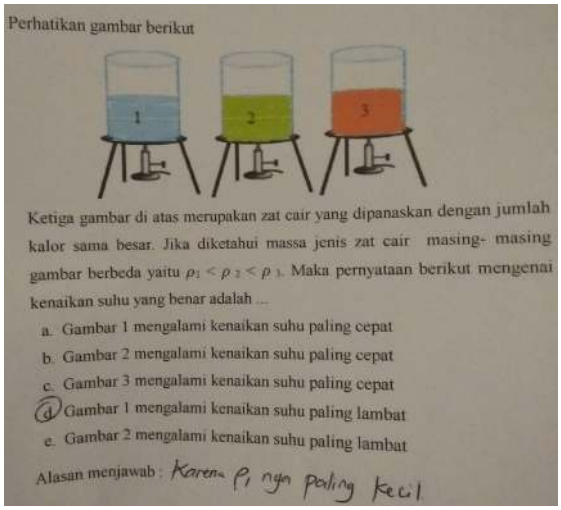

Perhatikan gambar berikut

Ketiga gambar di atas merupakan zat cair yang dipanaskan dengan jumlah kalor sama besar. Jika diketahui massa jenis zat cair masing- masing gambar berbeda yaitu $\rho_1 < \rho_2 < \rho_3$. Maka pernyataan berikut mengenai kenaikan suhu yang benar adalah ...

a. Gambar 1 mengalami kenaikan suhu paling cepat
b. Gambar 2 mengalami kenaikan suhu paling cepat
c. Gambar 3 mengalami kenaikan suhu paling cepat
d. Gambar 1 mengalami kenaikan suhu paling lambat
e. Gambar 2 mengalami kenaikan suhu paling lambat

Alasan menjawab : Karena Massa Jenis Zat Cair Paling Besar

(a) The 7E Learning Cycle


Perhatikan gambar berikut

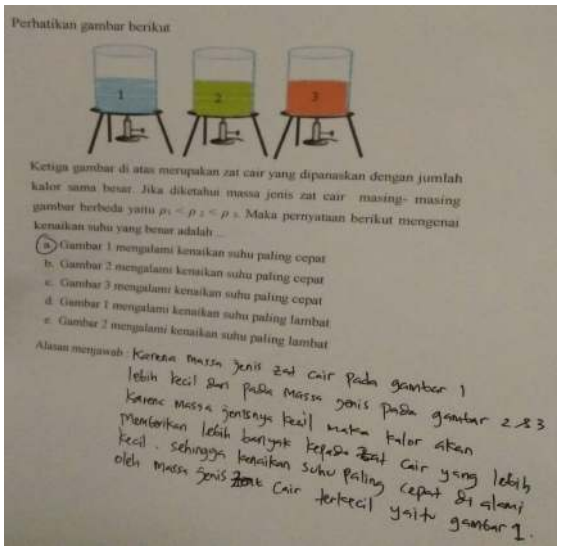
Ketiga gambar di atas merupakan zat cair yang dipanaskan dengan jumlah kalor sama besar. Jika diketahui massa jenis zat cair masing- masing gambar berbeda yaitu $\rho_1 < \rho_2 < \rho_3$. Maka pernyataan berikut mengenai kenaikan suhu yang benar adalah ...

a. Gambar 1 mengalami kenaikan suhu paling cepat
b. Gambar 2 mengalami kenaikan suhu paling cepat
c. Gambar 3 mengalami kenaikan suhu paling cepat
d. Gambar 1 mengalami kenaikan suhu paling lambat
e. Gambar 2 mengalami kenaikan suhu paling lambat

Alasan menjawab : Karena Pi nya paling kecil

(b) The Conventional Model

Figure 9. The Student Answer before the Implementation of the 7E Learning Cycle and the Conventional Model

