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Research Article:

What Creative Ideas Came Up about Global Warming in RADEC Online Class?

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ABSTRACT

The study aims to investigate the effects of an online learning model, *Read-Answer-Discuss-Explain-Create* (RADEC), on the emergence of creative ideas and projects for 7th-grade students when designing local solutions to global warming problems. Case studies were used in this research by implementing learning in environmental science concepts. This one-shot case study research was conducted on 30 7th-grade students (16 boys and 14 girls) selected through the purposive sampling technique. The research was conducted in Bandung, Indonesia. Five stages are carried out in the RADEC learning model, including the *Read-Answer* stage, where students answered pre-learning questions outside the classroom; the *Discuss-Explain* stage, where students responded to their pre-learning questions in small and large groups; and the *Create* stage, where students agreed on solutions to a problem and realised the product of a creative project. Qualitative data were collected through worksheets, posters, and guided interviews. Although students have not been able to demonstrate originality thinking skills, the implementation of the online RADEC model stimulated students' fluency and flexibility thinking skills. This was evident from the many creative ideas or projects of students. Besides, students could decide on ideas or group projects to solve global warming problems with rational considerations. Although the online RADEC model has not been able to produce original creative products, its implementation has stimulated students to think creatively about solving global warming problems. In addition, the implications, limitations, advantages and potential of further research are discussed in this paper.

Keywords: Creativity, engineering design process, global warming, online learning, RADEC

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INTRODUCTION

The Air Quality of Life Index plays a significant role in inferring the life expectancy for humans and all living things. Environmental problems impact much of Indonesian life, especially the daily activities of individual people. For example, there is a continuing decline in the amount of clean water suitable for human consumption in various regions in Indonesia, fossil fuel consumption is predicted to increase in the next few years, and Indonesia's air quality is the 9th worst in the world (Alkusma et al., 2016; Greenstone & Fan, 2019; Jayachandran, 2009). Through education, teachers can help students learn how to contribute to solving local problems by raising their awareness of environmental issues and then designing solutions to local problem (Danielraja, 2019; So & Chow, 2019). Creativity, one component of the RADEC model, is one of the fundamental competencies students must possess in the 21st century that can help them solve the problems they encounter in everyday lives (Huang & Wang, 2019).

Creativity does not arise spontaneously but must be stimulated and nurtured by the teacher. Students need to understand the fundamental science concepts related to environmental education to construct a simple tool that can address local problems such as water or air pollution. RADEC is a learning model that integrates science content knowledge, engineering design, and creativity to help students understand the fundamental concepts of science in the science and other components of the required curriculum of Indonesia. One of the attractive features of the RADEC model in this regard is that it facilitates student literacy improvement. Several studies have documented that the RADEC learning model has built students' independence in that they became more active and independent in reading various sources of information as their literacy of science concepts increased (Handayani, Sopandi, Syaodih, Setiawan, & Suhendra, 2019; Setiawan et al., 2020).

The RADEC learning model has also been documented as an easy-to-implement learning model by teachers because it is aligned with the characteristics of students and the curriculum in Indonesia (Sopandi et al., 2019, 2020; Sopandi & Handayani, 2019). Field research on implementing the RADEC learning model has shown it does improve students' mastery of fundamental science concepts (Handayani, Sopandi, Syaodih, Setiawan, & Suhendra, 2019; Siregar et al., 2020) and their confidence in their answers (Fuadi et al., 2021). Both are important for students in that they provide the foundation necessary for creativity to emerge if it can (Sukardi et al., 2021a).

This article documents how applying the RADEC learning model allowed students to produce creative ideas addressing local environmental pollution. Specifically, individual components of the RADEC learning model are compatible with stimulating originality and creativity as follows:

1. *Read* stage: reinforces the originality aspect by directing students to think about unique solutions that have not been thought of by others
2. *Answer* and *Explain* stages: intentionally engage students in solving problems through multiple ways and then present those solutions in public
3. *Discuss* stage: allows students opportunities in groups to interpret pictures, stories, or problems

4. *Evaluation* aspect: includes designing a work plan of triggered ideas, and with the originality aspect in choosing another more distinctive method
5. *Create* stage: is compatible with the elaboration aspect in developing and enriching ideas

Several research studies confirm that implementing the RADEC learning model results in the production of creative outcomes by students (Maruf et al., 2020; Siregar et al., 2020; Wulandari et al., 2020). Instructions related to environmental pollution are expected to not only build students' understanding of the fundamental concepts of science but also to foster students' creativity as they generate ideas or projects to save the environment. Implementing principles from the RADEC model is expected to generate ideas or projects related to saving the environment, even if it is carried out online. Therefore, the purpose of this case study was to collect and describe students' creative ideas or projects related to handling environmental pollution problems when the RADEC model was delivered online. The research questions are:

1. What are students' initial ideas or projects in the RADEC learning model?
2. What are the chosen ideas or projects for each group in the RADEC learning model?

RADEC Online Mode

The RADEC learning model can potentially increased students' academic performance within the Indonesian national curriculum (Handayani, Sopandi, Syaodih, Setiawan, & Suhendra, 2019 Kuncoro & Sopandi, 2018; Pratiwi et al., 2018). Historically, the reading interest of Indonesian students has been in a low category. This can be seen from international surveys such as TIMSS, PISA or PIRLS, which are still low. In addition, Indonesia has a crowded curriculum that emphasises mastery of material content. Teachers find it difficult to memorise the syntax of learning models from abroad and also understand it. This particular condition is only well understood by people who know Indonesia (Sopandi et al., 2019). This learning model is founded on Vygotsky's constructivism theory – whereby students' actual abilities are seen when they complete tasks without the help of others and their potential abilities are seen when they complete tasks with the help of others. Within components of RADEC, students complete assignments without the help of others in the *Read* and *Answer* stages. Similarly, students complete assignments with the help of others in the *Create* stage. Throughout instruction using the RADEC model, a cognitive apprenticeship process occurs where students learn step by step from *Read* to *Create*, gaining knowledge through interaction with experts as they learn (Kusumaningpuri & Fauziati, 2021). The ways of communication between students and their teachers, both synchronously and asynchronously, do not eliminate the essence of principles in the RADEC learning model.

The current pandemic condition caused by the outbreak of COVID-19 shifted the learning modes from face-to-face to blended or fully online. Sukardi et al. (2021c) have adapted the RADEC learning model for online use, as shown in Figure 1.

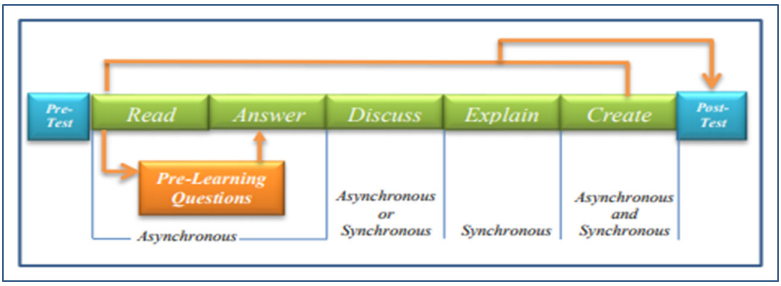

Figure 1. Syntax of online RADEC Instructional Model

During the *Read* stage, the teacher provides opportunities for students to enrich their knowledge through various sources of information presented in an asynchronous mode. At this stage, students can gain unintended knowledge that enriches their knowledge related to cross-disciplinary fields. In the *Answer* stage, students answer pre-learning questions, guiding students on the material they must master asynchronously. Teachers can utilise various Learning Management Systems (LMS) such as Google Classroom to distribute and collect answers to students' pre-learning questions. These two stages occur outside of class hours and can be asynchronous. In the *Discussion* stage, the teacher divides students into several small groups.

