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Student Worksheet Model Learning Cycle 7E to Practice 4C Skills Learners

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Abstract: Students' 4C skills cannot be trained properly because there are no 7E learning cycle model worksheets available on temperature and heat. So students still have difficulty understanding abstract concepts in the material. The aim of this research is to determine students' 4C skills after using the 7E learning cycle model worksheet. The development method used is Research and Development (R&D) with a 4D model (define, design, develop and disseminate). The participants in this research consisted of 2 physics education lecturers and 1 psychology lecturer as validators, as well as 30 class XI MIPA students at MAN 3 Amuntai. The instruments of this research are validity questionnaires, pretest-posttest questions, communication and collaboration self-assessment sheets, and creative thinking observation sheets. 4C skills after using the 7E learning cycle model worksheet, namely critical skills obtained N-gain, namely 0.54% in the "medium" category, creative thinking skills were 60.78% at the first meeting and 62.01% at the second meeting, with the category " quite creative", communication skills got 78.8% in the "good" category and collaboration skills got 78.2% in the "good" category.

Keywords: 4C skills, learning cycle 7e, worksheet

Abstrak: *Keterampilan 4C peserta didik belum dapat terlatih dengan baik dikarenakan belum tersedianya lembar kerja model learning cycle 7E pada materi suhu dan kalor. Sehingga pserta didik masih kesulitan memahami konsep abstrak pada materi tersebut. Adapun tujuan penelitian ini untuk mengetahui keterampilan 4C peserta didik setelah menggunakan lembar kerja model learning cycle 7E. Metode pengembangan yang digunakan adalah Reseacrh and Development (R&D) dengan model 4D (define, design, develop dan disseminate). Partisipan penelitian ini terdiri dari 2 dosen pendidikan fisika dan 1 dosen prikologi sebagai validator, serta 30 peserta didik kelas XI MIPA di MAN 3 Amuntai. Instrumen penelitian ini yakni angket validitas, soal pretest-posttest, lembar penilaian diri komunikasi dan kolaborasi, serta lembar observas berpikir kreatif. keterampilan 4C setelah menggunakan lembar kerja model learning cycle 7E yakni keterampilan kritis memperoleh N-gain yaitu 0,54% kategori "sedang", keterampilan berpikir kreatif sebesar 60,78% pada pertemuan pertama dan 62,01% pada pertemuan kedua, dengan kategori "cukup kreatif", keterampilan komunikasi memperoleh 78,8% kategori "baik" dan keterampilan kolaborasi sebesar 78,2% kategori "baik"*

Kata kunci: *keterampilan 4c, learning cycle 7e, lembar kerja*

▪ INTRODUCTION

21st century learning also influences the curriculum in Indonesia. The 2013 curriculum implements the competencies that students must have in facing the challenges of the 21st century or what is known as 21st century skills. The 21st century skills in question are that students must have the 4Cs (Communication, Collaboration, Creativity, and Critical Thinking) which are the achievements of the 2013 curriculum (Makhrus et al., 2018). These skills are very necessary because in the era of globalization, technological progress is developing rapidly. Based on this, many children are not ready to face the challenges and influences of technology. So skills are needed, namely the 4Cs, to be included in learning at school. Another reason is also because education in the past,

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namely reading, writing and arithmetic, were not sufficient skills for students to face the 21st century (Kivunja, 2015). The 4C skills also cannot be separated from one another. Like collaboration which cannot be separated from communication. Creativity cannot be separated from critical thinking. These four things are related to each other (Saimon et al., 2023).

Nowadays, many students still think that physics lessons are difficult because they require perseverance, a lot of practice, and students have to memorize a lot of formulas (Astalini et al., 2018). Therefore, teachers must be able to eliminate this perception, so that students enjoy studying physics. Apart from that, the competence of professional teachers in the 21st century is not only to convey knowledge, but as an agent of change, able to improve the quality of learning and plan a good teaching and learning process (Sulastri et al., 2020). Based on research (Tridiana & Rizal, 2020), learning using the same method will reduce student motivation and students will not be enthusiastic about learning in class.

In accordance with the results of the researcher's observations, the learning resources used at MAN 3 HSU are short textbooks or worksheets which contain material and questions. It was further stated that students had never used worksheets as a teaching medium. Students only use textbooks as a learning tool. In line with research conducted by (Yohanasonyangaku et al, 2021) teaching materials that are less interesting and less effective will cause students to be less motivated.

