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EFFECTIVENESS OF GENERATION, EVALUATION, AND MODIFICATION-COOPERATIVE LEARNING (GEM-CL) MODEL *SELARAS BAKAR BATU* CULTURAL PRACTICE IN PAPUA

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ABSTRACT

This study intended to describe the effectiveness of the GEM-CL learning model *Selaras Bakar Batu* cultural practice on chapter heat and temperature. This type of research was quasi-experiment with pretest and post-test control group design. The study population was all students of class XI IPA SMAN 1 Jayapura. The sampling technique used was simple random sampling. The selected classes were XI IPA-3 as an experimental class and class XI IPA-5 as a control class. Data collection instruments were tests based on higher-order thinking skills and questionnaires to collect students' responses. Data analysis was done by t-test, N-gain, and effect size for data collecting from test data while data from questionnaires were analyzed by descriptive qualitative analysis. It was concluded that the model is effective to apply in physics learning to preserve students' conceptual understanding and improve students' higher-order thinking skills. Further study on GEM-CL to other cultural practices and physics chapter in Indonesia would strengthen this learning model.

Keywords: GEM-CL learning model; *bakar batu* cultural practice in Papua; heat and temperature

INTRODUCTION

The high and fast development of science in this era has given an impact on the wider community, including society in Indonesia, including the world of education (Hurrell & Albuquerque, 2012; Jegede, 1995). Based on the development of science, it is necessary to reform in the world of education, including the learning strategies carried out by teachers in the classroom. The curriculum in Indonesia changes with the development of science. Papua is the easternmost province of Indonesia. Due to geographical constraints, Papua is late in following curriculum development.

At present, the 2013 curriculum is being implemented in Papua. It is considered late to implement it due to the emergence of several factors, including geographical location, human resources (teachers), school facilities and infrastructure. However, the success of curriculum implementation is very dependent on how the curriculum is implemented. No matter how good the curriculum is designed and developed, the implementation of it has to be supported by a proper learning model, the availability of books

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as teaching materials and learning resources, strengthening the role of government in coaching and monitoring the school, maintaining school management, and preserving good culture study. These components have to be fulfilled so the curriculum can achieve the expected results (Hiwatig, 2008; Ogonnaya, 2011; Ogunleye, 2009).

As one of the lagging, outermost, and foremost areas in Indonesia, Papua has several local cultures that have not been considered as local wisdom and integrated with physics learning. The importance of this research is to find out the local cultural practice in Papua so that physics learning in the classroom will be more contextual for students.

Physics is part of science (natural science) as a branch of which focus is the study of nature and the processes that are in it. Science is not just an arrangement of facts, concepts, and principles, but the process of discovering the concepts as well. According to Abd-El-Khalick, et al. (1998), the nature of science is knowledge of the methods of science, the process of science, or the values and beliefs to develop science. The essence of science is an invention, which includes products, processes, and attitudes. Science learning should emphasize the process, where students actively build their knowledge in a series of learning activities so that learning becomes meaningful to students. According to Kubieck (2005), science education is directed at the discovery of concepts, where students are directly involved, and gain a deeper understanding of the natural surroundings. Science learning can be taught in line with the nature of science phenomena by suitable and proper learning approaches, models and methods. By suitable learning properties, students will realize and learn that scientific knowledge is obtained based on facts, giving rise to the view that scientists provide the correct answer to a question (Yip, 2006). Thus the nature of science is in line with constructivism learning, where learning does not only emphasize the product (Nugroho, 2017).