They discuss synchronously in online platforms such as Google Meet or Zoom Cloud Meetings. They agree on which answers will be handed out as the group answer. Those answers become the basis for the teacher to classify which concepts students find challenging and which require additional attention by the teacher. At the *Explain* stage, the teacher acts as a moderator who provides opportunities for students to support or reject the answers given by the presenter. The teacher guides students to gain scientific conceptual knowledge through probing questions through synchronous communication, i.e., in Zoom Cloud Meetings. The last stage is the *Create* stage, where students agree upon an idea and do a project based on the result of their discussion in advance. At this stage, the teacher provides a special worksheet that collects students' creative ideas or projects. Students choose one creative idea or project from the list on the worksheet. Then they complete the project in a small group. Finally, a group representative presents the project or creative idea in front of the class. The final project typically included a poster about the proposed solution.

Engineering Design Process (EDP) in RADEC

The *Create* stage of the RADEC model engages students in the designing, building and testing creative products related to a specific local environmental problem. This stage is supported with a worksheet of product inspirations that the students can make. In addition, this worksheet also collects students' creative ideas in small groups before finally deciding on one idea as a group idea. the worksheet includes a checklist for tools, materials, and project work procedures. Probing questions on the worksheet also guide students to work on project procedures based on actual to potential abilities and can help students improve

critical and creative thinking skills (Bakri et al., 2020; Muskita et al., 2020). The complete worksheet for the Create stage can be seen in the Appendix.

The engineering design process (EDP) in the *Create* stage begins when students agree on an idea or project to solve a local problem of environmental pollution. Students learn to select various possible solutions from their ideas. The resulting product must meet the following criteria:

1. The materials used are easy to obtain by students
2. The final products must provide economic, social, and cultural benefits
3. The final products can be replicated so that it is easy to replicate

The third requirement is essential because, in addition to producing a workable product, idea or device, students must also be able to disseminate information about their project to others. For example, a solar cooker produced from materials available locally would meet these criteria (Lancor & Lancor, 2018). The next stage is the planning stage. This stage requires the teacher to stimulate students to recall all the science concepts and engineering processes needed to design and test their projects. Students, for example, should recall and link to fundamental science concepts involving the engineering of waste filter products. Students must understand the nature of mixtures, the principles of physical and chemical separation, and how to calculate the ratios of reagents needed in chemical reactions. Students will also optimise the efficacy of their simple technologies based on knowing these scientific concepts. In this example, the final stage is making a prototype that incorporates all of the ideas involved in the initial idea. For product refinement, if there is still time allocation in the curriculum, students can evaluate and refine the product they have made. The engineering design process (EDP) stage in the *Create* stage is shown in Figure 2.

Figure 2. Engineering Design Process (EDP) in *Create* stage

Global Warming

Global warming is the gradual warming of the Earth's surface that has been seen since the pre-industrial era (between 1850 and 1900). It is attributed to human activity, notably the burning of fossil fuels, which raises the levels of heat-trapping greenhouse gases in the atmosphere. Human activities are thought to have contributed to an increase in Earth's average global temperature of about 1 degree Celsius (1.8 degrees Fahrenheit) since the pre-industrial era. This temperature increase is currently happening at more than 0.2 degrees Celsius (0.36 degrees Fahrenheit) per decade. Without a doubt, human activity since the 1950s has contributed to the current warming trend, which has been accelerating at an unheard-of rate for millennia.

These indisputable facts demonstrate that human activity is the primary contributor to global warming. Students in elementary and secondary schools need to comprehend how global warming works. They might be motivated by this to cherish the planet. The findings of Sukardi et al.'s (2017) study indicate that students' comprehension of global warming is still a significant problem. Global warming is inseparable from the greenhouse effect. Data shows that only a few of the students answered sub-microscopic representation correctly of greenhouse effect. They may depict how the atmosphere is covered in carbon dioxide, preventing sunlight from reflecting. Numerous studies also reveal that students think companies and cars are to blame for rising atmospheric carbon dioxide. It elevates the carbon dioxide layer that absorbs and reflects solar radiation. One of them is consistent with Shepardson Shepardson et al.'s research findings. Students in elementary school were able to represent microscopic objects visually. They hypothesised that the atmosphere is where carbon dioxide is trapped. Because of carbon dioxide, sunlight is absorbed and cannot exit the atmosphere. The image of carbon dioxide resembles a ball. It was a result of the ignorance of molecule structure.

The majority of students are misinformed about greenhouse gases and global warming. Implementing the RADEC learning paradigm is necessary to ensure students possess the appropriate foundational knowledge. Creative and innovative ideas are certainly needed to solve problems. This is the perfect solution to get out of this problem. By building an understanding of how burning fossil fuels produces greenhouse gases, then through the pre-learning questions contained in the RADEC model, teachers can direct students to look for an alternative, environmentally friendly energy sources. In addition, students are also directed to change lifestyles to reduce dependence on fossil fuels by reducing the use of air conditioners. After ensuring that students have a firm grasp of these essential ideas, the next stage is to foster their creativity so they may produce innovative goods that will protect the environment from harm brought on by the usage of fossil fuels.

Global Warming through RADEC Learning Model

The problem of global warming is one the socio-science issues. This shows that students of all skill levels can easily access and comprehend this information, regardless of level. According to the findings of a study by Sukardi et al. (2017), teachers believed that the

topic of global warming was not urgent enough to be covered in class because, in addition to being a hot topic, it had not frequently been asked about in national-level exam questions in the past. There is not enough time for teachers to teach this information.

This can be accommodated because of the time-effective syntax of the RADEC learning paradigm. The teacher encourages students to look for, perform reading comprehension, and analyse material about global warming using pre-learning questions provided at the *Read* stage. Following the completion of the *Answer* stage, student feedback is gathered. The teacher then charts out students' grasp of the notion of global warming, identifying which concepts need to be repeated for them and which do not because the students have previously understood them. This allows teachers to investigate additional activities that will stimulate students' thinking processes and help them come up with original ideas.

Students check their comprehension of the idea of global warming during the *Discuss* and *Explain* stages through group discussions in both small and large groups. The teacher first develops students' environmental awareness through the reconstruction of information, which culminates in the generation of original ideas during the EDP (engineering design process) stage. Students require the creative items that are produced from this concept. The RADEC learning approach is an effective way to teach about global warming since it helps students understand the basics, develops their capacity for creative thought, and inspires environmental awareness among them by having them produce meaningful works of art

METHODOLOGY

Research Design

The method investigation actualises a one-shot case study that looks at the impact of executing the RADEC learning demonstration on students' inventiveness in understanding global warming issues. A one-shot case may be a straightforward quasi-experimental plan that looks at the impact of a treatment on a variable globally; it is appropriate for this investigation to seek out the common impact on show learning execution.