Physics material that can be applied using the 7E Learning cycle model with the aim of improving 21st century skills is heat. The stages of the 7E learning cycle model are elicit, engage, explore, explain, elaborate, evaluate, and extend (Adam et al., 2022). According to interviews conducted with MAN 3 HSU physics teachers, students still have difficulty understanding temperature and heat material. This statement is supported by research by Astiti (2019), that temperature and heat are abstract material so students have difficulty understanding the material. Of course, these abstract physical concepts cannot be observed in reality in the environment, but can only be explained theoretically based on experts or with the help of technology (Suseno, 2014). As in the case of temperature and heat, namely when a microscopic heat transfer process occurs, this is related to the state of the particles in the object (Himawan et al., 2020). Then one of the misunderstandings faced is the mismatch between understanding physics concepts and students' cognitive development (Türkmen, 2007).

Based on previous research in Turkish secondary schools which lasted around 12 weeks. Research was conducted to determine the 7E learning process in physics lessons. After conducting interviews, observations and so on, it was found that almost all students liked learning using the 7E learning cycle model with physics material (Umit Turgut et al., 2017). Apart from that, other research proves that the 7E learning model has a very positive effect on student achievement in science learning (Balta & Sarac, 2016). Students' responsibilities and the level of guidance provided by teachers in the process influence their final learning outcomes (Çelik et al., 2018).

The difference with my research is that the previous research taught physics material, namely electromagnetic material and science learning, whereas I researched the 7E learning cycle model in one of the physics materials, namely temperature and heat. The most striking difference is that I developed worksheets specifically used by teachers in the learning process. This worksheet is designed in such a way that it can be used

effectively in the classroom. The latest thing from my research is that at stage 7E I specifically collaborated on each of the 4C skills at several stages so that students could practice their skills specifically. The stages that are collaborated on are engage to train critical thinking skills, explore to train critical thinking skills, explain to train communication skills and elaborate to train collaboration skills. In line with the findings of (Suwito et al., 2020), which uses the 5E learning cycle model as a learning model. The product developed is a textbook which contains colored pictures, experimental activities and images that can be accessed directly. This makes it easier for students to learn independently. The 5E learning cycle model is actually the same as 7E, only 7E is more elaborated than 5E. This reason is to ensure that teachers do not miss these stages, namely elicit and extend (Adam et al., 2022).

▪ METHOD

The population of this research is all MAN 3 HSU students. The research sample was 30 students from class XI MIPA. Then the product validators consist of 2 physics education lecturers and 1 psychology lecturer. The data collection technique uses one group pretest posttest design.

This research is development research using the Research and Development (R&D) method. Researchers made initial observations on October 22 2022. Then data collection was carried out on March 9-13 2023, through two meetings held for 3 class hours each. The following is Figure 3.1, the research design used.

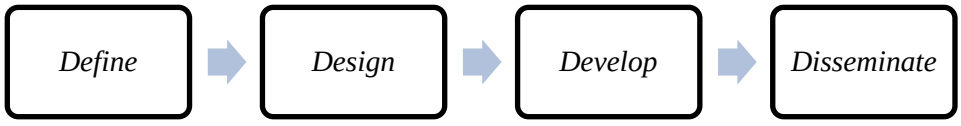

Figure 1. Stages of 4-D model

The model taken is 4D which consists of 4 stages, namely defining, designing, developing and disseminating, which was adapted by Thiagrajan (1974) to develop LKPD according to the needs of researchers (Winarni et al. , 2018). However, researchers only developed the product to the development stage, due to limited research time.

Define

Defining and setting the objectives of a teaching material with certain conditions (Winarni et al, 2018). At this stage, initial analysis, material analysis and student analysis are carried out. Based on initial observations, the curriculum still used by MAN 3 HSU students is the 2013 curriculum.

Design

At this stage, a Learning cycle 7E model worksheet was designed which contained 4C skills in temperature and heat material. This design process began on January 9 2023. The design developed is the learning process design (RPP). The RPP contains basic competencies and learning objectives that are adapted to the curriculum used. Apart from that, the media and learning resources are determined along with the preparation of the material at each meeting.