There are two learning models used to develop a new learning model that fits the teaching and learning process of physics to improve students' higher-order thinking skills (HOTs). First, constructivism learning is learning that emphasizes students can explore their knowledge through the learning process. According to Boghossian (2006), constructivism-based learning is the process of forming knowledge in individuals, the results of mental activities that are supported by the process of learning experiences. Thus it can be said that students gain knowledge in their way based on the learning experience he gained in the learning process. Second, cooperative learning is a small and divided group instructional technique. It establishes positive interdependence among students. It also unlike most current school-based programs as it does not mandate a formal curriculum. By giving the emphasis in cooperative learning on peer reinforcement for positive and helpful behavior during learning activities, cooperative learning would promote higher levels of pro-social behavior and these effects would be mediated by peer relatedness (Van Ryzin et al., 2020). Cooperative learning is proven through pedagogical studies to have a significant impact on physics learning (Fernandez-Rio et al., 2017). The two learning models then are combined to enhance students' higher-order thinking skills in physics learning through local wisdom.

Local wisdom can be found anywhere in the world but it has not been widely integrated with science learning at school. Some research that had been done to study about science learning with local wisdom or ethnoscience, especially physics in several chapters, found that each district had its cultural practices. The cultural practices could be explained with science (Narayanan & Adithan, 2015; Nofiana & Karyanto, 2013; Ramirez & Ganaden, 2008). As it is stated, this study has intended to examine and suggest a suitable learning model to learn physics with one local wisdom in Papua.

The concept of temperature and heat is very closely related to everyday life. One of the successes of students in learning science is the help of teachers in using culture in learning (Budiarti, 2017). The material temperature and heat are closely related to the stone burning cultural practice that is held in Papua, especially in the mountainous regions. This cultural practice hereinafter would be referred to as *Bakar Batu*. *Bakar Batu* is related to temperature, heat, and heat transfer as some of the physics concepts. The heat transfer that occurs in the rock combustion process includes heat transfer by conduction and radiation. The pilot study found that no teacher in Papua combined constructivism and cooperative learning models with Papua local wisdom in learning physics. Heat and temperature were still taught by using the old way of textbook-based teaching.

However, to the best of our knowledge in the literature review, there was no previous study examining the Papua local culture, which is *Bakar Batu,* to physics learning in both model or method. Furthermore, there was also no study combining the learning model with Papua local culture as a form of ethnoscience to conduct physics learning more contextually. Other studies had not revealed Papua local culture yet as they have elaborated on other islands in Indonesia (Andriana et al., 2017; Dwianto et al., 2017; Hartini et al., 2018). Also, based on the preliminary study, teachers in Papua needed a new learning model in physics teaching and learning. Based on this consideration, we elaborated and developed a new learning model called Generation, Evaluation, and Modification-Cooperative Learning (GEM-CL) Model *Selaras Bakar Batu* Cultural Practice in Papua. The research question on this study was how effective GEM-CL Model *selaras Bakar Batu* Cultural Practice in Papua is. As it was stated, the research question gave the limitation to find out the effectiveness of the new model we offered in this study.

METHODS

Research Design

This type of research was quasi-experiment with pretest and post-test control group design. The study population was all students of class XI IPA SMAN 1 Jayapura. Sampling was done by a simple random sampling technique and the selected classes were XI IPA-3 as an experimental class and class XI IPA-5 as a control class. Data collecting instruments were essay tests based on higher-order thinking skills and questionnaires to collect students' responses.

Before the experiment was begun, samples had been tested by a two-tailed t-test which required a pre-analysis test of samples' normality and homogeneity. Data used in this step was from a preliminary study through documentation of students' scores on the previous test. Based on the pre-analysis test, samples were originated from a normal and homogeneous population. Those samples were not having difference at the beginning of the experiment based on a two-tailed t-test. So that the only difference factor would be initiated by the treatment to experiment and control class (Afandi, 2018; Ramadhani et al., 2019). The data were collected through document analysis and tests. Those were analyzed with a two-tailed t-test with different cell content to determine the pre-analysis test result to get the decision of taking the comparative stage of between scores (Parinduri et al., 2017).

The pretest results were obtained from data collection instruments within the form of higher-order thinking skills tests. The pretest was held before the treatment of GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua. This result reflected on the treatment.

The post-test results were obtained from data collection instruments within the form of higher-order thinking skills tests. The post-test was held after the treatment applied in the implementation of the GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua.