Sampling Technique

This case study was implemented during instruction on environmental science concepts with 30 7th grade students (16 boys and 14 girls) selected through a purposive sampling technique. A purposive sampling technique was chosen for this study to minimise research bias (Fraenkel et al., 2012). All students are taught in a bilingual classroom in the city of Bandung by a teacher experienced with the RADEC learning model. The teacher participants had received an online coaching experience on the RADEC learning model prior to this study. Mixture separation was one of the science topics teachers were taught through the full RADEC online mode. Results from this training showed that teachers could teach students with correct syntax and stimulate students' creativity (Sukardi et al., 2021c). Students were accustomed to individually designing an idea or creative project at the end of the semester. Previously, in the chapter on mixture separation, students designed

projects such as a simple water purifier, a dust filter, an open letter to the mayor to limit the number of cars entering the city, a song about water, and a crossword puzzle. However, this study focused on investigating the effect of implementing the RADEC model on the growth of students' creative ideas and projects by both individuals and small groups.

Instruments

Instruments used to collect data included a pre-learning questionnaire, worksheets, and guided interviews. Pre-learning questionnaires were used to determine students' understanding of fundamental science concepts and possible solutions for solving local environmental pollution problems. These pre-learning questions played a role in directing students' focus on the material that must be mastered (Sukardi et al., 2021b). The pre-learning questions were arranged and made based on the indicators of concept mastery and creative thinking skills. They also had a content judgement from experts. At the end of the pre-learning questions, students got questions on how to solve global warming. It is an open question. They communicated their ideas freely. It can be seen in Appendix A. Worksheets were used to collect ideas or creative projects throughout the study, as well as tools, materials, and working procedures. It can be seen in Appendix B. Guided interviews, however, were used to confirm information that was unclear from student worksheets. These conversations happened spontaneously between the teacher and student. The teacher ensured students that the creative products were useful and easy to made. All data obtained were triangulated. Here is an example of a guided interview question.

> Teacher: What is a solar panel?
>
> Student: It absorbs heat energy from the sun and converts it into electricity.
>
> Teacher: Are you sure you want to make it?
>
> Student: Hmmm. It seems difficult. Maybe we change to make the stove. It is simple.

Based on the statistical test, the pre-learning questions can guide students to focus on fundamental concepts (Sukardi et al., 2021b). Besides, those questions can also develop students' creative thinking skills with easy-to-understand language. Language in pre-learning questions has a dominant role in achieving learning objectives. Some pre-learning questions require students to mention their creative ideas on solving global warming issues. Experts from chemistry education and biology education validated the worksheet. The worksheet was described as a set of probing questions on how students making creative projects.

Treatment

Students' creative and innovative ideas were tested twice. It was tested by pre-learning questions during the *Answer* stage and worksheet during the *Create* stage. The difference is that the *Answer* stage is just asking for their ideas and inspiration. The *Create* stage produces not only more creative ideas but also creative and innovative products. *Discuss* and

Explain stages not only train students' creative thinking skills but also help students develop communication and collaboration skills in groups. These skills stimulate the growth of students' creative ideas. The framework for how the RADEC learning model helps students produce more ideas is shown in Figure 3.

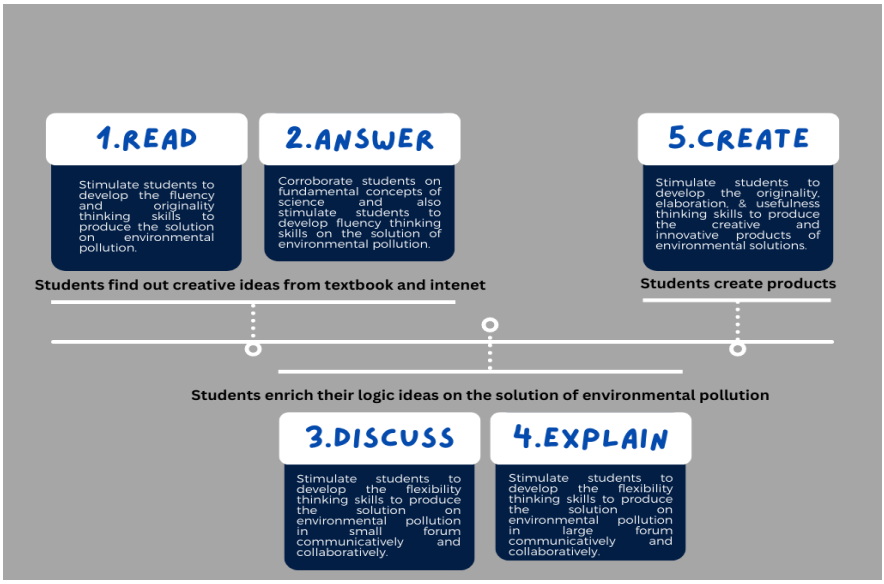

Figure 3. Framework for how does RADEC enrich the creative ideas of students

In the *Read* and *Answer* stages, the trained creative thinking skills are fluency and originality. However, achieving originality in producing solutions to environmental pollution problems is not an easy thing for students. At this stage, students can easily browse various sources of information from textbooks and internet pages. This condition provides opportunities for students to obtain various kinds of information that do not need to produce solutions to environmental pollution. This knowledge is called unintended knowledge. Therefore, the *Read* and *Answer* stages stimulate students' fluency in thinking skills but producing original creative ideas takes time.

The *Discuss* and *Explain* stages open space for students to discuss collaboratively and communicatively, as shown in Figure 3. Both stages provide opportunities for students to assemble various kinds of fundamental science concepts related to environmental pollution problems. After passing through these two stages, students are expected to have more creative and innovative ideas that are solutions to environmental pollution problems. Suppose students only transfer information from various sources at the *Read* and *Answer* stages. and at the *Discuss* and *Explain* stages. In that case, students will include other constructive ideas. In those stages, students share information. They also can strengthen the information or even negate the statement. They are expected to build new solutions to environmental pollution. At these stages, if they had previously collected and understood

the fundamental scientific concepts, now they could relate various scientific concepts related to solving the pollution problem. Meanwhile, the *Create* stage will train students to choose creative ideas that will be selected as group ideas. The idea is realised into a creative product that pays attention to social, economics and cultural benefits. Students were not only producing a product to solve the problem of global warming, but they could also investigate the problem of global warming and choose the solution or solve the problem of global warming. However, in this case, students were guided to produce a creative product.

Data Analysis

The data obtained are from students' creative ideas obtained through pre-learning questions. To obtain complete and representative information, unstructured interview questions were used to explore students' ideas. This data is then obtained by triangulation and then narrated the findings. Meanwhile, the data obtained from the worksheets include students' reasons for selecting creative ideas for group projects.

The data obtained from this study is a description of the creative ideas generated by students. Therefore, the triangulation technique is suitable for use. Triangulation alludes to using different strategies or information sources in a subjective personal investigation to create a comprehensive understanding of marvels. Triangulation has been seen as a subjective investigation methodology to test legitimacy by merging data from diverse sources (Carter et al., 2014). The complete data and how they were analysed can be seen in Table 1.

Table 1. Analysis data

No.	Purpose of data collection	Sources of data	Analysis
1	Finding out the initial ideas or projects of students in the RADEC learning model	1. Worksheet (primary) 2. Pre-learning questions (secondary) 3. Guided interview questions (secondary)	1. All the students' answers to the question in the worksheet were gathered described in detail. 2. Because the data from the worksheet were limited, the data were also taken from the individual pre-learning answers, both concept mastery and creative thinking skills. 3. Guided interview questions were used to confirm answer student's answers on how they got creative ideas. 4. Those findings are triangulated on how powerful RADEC learning model can grow up the students' creative ideas.

(Continue on next page)

Table 1 (continued)

No.	Purpose of data collection	Sources of data	Analysis
2	Finding out chosen ideas or projects for each group in the RADEC learning model	1. Worksheet (primary) 2. Guided interview questions (secondary)	1. The group idea innovative making the creative product was found in the worksheet. 2. The explanation of why they chose the idea of making an innovative product was gained through guided interview questions. The questions could also be used to guide students in choosing the creative products.