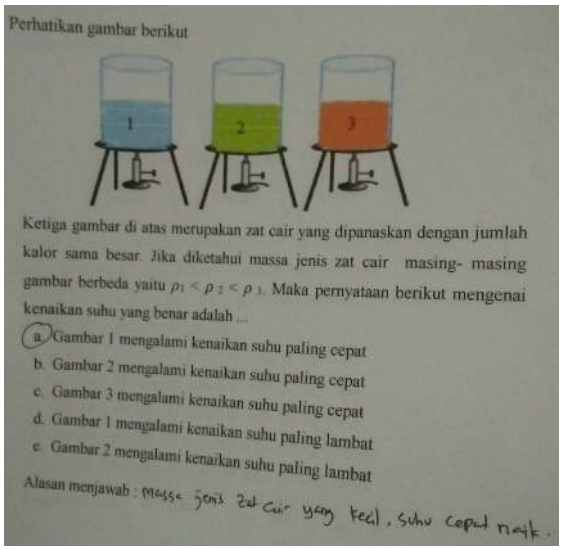

Perhatikan gambar berikut

Ketiga gambar di atas merupakan zat cair yang dipanaskan dengan jumlah kalor sama besar. Jika diketahui massa jenis zat cair masing- masing gambar berbeda yaitu $\rho_1 < \rho_2 < \rho_3$. Maka pernyataan berikut mengenai kenaikan suhu yang benar adalah ...

a. Gambar 1 mengalami kenaikan suhu paling cepat
b. Gambar 2 mengalami kenaikan suhu paling cepat
c. Gambar 3 mengalami kenaikan suhu paling cepat
d. Gambar 1 mengalami kenaikan suhu paling lambat
e. Gambar 2 mengalami kenaikan suhu paling lambat

Alasan menjawab : Karena massa jenis zat cair pada gambar 1 lebih kecil dari pada massa jenis pada gambar 2 & 3 karena massa jenisnya kecil maka kalor akan memberikan lebih banyak kepada zat cair yang lebih kecil. sehingga kenaikan suhu paling cepat di alami oleh massa jenis zat cair terkecil yaitu gambar 1.

(a) The 7E Learning Cycle


Perhatikan gambar berikut

Ketiga gambar di atas merupakan zat cair yang dipanaskan dengan jumlah kalor sama besar. Jika diketahui massa jenis zat cair masing- masing gambar berbeda yaitu $\rho_1 < \rho_2 < \rho_3$. Maka pernyataan berikut mengenai kenaikan suhu yang benar adalah ...

a. Gambar 1 mengalami kenaikan suhu paling cepat
b. Gambar 2 mengalami kenaikan suhu paling cepat
c. Gambar 3 mengalami kenaikan suhu paling cepat
d. Gambar 1 mengalami kenaikan suhu paling lambat
e. Gambar 2 mengalami kenaikan suhu paling lambat

Alasan menjawab : massa jenis zat cair yang kecil. suhu cepat naik.

(b) The Conventional Model

Figure 10. The Student Answer after the Application of the 7E Learning Cycle and the Conventional Model

In addition to the cognitive score results, the management of learning is also the key to the learning model's successful implementation. The following is an explanation of the learning management in this study.

Learning Management

The scoring percentage given by the physics teacher while the researcher was applying the learning model can be seen in the following figure 11.

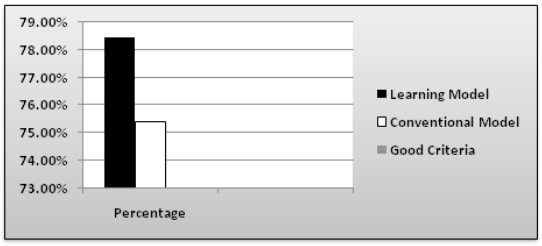


Figure 11. Graphic Percentage of Learning Management

Based on Figure 11, the gain percentage showed that the learning management through 7E Learning Cycle was 78.46% compared to the conventional learning which amounted to 75.38%. The percentage fell into satisfying criteria, and this improvement occurred due to sistematic implementation of the 7E Learning Cycle by the teacher. In the class where the 7E Learning Cycle was applied, the teacher started the lesson by eliciting knowledge and involving students through engaging demonstrations. In the Elicit step, the students responded enthusiastically when the teacher gave a question to raise students' initial knowledge. They were willing to present the answer in front of the class and thus brought about the impact of an active classroom atmosphere at the beginning of the learning process. In the class where the conventional model was applied, the teacher started the lesson by psychologically preparing the students through stories without demonstrations or involving the students.