Syntax of GEM-CL Learning Model Selaras Bakar Batu Cultural Practice in Papua

There are five main stages as the syntax of GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua. The first stage is the generation. The generation stage requires students to remember or describe phenomena related to the concept of heat and temperature. The generation stage supports the higher level of thinking in Bloom's taxonomy, namely analysis. At this stage, students analyze every problem to arrange and suggest a solution.

The second stage is the students' organization in learning. According to Slavin (1988) and Arends (2014) organization of students in learning is the process of students placing themselves in learning groups that have been formed by the teacher. The second stage of the GEM-CL Selaras Bakar Batu Cultural Practice in Papua aims to organize students in learning. The stage requires students to place themselves based on teachers' arrangement. The arrangements are based on students' achievements, gender, cultural background, and so forth.

The third stage is assist the teamwork and study. The third stage requires students' arrangements in learning, assists teamwork and study groups, and enables students to work together in heterogeneous groups both in their early ability, ethnicity, race, and religion. Assisting teamwork and study is the process of the teacher guiding study groups when students work on assignments. The third stage of the GEM-CL Selaras Bakar Batu Cultural Practice in Papua is assisted by teamwork and study held by the teacher within the lesson plan. The process of assisting teamwork means that students must work in a cooperative atmosphere. The study is held due to students' discussion (Arends, 2014; Slavin, 1988).

The fourth stage is the evaluation. The evaluation stage is the process of students evaluating/making connections / confirming between initial ideas and data/concepts found (Clement & Rea-Ramirez, 2008; Khan & Inamullah, 2011; Williams & Clement, 2015). This evaluation stage requires the ability to provide an assessment of the questions by choosing the best solution for a problem (Moseley et al., 2005). Evaluation can be interpreted as an activity to assess with certain criteria and standards (Dewi & Riandi, 2016). The evaluation stage supports the higher-order thinking skills or thinking level in Bloom's taxonomy, namely evaluation as well. At this stage, students try to list every possible scientific solution toward a problem based on their cultural background.

The fifth stage is the modification. The modification stage is the process of students modifying the relationship of initial ideas with data/concepts found based on the evaluation stage. Students are invited to modify initial ideas, practical results, and concepts from experts by writing (Mayer and Alexander, 2016). The modification stage supports the higher level of thinking in Bloom's taxonomy, namely creation. At this stage, students can come up with new ideas as a result of collaboration, planning, and producing.

Table 1 shows brief information on syntax and learning activity in GEM-CL. The stages were designed and combined with the cooperative learning model. GEM-CL model requires students to perform teamwork in probing and solving problems. In this model, teachers become facilitators and students need to be active during the physics learning process.

Table 1. Syntax of GEM-CL

No	Syntax	Learning Activity
1	Generation	Students are stimulated to remember or describe natural phenomena related to the topic or describe demonstrations conducted by the teacher or answer questions given by the teacher. Students bring up opinions about the heat and temperature related to *Bakar Batu* cultural practice in Papua.
2	Students' organization in learning	Students occupy positions in groups that have been determined by the teacher. The teacher has prepared the group and its members based on the students' initial abilities and cultural origin of the students.
3	Assist teamwork and study	Students discuss in groups to equalize initial perceptions on topics to be studied with the teachers' guidance.
4	Evaluation	Students evaluate the initial answers to learning activities after conducting experiments in groups.
5	Modification	Students modify their ideas/opinions from the beginning to the experimental activities, to get the correct concepts according to the experts.

RESULTS AND DISCUSSION

The result of the t-test for pretest results is obtained to compare the pretest mean of two class groups referred to the experimental and control class. The mean square between groups is 337.573 while the mean square within groups is 63.561. The significance value obtained is 0.024, which means lower than the alpha value of 0.05. While the F value obtained is 5.311.