Trustworthiness of the Findings

The findings have to fulfill the principle of trustworthiness; credibility, transferability, dependability, and confirmability. Students' creative ideas fulfilled the principle of credibility because those ideas were gained through many instruments, such as pre-learning questions, worksheets, and unstructured interviews. The teacher's strategy of giving pre-learning questions has been implemented several times in the same class on different topics with similar results. Students can show their performance in providing creative ideas so that the research results meet the transferability principle. This was shown by previous results that students could produce more creative ideas on mixture separation and electricity topics (Sukardi, Sopandi, Sutinah, et al., 2021). The research findings also fulfilled the principles of dependability and conformability because the procedures could be repeated to gain the relatively same results. They also could be avoided biased results.

Ethical Considerations

The research fulfilled the ethical considerations on these points. They are voluntary participation, informed consent, anonymity, confidentiality, the potential for harm, and results communication. Although the sampling techniques were purposive, students could choose to join. was. They can withdraw from the study at any time without any negative repercussions. They also got clear information on the beneficial joining the RADEC learning model. Keeping the anonymity, there were not any individual data collections except the result of creative ideas. The research also guaranteed to remove all identifying information from the results.

RESULTS

Initial Ideas or Projects of Students in the RADEC Learning Model

Before starting instruction with the RADEC model, students were given a pre-learning

questionnaire related to fundamental concepts of pollution. The step in implementing RADEC was to solicit and then collect creative ideas from the students about to handling environmental pollution problems. The ideas collected through the worksheet show that these creative ideas are not original ideas generated by students but are ideas taken from various sources (see Table 2). The total number of solutions was huge – 72 different ideas across 11 categories of projects after the implementation of the RADEC learning model. The pre-learning questions contain low-order thinking skills (LOTS) and high-order thinking skills (HOTS) in the context of fundamental science concepts and stimulate reading. They also contain many inspirations for the project or ideas that students could efficiently conduct. This indicates that the pre-learning questions given to students can grow the fluency aspect in mentioning several alternative solutions to environmental pollution, as presented by several researchers (Bakri et al., 2020; Maruf et al., 2020; Siregar et al., 2020).

Table 2. Students' ideas or projects

No.	Idea or project	Description	Number	
			Before	After
1	Create a poster with the theme "Save The Earth"	Content in the form of an invitation to take steps to save the environment, such as preventing global warming.	19	27
2	Making a water filter in the river	A prototype made to separate plastic waste from water bodies.	11	17
3	Making solar panel	The prototype is intended to absorb and convert sunlight energy into electrical energy.	0	8
4	Making windmill	Prototype intended to produce alternative electrical energy from wind power.	0	10
5	Make a water purifier with an absorber	A prototype that functions only to absorb and agglomerate chemicals in water bodies to obtain clean water.	0	5
6	Making a conventional water purifier	The prototype filter filters out micro-sized solid impurities while absorbing nano-sized harmful chemicals.	0	2
7	Making biogas from animal waste	The prototype is a tool capable of processing and converting animal waste into methane gas (CH_4).	0	2
8	Making bioplastic	A prototype that can be used as a plastic bag can be decomposed because it is made from plants.	0	2
9	Make a dust filter in the exhaust	A prototype capable of filtering out solid particles from motor vehicle combustion.	0	1

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Table 2 (continued)

No.	Idea or project	Description	Number	
			Before	After
10	Hydroponic farming	The prototype is in the form of agricultural land that uses water as a medium to grow crops so that it is pest resistant and does not require chemical fertilisers that have the potential to pollute water bodies.	0	1
11	Making compost from household leftovers	The prototype is in the form of compost which is expected to be able to reduce the number of chemical fertilizers that have the potential to pollute water bodies.	0	1
	Total		30	72

The number of creative ideas or projects written by students was 72 after implementing the RADEC learning model, indicating that many students could provide more than a single answer. Those creative ideas for making creative products come from students' answers written in the worksheet and pre-learning questions (Appendices A and B). In the worksheet, students are required to answer the product as shown in this question:

> Projects related to learning global warming in everyday life that can be made are….

Besides, in the pre-learning questions of concept mastery and creative thinking skills, students are asked to write down their creative ideas.

> Determine the three most effective approaches to lower greenhouse gas emissions based on the literature review! Justify and provide evidence for your choice!
>
> In order to lessen air pollution, Bogor's mayor, Aria Bima, restricts the number of cars that can enter the city. Do you think these regulations are appropriate? Give another suggestion if it's a not right!

Both of these inquiries seek to elicit unique student solutions to the global warming issue by reducing fossil fuel use. Table 2 demonstrates that pre-learning questions successfully boost students' number of original ideas from 32 to 72. Students are required to read comprehension questions as part of pre-learning activities, which forces them to comprehend the issue of global warming or greenhouse gases and come up with solutions that can be advantageous to many parties. Some students' answers are far from what the teacher expected but are still by the qualifications necessary for designing a solution to environmental problems.

Two students said that chemical fertilisers should be minimised because it affects aquatic organisms' life in rivers and the sea. When further interviews were conducted regarding the answers provided by these students, they explained that insecticides toxic to insects would eventually dissolve in water bodies and accumulate in seawater in the form of ions or

harmful chemical compounds. The knowledge they had gleaned from reading about these concepts is called unintended knowledge, as the main purpose of the teacher asking pre-learning questions was not on those concepts. However, the unintended knowledge gained by these students is in keeping with constructivist views of learning related to the material being taught.

Students in an unstoppable flow delivered creative ideas and projects. This shows how influential the RADEC learning model was in stimulating students to read, predict, and think about ideas. Students gain unintended knowledge from learning activities. Not all students make products related to science, even most students make posters. This indicates that not all students who study science have to become scientists, but many who become artists can campaign for environmental awareness. This is one of the uniqueness of the RADEC learning model (Sukardi et al., 2021b).

There were so many creative ideas or projects mentioned and written by students. All were diverse, and colourful, and addressed a solution to local issues of global warming. A more profound interview was conducted to investigate the reasons for choosing and making those products. The dust and plastic waste filter devices are ideas that are supported by students' understanding that mixtures can be separated through simple filtration with the principle of differences in the particle size of substances. The particles in the sieve must be smaller than the size of the substance to be filtered. This filtering principle involves only chemical reactions. Different answers were given by several students who said that chemical compounds must be used to absorb unwanted chemical substances. When asked further questions regarding the principle of absorption, some answered that the process was like agglomerating substances such as colloidal systems without specifying the name of the chemical compound they were referring to. These complete explanations were earned through deeper discussion with students in *Discuss* and *Explain* stages.

The guided interview questions were used to investigate how they produced the creative ideas. The results of interviews with students showed that the idea of processing biogas from animal waste emerged because they read the news that animal waste is the cause of global warming. Every day, a million volumes of methane (CH_4) are released into the air for nothing. Meanwhile, the idea of making bio-plastics came about when they read an advertising campaign by a department store that used plastic bags that were biodegradable as they were made from cassava peels. Meanwhile, various alternative energies have emerged as a solution to environmental pollution because Indonesia is a tropical country sunlight with high sunlight intensity every year and strong winds along the Indonesian coast.