The core activity in the 7E Learning Cycle began with the grouping to discuss the continuation of the demonstration by changing the object of the demonstration and discussion to find solutions to the questions given by the teacher (Explore). Then, each group conducted a presentation by explaining the results of the discussion (Explain). On the other hand, the teacher gave feedback to each group to expand the discussion materials in the group through question and answer between groups (Elaborate & Extend). In the class applying the conventional model, the core activity began with the teacher explaining the materials then forming a group to observe events related to the materials in daily life. Next, the students were asked to communicate the materials through assignments.

The closing activity in the 7E Learning Cycle was asking each group to conclude the discussion results, and the teacher concluded the overall results of the discussion. Diversely, the closing activity in the conventional learning was giving homework.

Based on the learning management description, the 7E Learning Cycle is student-centered while the teacher only acts as a facilitator. Contrarily, the conventional model is still teacher-centered. Thus, the 7E Learning Cycle is in line with the current 2013 curriculum applied in Indonesia which emphasizes student-centered learning. Other countries such as Finland, England, the United States, and other developed countries also implement student-centered learning, which is more effective than teacher-centered learning.

The effectiveness of the learning model implementation was analyzed with effect size formula. A further description is presented in Table 3.

Table 4. The Results of Effect Size

Class	Mean Gain	Standard Deviation	Effect Size	Category
Experimental	28.17	36.64	0.5	Average
Control	23.50	137.72		

Table 4 shows that the gain of effect size was 0.5 and belonged to the average category. This shows that the use of the 7E Learning Cycle model could effectively improve the students' understanding of Physics concepts.

Based on the recapitulation of the post-test scores, the students' conceptual understanding, in both the experimental and the control class, increased significantly. This might be caused by the fact that the 7E Learning Cycle model has such distinctive characteristics that the students not only listen to the teachers but can also play an active role in exploring and enriching their comprehension of the concepts studied.

The importance of conceptual understanding in school requires researchers to use various ways to analyze it including: (1) the use of interactive multimedia (Husein et al., 2017); (2) the realization of the 7E Learning Cycle for junior

high school students (Nurmalasari et al., 2014); (3) the utilization of PhET Simulation (Saregar, 2016); (4) the application of guided inquiry learning model (Setyawati et al., 2014); (5) the application of experiential learning models (Wahyuningsih, 2014); and (6) the use of TTCI and CRI instruments (Yolanda et al., 2016).

This study supports Nurmalasari et al.'s (2014) research that the 7E Learning Cycle could improve students' conceptual understanding. In the study, the 7E Learning Cycle was applied to the junior high school students, but in this study, it was applied to senior high schools students. It means that the model could improve both junior and senior high school students' conceptual understanding.

CONCLUSION

In short, the use of the 7E Learning Cycle is successful in enhancing students' conceptual understanding. In other words, the learning process through 7E Learning Cycle Model is more effective compared to the conventional model in escalating the students' concept understanding, especially on temperature and heat topic. This is because each learning process truly integrates the seven stages of the 7E Learning Cycle with the seven indicators that must be achieved.

REFERENCES

Alan, U. F., & Afriansyah, E. A. (2017). Kemampuan Pemahaman Matematis Siswa melalui Model Pembelajaran Auditory Intellectualy Repetition dan Problem Based Learning. *Jurnal Pendidikan Matematika*, *11*(1), 68–78.

Anwar, C., Saregar, A., Yuberti, Zellia, N., Widayanti, Diani, R., & Wekke, I. S. (2019). Effect Size Test of Learning Model ARIAS and PBL : Concept Mastery of Temperature and Heat on Senior High School Students. *Eurasia Journal of Mathematics, Science and Technology Education*, *15*(3), 1–9.

Balta, N., & Sarac, H. (2016). The Effect of 7E Learning Cycle on Learning in Science Teaching: A Meta-Analysis Study. *European Journal of Educational Research*, *5*(2), 61-72.