The result of the t-test for the post-test is obtained to compare the post-test mean of two class groups namely the experimental and control class. The mean square between groups is 533.865 while the mean square within groups is 32.300. The significance value obtained is 0.000, which means lower than the alpha value of 0.05. While the F value obtained is 165.135.

Based on the results of normality and homogeneity tests, it is found that the data are normally distributed and homogeneous so that it can be continued with the t-test for pretest, posttest, and n-gain. The significance level used in this study was 0.05. The significance column for both the experimental class and the control class is 0.024. As the significance value is less than 0.05, there are differences in this data. The significance level used in this study was 0.05. The significance column for both the experimental class and the control class is 0,000 (Table 2).

Because the significance value is less than 0.05, it can be said that there is a difference between before and after the use of the GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua as the treatment in this study.

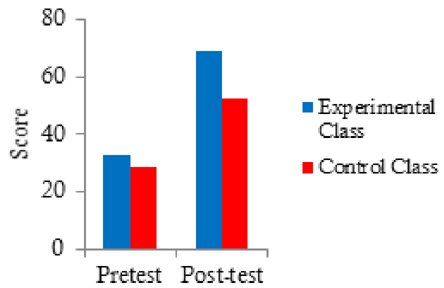


Figure 1. Mean Score of Pretest and Post-test for Experiment Class and Control Class

The comparative results of the pretest and post-test obtained can be shown with a bar diagram as shown in Figure 1 for the experimental and control class. It can be seen that the post-test results have a higher average value than the pre-test results. This means there is an increase from before and after the use of the GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua. The bar diagram shows the difference between the test.

In Figure 1, it can be seen that the experimental class has increased in value after learning using the GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua which is very significant from an average value of 32.5 to an average value of 69. Thus there is an increase in students' higher-order thinking skills using GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua that are higher in the experimental class compared to the control class.

Then the test results are tested using the t-test for N-gain. This test was conducted to find out the difference in the mean value of improvement achieved by the experimental class and the control class. N-gain gives an idea of which class has a greater increase in value. Table 3 shows a summary of the t-test results for the N-gain of both classes in the study. The results between classes were compared to know whether the experimental or control class was better. It reflected on how GEM-CL affected students' study process.

The data then analyzed to determine the results of the t-test analysis to compare the test results of two class groups namely the experimental class and the control class. The significance value obtained is 0.000, which means lower than the alpha value of 0.05. While the F value obtained is 94.911.

The analysis results obtained can be shown with a bar diagram as shown in Figure 2 for the experimental class and the control class. It can be obtained that the experimental class has a higher average gain score than the control class.

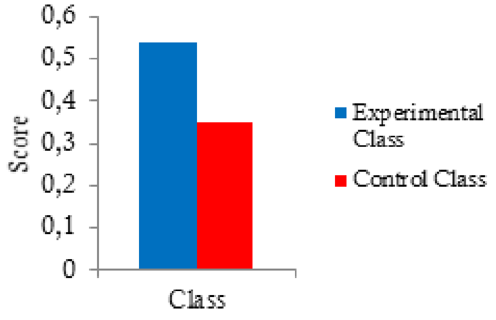


Figure 2. The Result of N-gain for Mean Score of Experiment Class and Control Class

In Figure 2, it can be seen that the experimental class experienced higher values after learning using the GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua. The mean results of the experimental class experienced a very significant increase from an average value of 32.5 to an average value of 69. Thus there was an increase in students' higher-order thinking skills that were higher in the experimental class compared to the control class.

The significance level used in this study was 0.05. The significance column for both the experimental class and the control class is 0,000. Because the significance value is less than 0.05, there are differences in the data. Based on Figure 2, it is seen that the average N-gain of the experimental class is higher than the control class.