The idea of making posters campaigning to save the earth shows that students cannot make products. They have a basic knowledge of science on how to minimise environmental pollution. Table 1 shows that this idea was the most written by students. Of the 25 students, only three did not write this idea down in their worksheet worksheets. This data is easy to collect from students because it uses the Google Form platform. This large number of ideas is a challenge for teachers to improve students' understanding of fundamental science concepts and their creativity. In addition, the large number of ideas or projects indicates

that students' actual knowledge has great and excellent opportunity to further develop.

Creative ideas are collected through pre-learning questions and worksheets. Some of the creative ideas conveyed by students were unclear. Therefore, conformation was carried out through guided interview questions. The answers to the guided interview questions indicated that students could generate a lot of creative ideas because they were required to read and answer questions before learning was carried out in class. This question also confirms if creative ideas are not in accordance with the content and learning context. The next stage is the data triangulation process. Pre-learning questions, worksheets, and guided interview questions are instruments in the RADEC learning model. The results of data triangulation show that there is synergy between pre-learning questions and worksheets in stimulating students' creative ideas. Both instruments force students to learn independently to find creative ideas so that only a few are found at first. However, after discussing pre-learning questions and worksheets, students have more references regarding creative ideas because they share information in discussion forums. An increase in the number of creative ideas can be seen in Table 2.

The Chosen Ideas or Project for Each Group

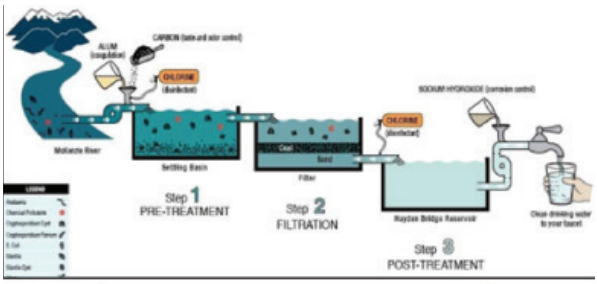
The teacher allows students to discuss in small groups using the Zoom cloud meeting platform at the *Create* stage. The pandemic condition that limits the mobility of students to gather in person is a typical obstacle in this study. Students can only discuss creative ideas or projects that are the mainstay of their group. Execution of product manufacturing is difficult to carry out unless one of the group members becomes a volunteer to make group products. However, the most critical part is determining the idea or project that represents the group.

The ideas or projects chosen by the five groups are as follows: one saves the earth poster, two water filters, one solar stove, and one project for making biogas from cow dung. Figure 4 shows how students communicate messages to their fellow students to save the earth through attractive posters without verbal messages. They might choose the pictures from the internet after selecting hundreds of pictures. Students campaign for simple things that they can do to save the earth, such as reforestation and reducing the volume of smoke from private vehicles. This group is already at the *Create* stage in the engineering design process.

Two other group projects were a solar cooker and a water filter. However, these projects have not been realised due to the limited mobility of students to work in groups. The engineering process in designing these projects can be seen in Figures 5 and 6. Those were gained from the worksheet.

Figure 4. Save The Earth

The water filter project presented in Figure 5 shows that students do not easily carry out the idea or project without the assistance of teachers or parents. This indicates that the simple filter tool they designed is not an original idea but an idea that emerged while googling on internet pages. The process that the students did not consider when designing the device was how to test the quality of the water produced from the filter. The investigation results through guided interview questions stated that students chose the idea because the tool could be mass-produced and used, providing significant benefits to the community even though the idea was not original. This selection consideration shows that students have flexibility in deciding on an idea/project. The project does involve not only physical and biological working principles but also involves chemical reactions. The two groups who chose the idea/project for a tool like this had not yet reached the *Create Product* stage but had only reached the *Plan* stage in the engineering design process, so a prototype had not yet been produced.



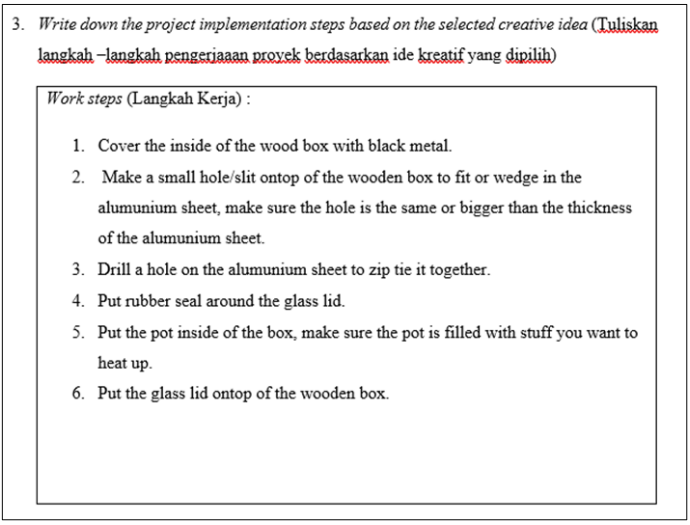
Work steps (Langkah Kerja) : So we use EWEB or Water Filtration Process to solve our problem for sanitation. So first thing first we need to prepare three session container. First we fill the first pipe with ALUM (coagulatin) , Carbon(taste and odor control) and Chlorine for the disinfectant. After that we are going to the Step 1 (Pre-Treatment) at first container or we called it setting basin, we separating big rubbish for example plastic and iron. Next we send the water to Step 2 (Filtration) at the second container,and we called it Filter. We fill it with Coal and Sand for separating little things from water. After that we send again the water with pipe who have Disinfectant in that to clean it and ready for Step 3 (Post-Treatment) or Hayden Bridge Reservoir.And finally we send it to village so we it will be Clean Drinking water to our faucet

Figure 5. Making water filter

Meanwhile, the idea or project for making a solar cell stove in Figure 6 arose because of students' understanding of the intensity of sunlight in a tropical country like Indonesia. The cooker works like a greenhouse where the incoming sunlight is focused and trapped at several points so that the high temperature can ripen the food in the tool. Like water filters, the solar cookers idea has only reached the *Plan* stage in the engineering process. The answer to guided interview questions also showed that students changed their idea from solar panels to solar cookers because of its complexity. They only found the idea of solar panels from the internet, but students have not mastered the fundamental principle. The teacher suggested that students to choose another simple idea.

For ideas of making biogas from animals, students choose to take cow dung from dairy milk around the city of Bandung. This group has not yet completed the work steps that must be done. So, what is obtained is only at the *Choose Possible Solution* stage. During the guided interview with the students, information was obtained that they were inspired by the news which stated that a lot of methane gas evaporates into the earth's atmosphere for nothing, thereby increasing greenhouse gases, even though methane can be used for household and industrial fuel. Some students claimed that the process of creating this innovative product was genuinely repulsive because it was made from animal excrement. One of them claimed to create a device that would automatically produce goods without ever coming into contact with these excrements. However, factually, they have not known how to make the product

in detail because of a lack of information. Students said that apart from methane (CH_4), this process also produces other gases such as propene (C_3H_8), hydrogen sulfide (H_2S), nitrogen (N_2), carbon monoxide (CO), oxygen (O_2), and even a little heat energy.


3. *Write down the project implementation steps based on the selected creative idea* (Tuliskan langkah –langkah pengerjaaan proyek berdasarkan ide kreatif yang dipilih)

Work steps (Langkah Kerja) :

1. Cover the inside of the wood box with black metal.
2. Make a small hole/slit ontop of the wooden box to fit or wedge in the alumunium sheet, make sure the hole is the same or bigger than the thickness of the alumunium sheet.
3. Drill a hole on the alumunium sheet to zip tie it together.
4. Put rubber seal around the glass lid.
5. Put the pot inside of the box, make sure the pot is filled with stuff you want to heat up.
6. Put the glass lid ontop of the wooden box.