Next, a 7E learning cycle model stage was designed which included 4C skills. At the engagement stage, the worksheet is used to measure the increase in critical thinking skills. At this stage, students are directed to analyze the physics theories in the video. Then the teacher provides questions related to the video they have observed. Exploration stage worksheet to measure students' creative thinking skills. Students carry out experiments regarding gas expansion and convection events. Of course, students can maximize their creativity in using tools and materials. Explain stage to practice communication skills. Communication makes it easier for students to understand physics concepts well and participate actively in learning activities (Mahdalena & Daulay, 2020). At this stage the teacher directs students to express their opinions in writing regarding questions on the worksheet according to the results of the experiment. Lastly, the elaborate stage of the worksheet is designed to train collaboration skills. collaborate to provide solutions to short events in everyday life that they often encounter.

Develop

Researchers develop products that have been designed in 2 stages, namely the first stage is validating, the second stage is testing the product on students (Winarni et al, 2018). The worksheet was validated by 2 expert lecturers, namely Mr. Eko Wahyu Nur Sofianto, M.Pd and Mrs. Sitti Rahmasari, M. Pd. The results of the validation are that overall the percentage criteria for this worksheet are very valid with a percentage of 88.73%. Among the aspects assessed were relevance obtained 85.71% (very valid), accuracy 85% (quite valid), completeness of presentation 100% (very valid), systematic presentation 85% (quite valid), language rules 90% (quite valid), readability and communicativeness 86.67% (very valid). The second stage is product testing which is carried out in two meetings with material on temperature and heat. The first meeting of researchers took material on temperature, thermometers, expansion, heat and Black's Principle. The second meeting was about changes in form and heat transfer.

The instruments in this research consisted of 4 types, namely worksheet validation sheets, critical thinking skills test sheets, creative thinking observation sheets and communication and collaboration self-assessment sheets. This learning cycle model worksheet validation sheet uses valid primary sources, totaling 29 statements. The aspects used are relevance, accuracy, completeness of presentation, systematic presentation, language and communicative rules (Akbar, 2016). Then the critical thinking skills test sheet instrument used 5 questions, adapting from previous research. Each question refers to one aspect, namely basic support, inference, advance clarification, elementary clarification, and strategies and tactics (Purnomowati, 2021). Apart from that, the creative thinking observation sheet instrument has 11 statements, sourced from previous journals, with the aspects measured being fluency, flexibility, originality, and analyze (Fuadah, 2013). Next, a self-assessment sheet measures two types of skills, including communication and collaboration skills. Researchers develop their own self-assessment sheets based on existing aspects or indicators. In the self-assessment of communication skills, there are 4 aspects that are measured, including expressing ideas logically, listening carefully, using technology and communicating in different environments. This communication skills self-assessment instrument consists of 10 statements, obtaining a validity of 0.87 (very valid) and a reliability of 0.81 (high). then, the collaboration skills self-assessment sheet instrument measures 4 aspects, namely, giving and receiving, dividing tasks, listening to others, and supporting group decisions. This collaboration

skills self-assessment instrument with 11 statements obtained a validity of 0.90 (very valid) and a reliability of 0.69 (fair).

The data analysis technique uses quantitative descriptive which analyzes data in the form of numbers, namely: Results of critical thinking skills A test was carried out using N-Gain to determine any differences after learning using the 7E learning cycle model worksheet. Result of creative thinking observation. Result of communication self assessment. Result of collaboration self assessment.

$$Normal\ gain = \frac{Posttest\ Score - Pretest\ Score}{ideal\ score - Pretest\ score}$$

$$\text{creative thinking} = \frac{\sum total\ \ score}{\sum total\ criteria\ scores} \times 100$$

$$\text{score} = \frac{\sum total\ \ score}{\sum total\ criteria\ scores} \times 100$$

$$\text{score} = \frac{\sum total\ \ score}{\sum total\ criteria\ scores} \times 100$$

▪ RESULT AND DISSCUSSION

At the defining stage, the researcher sets the objectives for developing teaching materials, carries out initial analysis using observation. It is known that the learning method that is often used is the conventional model, due to time constraints so that teachers are required to complete the material in a short time. Next, an analysis of the students was carried out, where it was found that students often felt bored with conventional learning methods. Finally, material analysis was carried out, namely temperature and heat material which has actually been studied but there is some material which is still difficult to understand. This is because some temperature and heat material is still considered abstract, so students have difficulty understanding this.