The calculation of the influence of height categories using effect size has been done after comparative analysis. The results of calculations using the effect size as follows:

$$d = \frac{M_2 - M_1}{\sqrt{\frac{S_1{}^2 + S_2{}^2}{2}}}$$

$$d = \frac{69.0312 - 52.5962}{\sqrt{5.6804^2}}$$

$$d = 2{,}89$$

Based on the results of the calculation of the effect size, the effect size is obtained at 2.89 ≥ 0.8. Thus, it can be concluded that the effect size lies in the high yield, which is 2.89, so there is an influence of 'height'. The GEM-CL learning model *selaras Bakar Batu* cultural practice has a high influence on students' higher-order thinking skills on temperature and heat. According to (Lakens, 2013), the value of effect size is influenced by data from both the control and experimental classes. Data influence in the form of mean and variance of control and experimental classes after and before treatment.

Table 2 shows the average value of student responses in the experimental class to examine the GEM-CL model *selaras Bakar Batu* cultural practice in Papua.

Based on Table 2, the average student response is 76.07, so it is categorized as very interesting. The results of these student responses were obtained after students followed the teaching and learning process with the GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua. The results of these student responses are very supportive of the learning process that has been passed, so it can be said the results of these student responses support the effective use of the GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua as an innovative learning model developed. It can lead to students' higher-order thinking skills development. This result is supported by some research that also found that higher-order thinking skills can be developed through the various way of learning (Bagarukayo et al., 2012; Brookhart, 2010; Conklin, 2011; Istiyono et al., 2014; Khan & Inamullah, 2011; Yee et al., 2011). The results from other findings related to elevating students' higher-order thinking skills are also supported by mind map and collateral local wisdom (Clement & Rea-Ramirez, 2008; Narayanan & Adithan, 2015; Nofiana & Karyanto, 2013; Ramos et al., 2013; Zohar & Dori, 2003). The fact leads to integrating ethnoscience to learning physics in the classroom.

Table 2. Mean Score of Experiment Class Students' Responses

No	Question of Responses	Percentage of Students' Responses (%)			
		Very Interesting	Interesting	Less Interesting	Not Interesting
1	What do you think about teaching materials, student textbooks and the learning atmosphere?	79.37	20.62	0	0
2	What do you feel about teaching materials, student textbooks and the learning atmosphere?	78.12	20.00	1.87	0
3	What do you think about the learning model conveyed by the teacher?	77.50	22.50	0	0
4	Do student learning models and books improve higher-order thinking skills?	78.75	21.25	0	0
5	Does this learning model play a role as a facilitator in helping to solve problems?	76.25	21.25	1.25	1.25
6	In your opinion, can this learning model explain the physical phenomenon of temperature and heat matter?	70.00	22.50	2.50	5.00
7	How do you feel in answering items/ tests?	72.50	27.50	0	0

According to Solomon (Baker & Taylor, 1995), students' initial knowledge comes from and is influenced by the culture in which they live. This is also supported by Battiste & Kawagley (Barnhardt & Oscar Kawagley, 2005), that students can be actively motivated to learn if the learning process starts from the facts/phenomena they observe around the place of residence. The potential of local culture which is synergized in learning physics prioritizes student activeness, thus providing opportunities for students to explore the knowledge they have that comes from everyday life experiences (Budiarti, 2017). Thus learning physics that accommodates local culture can improve student learning outcomes. This is proven by the effectiveness of the GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua. Other cultural practices that have been integrated in physics learning also found that physics can be more contextual when it is combined by local wisdom or cultural practices (Abonyi et al., 2014; Arfianawati et al., 2016; Fasasi, 2017; Pusparani et al., 2017; Van den Berg, 2004). The example ethnoscience that has been integrated into Javanese has been done by the researcher from Central Java about *Batik Jumputan* and its correlation with physics (Atmojo, 2015), mitigation of local disaster (Atmojo, et al., 2018), and local wisdom-based textbook (Rahayu & Sudarmin, 2015).