Figure 6. Making solar cooker

The five ideas or projects students chose as group ideas were not their original ideas. However, what matters is how they formulate the problems they face, gather the information that supports the decision-making process, and express logical arguments to choose the best idea or project they can work on. This indicates that at the *Create* stage, the RADEC learning model stimulates student creativity and builds creative thinking skills (Satria & Sopandi, 2019). The implementation of the RADEC learning model in the school is still in the early stages. Thus, it can be understood that at the creation stage, new students can merely imitate ideas or projects that already exist before. It is interesting to investigate further whether sustainably implementing this learning model can ultimately lead to original creative ideas.

DISCUSSION

Initial Ideas or Projects of Students in the RADEC Learning Model

The analysis of the quality of creative ideas shows that they are all imitations of various sources on internet pages. No new ideas were found from all of them. However, the thing that is of concern is the diversity of how they view solutions to problems that must be resolved. Suppose a student thinks bioplastics should be made to save the environment, while other students prefer to make posters as shown in Table 2. This difference in point of view of ideas is interesting to investigate because it shows the depth of concepts they understand more than just exploring ideas creatively from the internet.

The question given to all students is the same: what is the solution to global warming? The results of unstructured interviews with students who gave ideas for making bioplastics showed that they thought the energy used to make bioplastics was relatively smaller than making paper. In addition, bioplastic is more environmentally friendly, and the decomposition time is relatively fast. This condition will reduce the carbon footprint generated by the plastics industry. Students said bioplastic could be used for various needs, one of which is replacing plastic or food wrapping paper. Of course, such ideas do not come directly from students but instead from a relatively lengthy process (Haynes, 2020; Sukardi, Sopandi, Riandi, & Tanuatmadja, 2022; Syahrin et al., 2019). The fact shows that the idea of making bioplastic emerged after students discussed it with their group friends. However, some students only gave ideas related to making posters even though they had gone through the discussion process. This indicates that the RADEC learning model can accommodate various levels of students' academic abilities (Tulljanah & Amini, 2021). Students with good academic abilities can develop their creative ideas but students with low academic abilities show different things. They cannot produce creative ideas other than those exemplified by the teacher in the worksheet even though the teacher has carried out the discussion and reinforcement process in the *Explain* stage.

During their search for creative ideas, students get a variety of knowledge they do not need to build creativity related to global warming solutions. This knowledge is unintended, such as students finding information about vegetarianism and hydroponic farming. The internet page describes the health benefits of a vegetarian lifestyle but does not mention that reducing beef consumption will reduce the production of methane gas produced by cow dung. This important information was obtained through unstructured interviews with students. If students only move the information on the internet page into the answer sheet, of course, this information will be written down by the students. However, in fact, students do a re-assessment before writing down these ideas. Students will think selectively in processing and writing answers (Lestari et al., 2021; Sukardi, Sopandi, Riandi, Rahmawati, et al., 2022).

The read-and-answer stages help students develop fluency thinking skills (Fuadi et al., 2021; Sujana et al., 2021). In the pre-learning questions, besides being asked about the fundamental concepts of science, students are also asked about possible solutions to solve global warming. This is what is called a creative idea *Before* the stage. Meanwhile, in the *Create* stage worksheets were also asked about the creative ideas students chose to solve global warming. Students are given inspiration in the form of choices of creative ideas. This is a creative idea in the *After* stage, as shown in Table 2. The improvement is very significant after going through the *Discuss* and *Explain* stages. Without learning the RADEC model, creative ideas may also develop, but the question is how long it will take to develop these creative ideas. It will take a very long time. The RADEC learning model is a step to stimulate and accelerate the development of thinking skills for students (Imran et al., 2021; Rindiana et al., 2022; Rohmawatiningsih et al., 2021).

Creative ideas that must be made by students must consider the benefits in the economic, social, and cultural fields. This is the most crucial thing because the students in the group

have to choose the right ones (Sukardi, Sopandi, Riandi, Avila, et al., 2022; Suwarno et al., 2020). The various ideas written after the *Explain* stage must finally condense to a single choice of ideas. The idea is realised into a simple product but has great benefits. As a result, the product includes imitation of existing products. However, the positive side that can be obtained is how students are trained to think critically. Even some of the students only came to the design of the idea. The written work procedures also vary; some are modified or imitations of internet pages, as shown in Figures 5 and 6. The procedure shown in Figure 5 is not a simple step. However, students think that if the project is made by a professional or involves adults, it will benefit social, economic, and cultural aspects. This is because the product is what students think is needed to meet the need for clean water. This project is an imitation. The project shown in Figure 6 is an imitation project that can be found easily on the internet. However, the modification is in the work procedure. Students design the device only to heat water. This idea is very applicable and has the probability of being realised, but unfortunately, the manufacture of this product has only reached the planning stage.

Students will find unintended knowledge when searching for creative ideas from textbooks and internet pages (Sukardi, Sopandi, Riandi, Avila, et al., 2022). The student who optimises the search without pre-learning questions will write down all the ideas. However, the fact is that students become selective in taking creative ideas related to a problem after getting used to getting pre-learning questions in class (Imran et al., 2021; Siregar et al., 2020). Pre-learning questions play a role in shaping the fundamental concepts of science through measurable and tiered cognitive guidance (Sujana et al., 2021). The discuss and explain stage is a stage that trains and tests students' thinking skills because they will face many questions from teachers and other students during the brainstorming process.

Previous research on the number of students' creative ideas after implementing the RADEC model showed that the number of students' ideas was not as much as in this study. Besides, the creative ideas generated are so diverse that they are not limited to efforts to filter dirty air with specific tools. Students can mention ideas about creating alternative energy to decrease energy consumption derived from fossil fuels. Previous research conducted by Siregar et al. (2020), Maruf et al. (2020), and Wulandari et al. (2020) shows that the creative ideas conveyed by students are almost all the same. This is different from the results of the study, which are so diverse. The number of creative ideas written by students has increased markedly, as shown in Table 2. Previous research has also optimised the use of various online learning platforms both synchronously and asynchronously. However, the most significant difference is that in this study, all learning was done through virtual face-to-face meetings. What is interesting is the emergence of new habits of students who prioritise searching for information sources online compared to searching for information manually in the printed textbook suggested by the teacher.

Another fundamental difference between RADEC full online learning and RADEC blended learning conducted by Siregar et al. (2020) is related to a platform to communicate asynchronously and collect answers to pre-learning questions. Students are provided with Google Classroom to communicate, but they prefer to use the WhatsApp Group or meet

synchronously via Zoom Cloud Meeting or Google Meeting. This is because they think these two platforms are more accessible and effective. They create a virtual face-to-face meeting link independently to discuss the creative project they will make. The use of this online platform does not mean without problems because, many students are active in discussions but also passive and act as listeners. Teachers work hard to stimulate student activity in searching for creative ideas on internet pages. Research conducted by Imran et al. (2021) produces diverse products, not only in the form of objects but in the form of research ideas or problem-solving. Different findings from this study stimulated students to design a creative product by optimising the engineering design process. The findings of previous research produced ideas such as songs that tell about the process of flooding or water pollution, which only stimulate cognitive development. At the same time, this research also stimulates students' psychomotor development.