Bozorgpouri, M. (2016). The Study of Effectiveness of Seven-Step (7E) Teaching Method in the Progress of English Learning in Students Shiraz City. *The Turkish Online Journal of Design, Art and Communication*, *6*(2016), 341–346.

Cohen, J. (1998). *Statistical Power Analysis for the Behavioral Sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Damar, S. Y. (2013). *The Effect of the Instruction Based on the Epistemologically and Metacognitively Improved 7E Learning Cycle on Tenth Grade Students' Achievement and Epistemological Understandings in Physics* (Thesis, The Graduate School of Natural and Applied Sciences of Middle East Technical University). Retrieved from http://etd.lib.metu.edu.tr/upload/12615646/index.pdf

Febriana, E., Wartono, & Asim. (2014). Efektivitas Model Pembelajaran Learning Cycle 7E Disertai Resitasi terhadap Motivasi dan Prestasi Belajar Siswa Kelas XI MAN 3 Malang. *Jurnal Online Universitas Negeri Malang*, *2*(1), 1–13.

Ghaliyah, S., Bakri, F., & Siswoyo, S. (2015, October). Pengembangan Modul Elektronik Berbasis Model Learning Cycle 7E pada Pokok Bahasan Fluida Dinamik untuk Siswa SMA Kelas XI. In *Prosiding Seminar Nasional Fisika (E-Journal)* (Vol. 4, pp. SNF2015-II).

Gönen, S., & Kocakaya, S. (2009). A Cross-Age Study on the Understanding of Heat and Temperatures. *Eurasian Journal of Physics and Chemistry Education, 2*(1), 1-15.

Hake, R. R. (1998). Interactive-Engagement Versus Traditional Methods: A Six-Thousand-Student Survey of Mechanics Test Data for Introductory Physics Courses. *American journal of Physics*, *66*(1), 64-74.

Hodson, D. (2014). Learning Science, Learning about Science, Doing Science: Different Goals Demand Different Learning Methods. *International Journal of Science Education*, *36*(15), 2534-2553.

Husein, S., Herayanti, L., & Gunawan, G. (2017). Pengaruh Penggunaan Multimedia Interaktif terhadap Penguasaan Konsep dan Keterampilan Berpikir Kritis Siswa pada Materi Suhu dan Kalor. *Jurnal Pendidikan Fisika dan Teknologi*, *1*(3), 221-225.

Kampeza, M., Vellopoulou, A., Fragkiadaki, G., & Ravanis, K. (2016). The Expansion Thermometer in Preschoolers' Thinking. *Journal of Baltic Science Education*, *15*(2), 185–193.

Karabulut, A., & Bayraktar, Ş. (2018). Effects of Problem Based Learning Approach on 5th Grade Students' Misconceptions about Heat and Temperature. *Journal of Education and Practice, 9*(33), 197- 206.

Latifah, S., Susilowati, N. E., Khoiriyah, K., & Rahayu, R. (2019, February). Self-Efficacy: Its Correlation to the Scientific-Literacy of Prospective Physics Teacher. In *Journal of Physics: Conference Series* (Vol. 1155, No. 1, p. 012015). IOP Publishing.

Lestari, P. A. S., Rahayu, S., & Hikmawati, H. (2017). Profil Miskonsepsi Siswa Kelas X SMKN 4 Mataram pada Materi Pokok Suhu, Kalor, dan Perpindahan Kalor. *Jurnal Pendidikan Fisika dan Teknologi*, *1*(3), 146-153.

Maharani, L., Rahayu, D. I., Amaliah, E., Rahayu, R., & Saregar, A. (2019, February). Diagnostic Test with Four-Tier in Physics Learning: Case of Misconception in Newton's Law Material. In *Journal of Physics: Conference Series* (Vol. 1155,

No. 1, p. 012022). IOP Publishing.

Ngalimun, N. (2014). *Strategi dan Model Pembelajaran*. Yogyakarta: Aswaja Pessindo.