The GEM-CL model *selaras Bakar Batu* is aligned and integrated with the *Bakar Batu* cultural practice in Papua using the methods of experimentation and demonstration, where students are actively involved in working together in their groups. *Bakar Batu* is a traditional ritual in Papua which require the citizen to come in the stone field and bring the harvest from field and livestock to cook and eat together (Elas, 2019). This is also supported by research conducted by Parmin, et al. (2015) which states that students who are studying science in Indonesia are inseparable from the values developed in society, because of various ethnicities as cultural backgrounds. Learning with the GEM-CL model means using ethnoscience: learning science using GEM-CL model *selaras Bakar Batu* cultural practice in Papua. This is supported by research conducted by Parmin, et al. (2017). Ethnoscience can be stated as knowledge owned by a nation or a particular ethnic group or local citizen group. It is conducted based on local wisdom in the surroundings. Ethnoscience is given to students to integrate original knowledge as an integral part of science learning (Andriana et al., 2017; Dwianto et al., 2017; Hartini et al., 2018).

Five stages of the GEM-CL model *selaras Bakar Batu* cultural practice in Papua had been completed in this study. At the generation stage, teachers accommodated the students to identify the problems toward Bakar Batu cultural practices by showing several videos. Then students were asked whether they have ever joined the practice or not. Students were analyzed their experience and drew a scientific question about Bakar Batu cultural practice.

The second stage of this study showed at the first lesson. The teacher had prepared students in groups based on the syntax of the students organization learning. The teacher divided students into groups based on initial abilities and heterogeneous tribes. Students placed themselves in groups that had been determined by the teacher. At the second lesson, students already knew friends in the group, so students were quick to join and put themselves in groups. At the third lesson, and the fourth lesson, students immediately placed themselves in their groups.

The third stage of GEM-CL, assist teamwork and study, was shown by the first lesson. Students were directed to be actively involved in groups in particular and learning in general. In this first lesson, students were still adjusting to the other members of the group. The second lesson with the heat sub-material, student activity had increased properly and significantly. This was indicated by the activeness of students in discussing doing worksheets in groups. Students could adjust and work together with friends in groups. The teacher quickly responds to ideas/opinions/questions from students and accompanies students in groups. At the third lesson with Blacks' principles, students were actively involved in learning, especially in group discussions. In this third lesson, students had difficulty in solving the problem of the principles, so that student activity had decreased to a good category. The fourth lesson with the heat transfer sub material, students were very enthusiastic about being actively involved in learning and group discussions, this was because learning took place outside the classroom to conduct the Bakar Batu cultural practice.

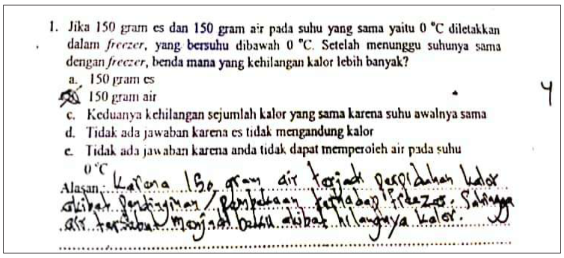
The evaluation stage in this study was shown by students who were analyzing their initial thought on Bakar Batu and their experience joining the traditional process. Teachers accommodated this stage with scientific concepts which were heat and temperature. This process of ethnoscience learning was supported by Ringo (2019). Meanwhile, it was in contrast with other findings by Hou et al., (2020) that stated evaluation stage in their studies were not in line with students' evaluation process because students were stuck at determining the contextual problem.

It was expected that after doing this stage students' abilities in evaluation could be better. For example, students could elaborate on the main problem then analyze it to create a solution when solving a physics problem. At this evaluation stage, learning activities were held to assess the level of students' thinking skills. The assessment was done to make judgments based on criteria and standards. This evaluation stage supported the pattern of students' higher-order thinking skills level. Students with better higher-order thinking skills were able to identify the scientific process of Bakar Batu cultural practice.