The Chosen Ideas or Project for Each Group

The previous results showed that the creative project could not be run well because of the restricted mobility during the pandemic time. They merely used the Zoom cloud meeting platform to have a virtual discussion. Communication and collaboration were conducted by planning the projects. The making product has not been conducted well. They had a good time for minds-on activities in the virtual platform but were confused with hands-on activities in making products. Sukardi et al. (2021c) said that the virtual platform was good for showing up for the discussion in producing critical and creative thinking skills. However, it needed more strategies to show up physical collaborative work. Those weaknesses of the virtual platform did not decrease the beneficial function of the virtual platform to accelerate the students' fundamental concepts developed through discussion.

The platform used in learning is Zoom cloud meetings where students can discuss in small groups in the breakout room. Using this platform is both an opportunity and a challenge. This is an opportunity because indirectly learning the RADEC online mode can improve students' digital literacy. However, this can also be called a challenge because online learning takes a relatively long time to build the expected learning climate. One of them is activating students in communicative and collaborative discussions as shown in Figure 7. Teachers needed the extra energy to stimulate and trigger students to be involved in discussions. Some of the students did not open the camera but tried to deliver their ideas.

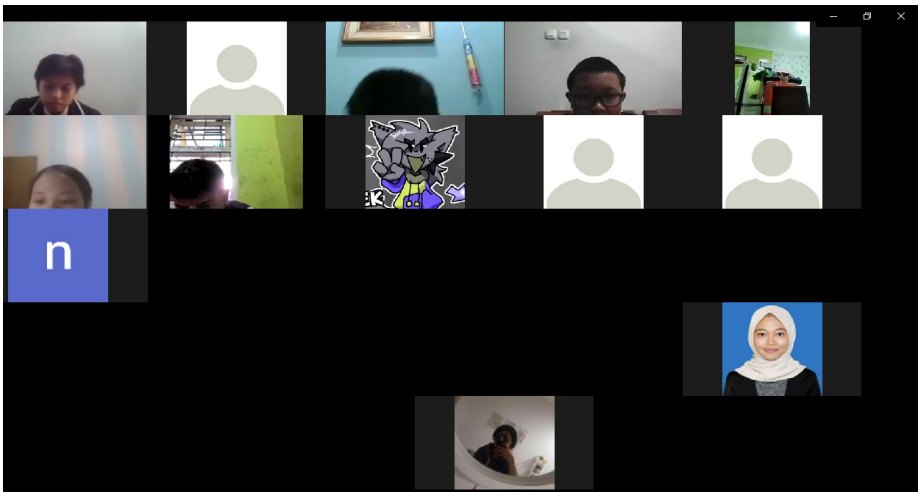


Figure 7. Students' discussion in planning the project

The engineering design process is ideally carried out directly where students can submit their creative design ideas and get feedback from their classmates and teachers. They also work in a Google Docs so anyone can directly edit the product manufacturing procedure as shown in Figures 6 and 7. Before designing the procedure for a project, students first agree on what ideas will be used as projects by considering that the products made are not only easy but also provide benefits to the community, social, economic, and cultural aspects. Up to this stage, this platform can work optimally. However, the problem arises when going to work on the project. Some groups are trying to make a product in the form of a simple water filter. Each group member makes it independently so that later in the group, which one is the best and will be the product of the group. This condition does not involve collaborative student work in groups. They work individually, so the collaboration and communication process does not go well. Some groups even only reached the planning stage. They create prototypes of creative projects using online image-making applications such as *canva* and others. The mobility of students to gather is minimal because they collide with strict rules regarding the COVID-19 prevention health protocol. This limitation needs to be addressed immediately to produce a better learning process.

Students previously had the chance to meet, personally communicate, and work on creative projects, a huge shift from earlier creative projects. However, this class uses a fully online mode, limiting their interaction to the internet. Each student in a group creates a tool on their own while working on the solar cooker project. The best tool is then chosen, which will be the group's output. The students have agreed to this agreement. The students' varying skill levels in carrying out product production meant that this scenario did not function as intended in practice due to several constraints. Students in the EDP (engineering design process) only complete the designing phase; no products have yet been created. Since product judgement cannot be made, group concept judgment must be used instead. The area of EDP, which specifically connected the project to fundamental concepts, was

not included in earlier studies on the impact of using the RADEC model on students' innovative ideas (Siregar et al., 2020; Wulandari et al., 2020).

However, based on the answers to guided interviews, almost all creative products produced are imitations and only slightly modified. The modified product made by the students is related to the environmental saving campaign poster. Students can process information and execute it in detail. This poster will certainly be an authentic product because it presents information with various dictions unique to each student.

The virtual platform has not optimally facilitated students in doing physical collaborative projects. They have not been able to have a trial of their products. They also have not been able to perform the performance skills of making products. However, the virtual platform has facilitated students to build their creative and critical ideas in producing products. Through the virtual platform function, students could consider the best project that considers many aspects, e.g., social, economic, and cultural. They also can write and draw the planning of the projects directly in the virtual platform.

CONCLUSIONS, LIMITATIONS, AND RECOMMENDATIONS

The results above show how the RADEC learning model promoted student creativity and problem-solving. Students came up with multiple intriguing solutions to local-global warming problems and communicated their solutions to others. These solutions were documented in student presentations and the posters students constructed urging others to keep the environment clean and combat global warming at the local level. Besides, the virtual meeting platform must be optimised because it has not been able to accommodate how students could work in group collaboratively dan communicatively to produce a product. Some of products were made or drawn in a picture. The following research on the development of the RADEC learning model online mode has to accommodate those needs where students could collaborate and communicate the activities of EDP directly.

Realising the physical activities in making a project cannot conduct collaboratively, the instruction in EDP should be modified. Teachers instruct students to design the product with a different function. For example, each group members make a product of water filtration. They make two kinds of products, e.g filtration of physical and chemical impurities. They make them individually and then share the trial through the virtual platform. They choose the best products that show the best performance. These instructions in the engineering design process enable students to have collaborative and communicative works by optimising the hands-on and minds-on activities.

Another drawback of RADEC learning fully online is that not all students respond promptly during the Discuss stage by opening the zoom camera. Some students dominated in offering clarification, making assessments, and even making arguments in opposition to the presenter's material. However, others do not even open their cameras throughout the *Discuss* and *Explain* stages, are unresponsive, or both. In order to learn the RADEC fully online mode, socialising and a personal approach to pupils are required

first. This is a problem that is fairly intricate and demands a personal approach. It is expected that they will actively participate in discussion forums with the same dedication.

The restricted direct meeting triggered the use of a virtual platforms for learning because of covid-19 pandemic. In Indonesia, it was the beginning of digital literacy improvement in learning process. The RADEC learning model in online mode also opens borderless vast opportunities to collaborate and communicate. It not only enables students to build the understanding of science fundamental concepts but also empowers students to develop other thinking skills. In some regions of Asia Pacific, the implementation of a learning model that enable students to develop creativity through online platform was relatively new, including in Indonesia. The RADEC learning model can be applied across the countries in the Asia Pacific. The collaboration could be an acceleration process in developing science education in Asia Pacific.