The next stage is designing, namely designing the product which is developed through several processes. First, analyze the curriculum and materials used in accordance with K13. For this reason, researchers created a learning process design (RPP) that was adapted to the material of temperature and heat. It contains basic competencies and learning objectives. Designing the stages of the 7E learning cycle model which contains the 4Cs, where the four learning stages of engage, explore, explain, and elaborate are adjusted to each student's skills that want to be discussed. Next, design a learning strategy, including determining images, learning videos and barcodes to make it easier for students to learn online. Finally, develop research instruments according to the researcher's needs according to the description at the research method stage. The following is Figure 1.2, a display of the engange stage to train students' critical thinking skills.

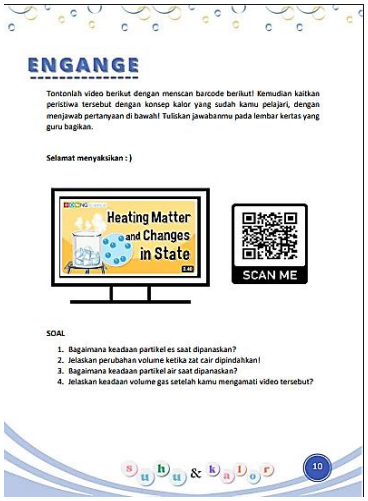

Figure 1. Cover and list of content

Critical thinking skills consist of several aspects. Aspects that are benchmarks in critical thinking are providing explanations (elementary clarification), building basic skills (basic support), concluding results (inference), providing advanced explanations (advanced clarification), and organizing strategies (strategy and tactics) (Mufidah & Putra, 2021). In worksheet critical thinking skills are honed at the engage stage (attracting attention). Students learn the types of heat transfer by observing the learning video by scanning the barcode listed on the worksheet. To determine students' abilities in critical thinking, researchers conducted a pretest and posttest related to the material that students studied.

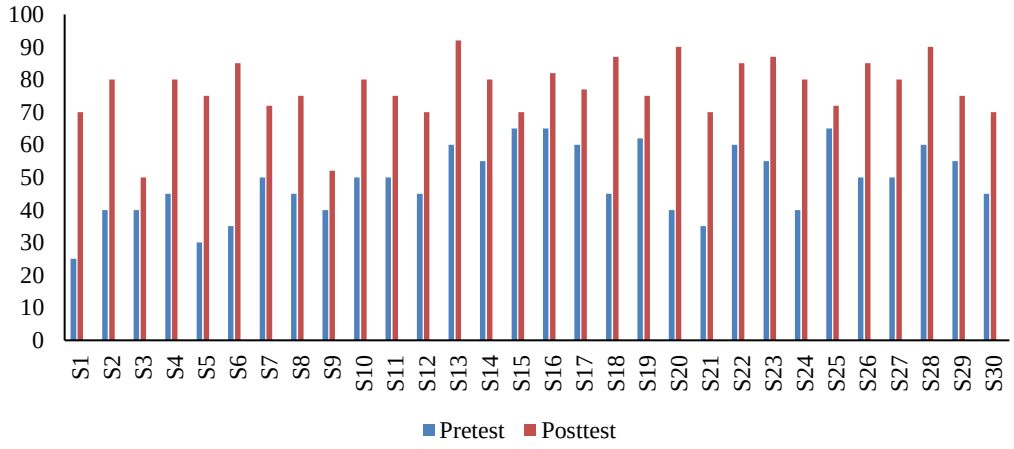

Figure 1. Different one group pretest and posttest design

After calculating the average of the pretest and posttest, the difference in students' N-Gain was obtained. The N-gain score obtained was 0.54, namely in the "medium" category. This category states that there are differences in students' critical thinking skills before and after using LKPD. Students who have moderate critical thinking abilities have quite critical abilities, because on average they are only able to fulfill three aspects of

critical thinking (Amalia et al., 2021). The three aspects that are fulfilled are simple explanation (elementary clarification), building basic skills (basic support), and explaining further (advanced clarification). Explaining simply is a basic skill that must be prossessed in critical thinking (Mardiana dkk., 2022). Besides that, students don't easily accept information from one source before seeking clarity (Monalisa et al., 2019). Applying the right learning model can provide opportunities for students to search, find and solve problems (festiyed, 2022). So that the critical thinking indicators that are trained can help students' learning process.