The findings on modification were shown by the students' suggested ideas on Bakar Batu cultural practice. As the new ideas stated, students, modify and elaborate on the integration between their local culture with heat and temperature concepts. Students were asked to enhance the parameters of cultural practice. Students stated that there were differences in the time duration of heat transfer by using sediment rocks and metamorph rocks. Students also suggested modifying the process in various spots above the sea levels, such as the downhill and the field (Touret, 2001) possibly formed on a wide range of P-T conditions, having also suffered, in most cases, extensive changes after initial trapping. The interpretation of fluid inclusion data can only be done by comparison with independent P-T estimates derived from coexisting minerals, but this requires a precise knowledge of the chronology of inclusion formation in respect to their mineral host. The three essential steps in any fluid inclusion investigation are described: observation, measurements, and interpretation. Observation, with a conventional petrographic microscope, leads to the identification and relative chronology of a limited number of fluid types (same overall composition, eventually changes in fluid density.

This, as done by GEM-CL model *selaras Bakar Batu* cultural practice in Papua, showed the effective learning process. Three stages of GEM-CL syntax were done and completed during the physics learning. Then, it could be said that GEM-CL model *selaras Bakar Batu* in Papua was effective to elevate students' higher-order thinking skills in physics learning, especially on chapter heat and temperature. The results of this study emphasized the findings of previous studies about local wisdom, ethnoscience, and physics learning. Also, this study found a new suitable learning model to teach ethnoscience namely GEM-CL (Atmojo, 2015; Atmojo et al., 2018; Elas, 2019; Fasasi, 2017; Pusparani et al., 2017; Rahayu & Sudarmin, 2015

One of the items in the higher-order thinking skills test was shown in Figure 3. The problem was to find out which one of the matters losing more heat. There were 150 grams of ice and 150 grams of water. Both were having the same temperature which was 0°C and placed in the freezer (the temperature in the freezer was below 0°C). Students were required to solve the problems and they analyzed which matter that was losing more heat. Figure 3 also attached students' answer which was option B. He answered that 150 grams of water lost more heat than 150 grams of ice.


1. Jika 150 gram es dan 150 gram air pada suhu yang sama yaitu 0 °C diletakkan dalam *freezer*, yang bersuhu dibawah 0 °C. Setelah menunggu suhunya sama dengan *freezer*, benda mana yang kehilangan kalor lebih banyak?
   a. 150 gram es
   b. 150 gram air
   c. Keduanya kehilangan sejumlah kalor yang sama karena suhu awalnya sama
   d. Tidak ada jawaban karena es tidak mengandung kalor
   e. Tidak ada jawaban karena anda tidak dapat memperoleh air pada suhu 0 °C

Y

Alasan: Karena 150 gram air terjadi perpindahan kalor akibat pendinginan/pembekuan terhadap freezer. Sehingga air tersebut menjadi batu akibat hilangnya kalor.

Figure 3. The Example of Items in the Higher-Order Thinking Skills Test

The student also gave his scientific reason why he picked the option. He stated that 150 grams of water lost its heat because of heat transfer to the environment by cooling and freezing process. These two processes of water in the freezer needed more heat than ice. The water became ice because it lost its heat through the cooling and freezing process. The process of students analyzing their answers was categorized as one of the higher-order thinking skills aspects. By this test results, we got the students' pattern of their skills. It was reflected in the implementation of developed GEM-CL model *selaras Bakar Batu* cultural practice in Papua.

CONCLUSION

The effectiveness of the GEM-CL learning model *selaras Bakar Batu* cultural practice in Papua on chapter heat and temperature was categorized high with a score of 2.86. It was concluded that the model is effective to apply in physics learning to preserve students' conceptual understanding. The average results of student responses amounted to 76.07. It was concluded that GEM-CL model *selaras Bakar Batu* cultural practice in Papua on chapter heat and temperature was properly capable to improve students' higher-order thinking skills. Further study on GEM-CL to other cultural practices and physics chapter in Indonesia would strengthen this learning model. The expected wider conclusion is that GEM-CL as an innovative learning model will give a significant impact on ethnoscience teaching. GEM-CL learning model can enrich the correlation between local cultural practices and physics learning models.

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