Nurmalasari, R., Kade, A., & Kamaluddin. (2014). Pengaruh Model Learning Cycle Tipe 7E terhadap Pemahaman Konsep Fisika Siswa Kelas Vii SMP Negeri 19 Palu. *Jurnal Pendidikan Fisika Tadulako (JPFT)*, *1*(2), 2–7.

Olaoluwa, A. M., & Olufunke, T. B. (2015). Relative Effectiveness of Learning-Cycle Model and Inquiry-Teaching Approaches in Improving Students ' Learning Outcomes in Physics. *Journal of Education and Human Development*, *4*(3), 169–180.

Parasamya, C. E., Wahyuni, A., & Hamid, A. (2017). Upaya Peningkatan Hasil Belajar Fisika Siswa melalui Penerapan Model Pembelajaran Problem Based Learning (PBL). *Jurnal Ilmiah Mahasiswa Pendidikan Fisika*, *2*(1), 42-49.

Pitan, O. S., & Atiku, S. O. (2017). Structural Determinants of Students' Employability: Influence of Career Guidance Activities. *South African Journal of Education*, *37*(4), 1–13.

Pratiwi, H. Y. (2016). Pengembangan Instrumen Tes Pilihan Ganda untuk Mengidentifikasi Karakteristik Konsep Termodinamika Mahasiswa Prodi Pendidikan Fisika Universitas Kanjuruhan Malang. *Jurnal Inspirasi Pendidikan*, *6*(2), 842-850.

Pratiwi, N. W., & Supardi, Z. A. I. (2014). Penerapan Model Pembelajaran Learning Cycle 5E pada Materi Fluida Statis Siswa Kelas X SMA. *Jurnal Inovasi Pendidikan Fisika (JIPF)*, *03*(02), 143–148.

Putra, F., Nurkholifah, I. Y., Subali, B., & Rusilowati, A. (2018). 5E-Learning Cycle Strategy: Increasing Conceptual Understanding and Learning Motivation. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, *7*(2), 171–181.

Ratiyani, I., Subchan, W., & Hariyadi, S. (2014). Pengembangan Bahan Ajar Digital dan Aplikasinya dalam Model Siklus Pembelajaran 5E (Learning Cycle 5E) Terhadap Aktivitas dan Hasil Belajar (Siswa Kelas VII Di SMP Negeri 10 Probolinggo Tahun Pelajaran 2012/2013). *Pancaran Pendidikan*, *3*(1), 79–88.

Ravanis, K. (2013). Mental Representations and Obstacles in 10-11 Year Old Children's Thought Concerning the Melting and Coagulation of Solid Substances in Everyday Life. *Preschool and Primary Education*, *1*(2013), 130-137.

Rawa, N. R., Sutawidjaja, A., & Sudirman, S. (2016). Pengembangan Perangkat Pembelajaran Berbasis Model Learning Cycle-7e pada Materi Trigonometri untuk Meningkatkan Kemampuan Koneksi Matematis Siswa. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *1*(6), 1042-1055.

Sagala, R., Sari, P. M., Firdaos, R., & Amalia, R. (2019a). RQA and TTW Strategies : Which Can Increase the Students ' Concepts Understanding ? *Tadris: Jurnal Keguruan Dan Ilmu Tarbiyah*, *4*(1), 87–96.

Sagala, R., Umam, R., Thahir, A., Saregar, A., & Wardani, I. (2019b). The Effectiveness of STEM-Based on Gender Differences: The Impact of Physics Concept Understanding. *European Journal of Educational Research*, *8*(3), 753–761.

Saregar, A. (2016). Pembelajaran Pengantar Fisika Kuantum dengan Memanfaatkan Media PhET Simulation dan LKM melalui Pendekatan Saintifik : Dampak Pada Minat dan Penguasaan Konsep Mahasiswa. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, *5*(1), 53–60.

Saregar, A., Irwandani, I., Abdurrahman, A., Parmin, P., Septiana, S., Diani, R., & Sagala, R. (2018). Temperature and Heat Learning Through SSCS Model with Scaffolding : Impact on Students ' Critical Thinking Ability. *Journal for the Education of Gifted Young Scientists*, *6*(3), 39–54.