Based on research (Suardana et al., 2018), critical thinking skills in Indonesia are still relatively low due to the lack of literacy or reading culture among society. Meanwhile, critical thinking skills require deep thinking to analyze something and you need to read a lot to align your thoughts, so as to find the right theory. There are many benefits that can be obtained by thinking critically, including students paying attention to the actions and ideas produced, influencing students in providing solutions and problems to the problems they face and becoming good individuals in their behavior (Irham et al., 2022). In line with research that e-modules designed with the 7E learning cycle model are effective in helping student learning outcomes, because they contain video and image elements (Istuningsih et al., 2018).

Creative thinking skills are the thinking patterns possessed to think about a product creatively (Darwanto, 2019). The aspects measured in creative thinking are fluency (fluent thinking skills), flexibility (flexible thinking skills), originality (original thinking skills) and elaboration (detailing skills) (Simanjuntak, et al., 2019). In learning using worksheet learning cycle 7E model, students' creative thinking skills are trained at the explore stage. Exploration was carried out by conducting experiments on expansion and convection events. The following are the results of the percentage of creative thinking skills in two meetings.

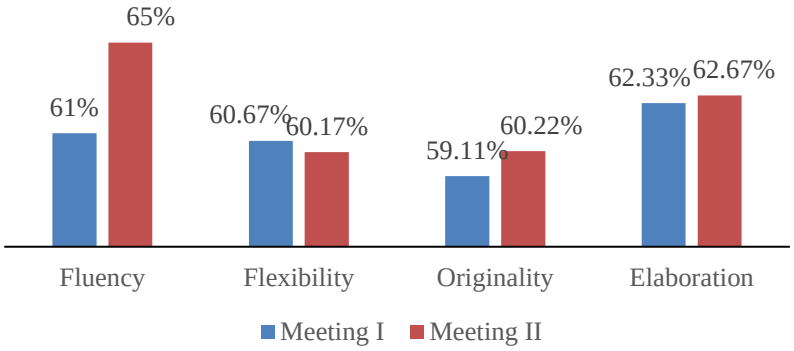

Figure 1.5 Creative thinking skills for meetings I and II

In the fluency aspect, the results were better than the previous meeting, namely 65%. Based on these results, students have the ability to generate their thoughts or ideas, with more than one answer in mind. According to Febrianti in Qomariyah & Subekti, (2021), students who are good at expressing ideas and are quicker at thinking than other students are said to have fluent thinking skills. However, the flexibility aspect experienced a decrease, namely 60.17%. Based on the results of observations in the classroom, students tend to use the same method in assembling experimental tools and

materials. This is in line with research by Armandita et al., (2017), only some students used different methods to solve physics problems.

This finding is in line with research results from (Umit Turgut et al., 2017), students who work in groups to carry out activities can constructively build or facilitate understanding of a subject with abstract content. Students can also understand temperature and heat in depth, as well as practice something new in a different environment. In the process of thinking creatively, students need to observe first and process what stage they want to do next, especially in assembling tools and materials (Patonah et al., 2021).

Communication skills are the skills of providing ideas verbally or non-verbally which are measured based on the way they are conveyed. Lively communication refers to students' ability to communicate ideas well with friends (Abaniel, 2021). There are 4 aspects assessed in communication skills, namely expressing thoughts, listening carefully, using technology and communicating in different environments (Arnyana, 2019). In the LKPD to train communication skills, the researcher included it in the explain stage. Students are expected to be able to explain the results of the experiments they have carried out. In the explain stage of the LKPD, students will fill in the answer column in their own language as a group. This method is the delivery of communication in non-verbal or written form (Hamida, 2020). The following are the results of students' communication skills in two meetings.

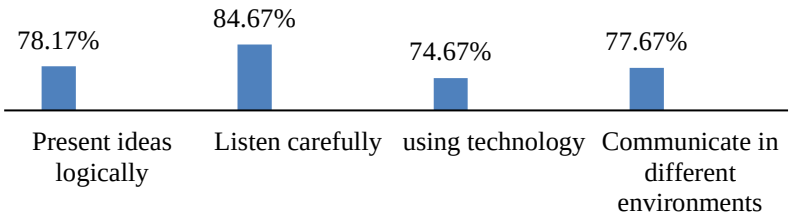

Figure 1. Percentage of students' communication skills

The highest aspect is listening carefully, namely respecting other people's opinions. The percentage result in this aspect is 84.67% which is categorized as good. This value proves that the level of respect for other people's opinions at MAN 3 school is quite good. Listening to other people's opinions or exchanging ideas is very necessary, because this is part of learning and teaching (Sundanah & Rahmadiansyah, 2022). The aspect of using technology, namely using electronic media to practice their skills, with a percentage of 74.67% in the good category. This stage is the lowest compared to other aspects, because students do not utilize technology as a learning resource. Based on research (Sari et al., 2019) technological media is a source of use to facilitate the learning process.