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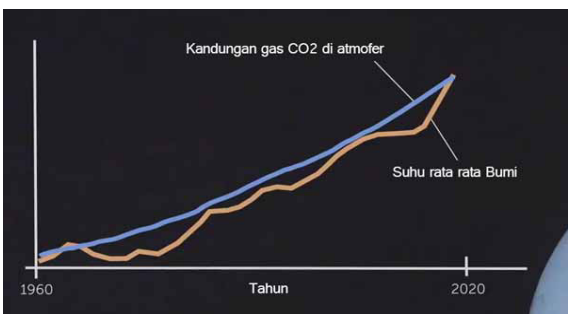
APPENDICES

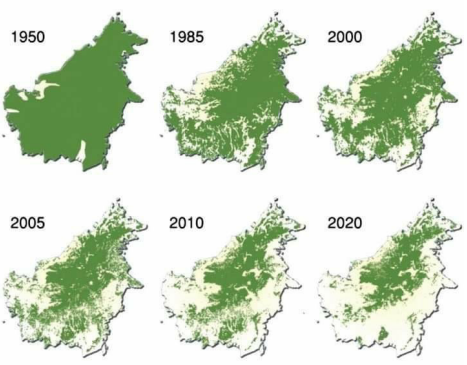
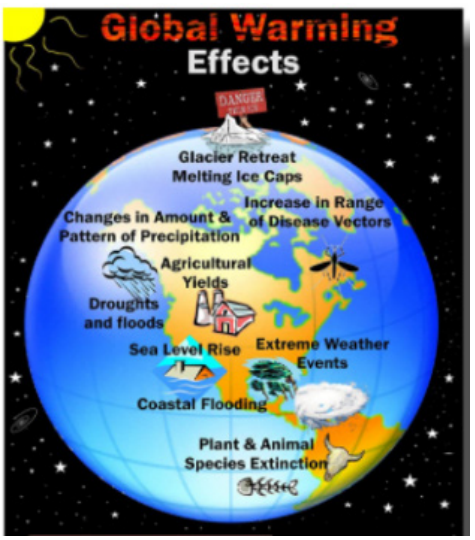
Appendix A

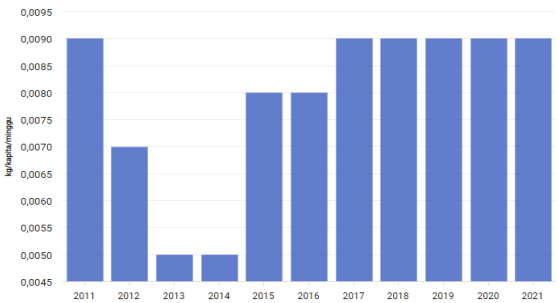
<table>
<tr><th>Indicators on Concept Mastery</th><th>Questions</th></tr>
<tr><td>Listing some instances of greenhouse gases that cause global warming.</td><td>The breakdown of the gases found in the earth's atmosphere is shown in the table below.

<table><tr><th>Gas</th><th>Simbol</th><th>Volume (%)</th></tr><tr><td>Nitrogen</td><td>N_2</td><td>78,08</td></tr><tr><td>Oksigen</td><td>O_2</td><td>20,95</td></tr><tr><td>Argon</td><td>Ar</td><td>0,93</td></tr><tr><td>Karbondioksida</td><td>CO_2</td><td>0,035</td></tr><tr><td>Neon</td><td>Ne</td><td>0,0018</td></tr><tr><td>Methan</td><td>CH_4</td><td>0,00017</td></tr><tr><td>Helium</td><td>He</td><td>0,0005</td></tr><tr><td>Hidrogen</td><td>H_2</td><td>0,00005</td></tr><tr><td>Xenon</td><td>Xe</td><td>0,000009</td></tr><tr><td>Ozon</td><td>O_3</td><td>0,000004</td></tr></table>
Mention any gases including greenhouse gases that cause global warming from the table above!</td></tr>
<tr><td>Explaining the process of global warming</td><td>Look at the picture!

What is the relationship between the CO_2 gas substance in the atmosphere and the average temperature on earth?</td></tr>
</table>

Indicators on Concept Mastery	Questions
Predicting the effect of decreasing green open space on the composition of greenhouse gases in the atmosphere.	Look at the picture below! The green color in the image shows green open land or forest areas on the island of Borneo.  What do you think will happen to the composition of greenhouse gases if the trend of decreasing land area continues? Describe in detail!
Predicting the global impact of increasing greenhouse gases on ecosystems.	The image below is an infographic regarding the impact of global warming on the environment.  From the various impacts of global warming presented in the picture, choose the 3 effects that are the most deadly in your opinion! Give an explanation!

Indicators on Concept Mastery	Questions
Developing alternative strategies to reduce the volume of greenhouse gases without eliminating the use of fossil fuels.	Based on the literature review, determine the 3 best ways to reduce greenhouse gas emissions! Explain your choice accompanied by reasons and evidence!
Explaining verbally and visually the concept of the greenhouse effect.	1. Describe the process of the greenhouse effect accompanied by an explanation! 2. What are the main factors causing the greenhouse effect? 3. What are the main factors inhibiting the greenhouse effect?
Indicators on Creative Thinking Skills	**Questions**
Fluency Capable to state a number of ideas fluently.	Look at the graph of the amount of Indonesian beef consumption below:  In the next few years, the amount of beef consumption is predicted to increase significantly. While cattle farming activities produce a greenhouse gas, namely methane. Try to name at least five solutions to this problem!
Flexibility Capable to consider various kinds of ideas flexibly	The hottest temperature in Bandung is 29°C. The temperature is predicted to rise due to the increase in the volume of greenhouse gases. Almost every week hundreds of cars from Jakarta enter Bandung. Bandung is also surrounded by hundreds of textile factories. The number of hotels and restaurants is also increasing. In your opinion, what are the five main causes of the increase in greenhouse gases?
Originality Mentioning ideas that are unique and different from existing ideas.	The Mayor of Bogor, Aria Bima, limits the number of cars entering Bogor to reduce air pollution. In your opinion, are these rules appropriate? If it's not right, give another idea!
Elaboration Building an idea based on conceptual knowledge.	Electricity production in Indonesia is highly dependent on fossil fuels. This of course will increase the amount of greenhouse gases in the air. The government has announced the use of alternative energy for electricity supply several times. In your opinion, what solutions can be made to reduce greenhouse gases by using alternative energy? Describe!

Usefulness
Capable to add value to an idea based on consideration of social, economic, cultural and environmental aspects.

Some creators are trying to create a stove that comes from solar energy like the picture below. The reason is not to use fossil fuels.

1. Try to analye whether the solar stove effectively reduces fossil fuel consumption?
2. Try to redesign the tool so that it has social, economic, and cultural use values!

Appendix B

WORKSHEET ON THE CREATE STAGE

Data : .....

Subject : .....

Group : .....(Leader)

.....(Member)

.....(Member)

.....(Member)

a. Projects related to the topic of learning about global warming in everyday life that can be made are:

1. .....
   .....
2. .....
   .....
3. .....
   .....
4. .....
   .....

b. Among the projects above (a), the most interesting to be realised immediately are:

.....
.....
.....
.....

c. Project (b) above is the most interesting to be realised due to the following things:
.....
.....
.....
.....
.....

d. Tools, materials, resources, or other things needed to realize project (b) above are as follows:

(1) Tools:.....
.....

(2) Materials:.....
.....

(3) Resources:.....
.....

(4) Others:….....
.....

e. The work steps, time allocation, and the person responsible/involved for each work step are as follows:

No	Works Step	Estimated time	Person Responsible	Description
1.				
2.				
3.				
4.				
Etc.				

f. Evidence of projects that have been made are as follows (can be in the form of photos, videos, scripts in the form of writing, models, tools, etc.).....
.....
.....
.....
.....

g. Difficulties encountered when completing projects and how to overcome them

.....
.....
.....

h. The project that has been made compared to the plan. …….....
.....
.....
.....