Sayyadi, M., Hidayat, A., & Muhardjito, M. (2016). Pengaruh Strategi Pembelajaran Inkuiri Terbimbing dan Terhadap Kemampuan Pemecahan Masalah Fisika pada Materi Suhu dan Kalor Dilihat dari Kemampuan Awal Siswa. *Jurnal Inspirasi Pendidikan*, *6*(2), 866-875.

Setyawati, N. W. I., Candiasa, I. M., Kom, M. I., & Yudana, I. M. (2014). Pengaruh Model Pembelajaran Inkuiri Terbimbing terhadap Pemahaman Konsep dan Keterampilan Proses Sains Siswa Kelas XI IPA SMA Negeri 2 Kuta Kabupaten Badung. *Jurnal Administrasi Pendidikan Indonesia*, *5*(1), 1-9.

Sugiyono, D. (2010). *Metode Penelitian Kuantitatif Kualitatif dan R dan D*. Bandung: Alfabeta.

Suharsimi, A. (2010). *Prosedur Penelitian, Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.

Sumiyati, Y., Sujana, A., & Djuanda, D. (2016). Penerapan Model Learning Cycle 7E untuk Meningkatkan Hasil Belajar Siswa pada Materi Proses Daur Air. *Jurnal Pena Ilmiah*, *1*(1), 41-50.

Surosos, S. (2016). Analisis Kesalahan Siswa dalam Mengerjakan Soal-Soal Fisika Termodinamika pada Siswa SMA Negeri 1 Magetan. *Jurnal Edukasi Matematika dan Sains*, *4*(1), 8-18.

Tanti, T., Jamaluddin, J., & Syefrinando, B. (2017). Pengaruh Pembelajaran Berbasis Masalah terhadap Beliefs Siswa tentang Fisika dan Pembelajaran Fisika. *Jurnal Ilmiah Pendidikan Fisika Al-Biruni*, *6*(1), 23–36.

Wahyuningsih, D. (2014). Motivasi Belajar dan Pemahaman Konsep Fisika Siswasmk dalam Pembelajaran Menggunakan Model Experiential Learning. *Jurnal Pendidikan Fisika Indonesia*, *4*(2), 63-66.

Widayanti, W., & Yuberti, Y. (2018). Pengembangan Alat Praktikum Sederhana sebagai Media Praktikum Mahasiswa. *JIPFRI (Jurnal Inovasi Pendidikan Fisika Dan Riset Ilmiah)*, *2*(1), 21-27.

Widayanti, W., Yuberti, Y., Irwandani, I., & Hamid, A. (2018). Pengembangan Lembar Kerja Praktikum Percobaan Melde Berbasis Project Based Learning. *Jurnal Pendidikan Sains Indonesia (In-*

donesian Journal of Science Education), *6*(1), 24-31.

Yıldırım, G., & Akamca, G. Ö. (2017). The Effect of Outdoor Learning Activities on the Development of Preschool Children. *South African Journal of Education*, *37*(2), 1–10.

Yolanda, R. Syuhendri, & Andriani, N.(2016). Analisis Pemahaman Konsep Siswa SMA Negeri Se-Kecamatan Ilir Barat I Palembang pada Materi Suhu dan Kalor dengan Instrumen TTCI dan CRI. *Jurnal Inovasi Dan Pembelajaran Fisika*, *3*(1), 1-13.

Yuberti, Latifah, S., Anugrah, A., Saregar, A., Misbah, & Jermsittiparsert, K. (2019). Approaching Problem-Solving Skills of Momentum and Impulse Phenomena Using Context and Problem-Based Learning. *European Journal of Educational Research*, *8*(4), 1217-1227.

Yulianti, E., & Gunawan, I. (2019). Model Pembelajaran Problem Based Learning (PBL): Efeknya terhadap Pemahaman Konsep dan Berpikir Kritis. *Indonesian Journal of Science and Mathematics Education*, *2*(3), 399–408.