There are several strategies necessary to facilitate communication skills. This strategy can be done by creating a technology-rich environment that makes it necessary for students to communicate to obtain the information they want to know. Can be through digital media or other means. Apart from that, students can also prioritize interests as inspiration in expressing something (Saimon et al., 2023). Apart from that, the factor of

students' courage in asking a question, either to the teacher or a friend, will of course indirectly train their communication skills (Ye & Xu, 2023).

Furthermore, students' collaboration skills are trained at the elaborate (apply) stage, in the 7E learning cycle model LKPD. The overall results of collaboration skills received a percentage of 78.2%, which is in the good category. Well-designed collaborative learning will develop students' academic knowledge and skills (Saldo & Walag, 2020). Students in groups relate heat to phenomena in the environment or everyday life. Students from different backgrounds have the opportunity to work together and depend on each other to achieve good results (Fitriani et al., 2021). The following is a graph of the results of student collaboration.

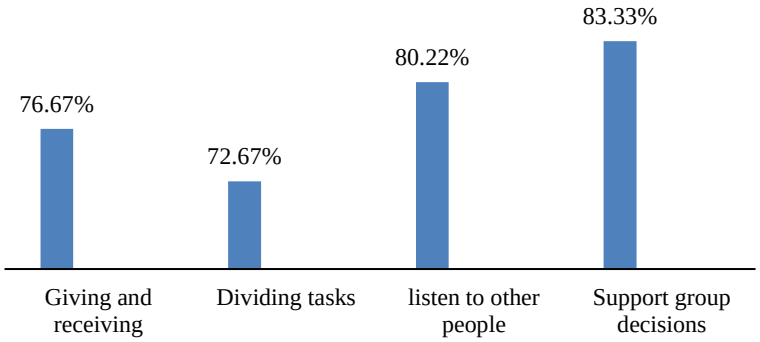

Figure 1.7 Percentage of students' collaboration skills

The aspect of supporting group decisions obtained a percentage of 83.33%, in the good category. This aspect received the highest percentage. Supporting group decisions, namely students can accept joint decisions. With collaboration skills, students can communicate so that a common vision is formed in solving temperature and heat phenomena that exist in life (Octaviana et al., 2022). The aspect of dividing tasks gets a percentage of around 72.67% which is included in the good category. This aspect is lower compared to the others. This is because, when students divide their group assignments, there are some people who deliberately choose phenomena that they feel are easy to work on. In groups, students should be able to share their respective tasks and exchange ideas regarding how to do them well (Febriani & Al Ghozali, 2020).

Cooperation or collaboration is of course very closely related to communication. Based on research (Ye & Xu, 2023), students who learn collaboratively can gather information as much as possible, by deepening the thinking process, finding and solving problems, and maintaining communication. Apart from that, teachers also provide space for students to express their ideas so that they are able to develop their knowledge and ideas (Sulisworo & Sutadi, 2017). Innovation will also emerge when students can collaborate with friends, that is, they can share opinions with one another (Erdoğan, 2019).

▪ CONCLUSION

The 7E learning cycle model worksheet can train students' 4C skills on temperature and heat material. The validity of the 7E learning cycle model worksheet is in the "valid" category, namely with a score of 88.73%, so it is suitable for use. The acquisition of each

critical thinking skill is with N-Gain in the "medium" category, creative thinking skills in the "fairly creative" category, communication skills in the "good" category and collaboration skills in the "good" category.

So, the 7E learning cycle model worksheet can be used to maximize the learning process in class and plan more thorough preparation and can be used on different materials. Suggestions for the future are that research using the 7E learning cycle model worksheet can be researched more specifically, either by adding indicators for each aspect studied, increasing questions for the critical thinking aspect, explaining in detail the observation sheet or developing other instruments to assess communication skills and collaboration.

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