

Lectures during the COVID-19 pandemic using the Education for Sustainability Development Oriented RADEC learning model

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Abstract

The COVID-19 pandemic has lasted for more than 2 years. The education sector is one of the most influential fields to apply online learning policies. Indonesia has implemented online learning since the pandemic in 2020. This study aims to provide an overview of knowledge during the COVID-19 pandemic using the education for sustainable development (ESD)-oriented read, answer, discuss, explain and create (RADEC) model. This study used the descriptive method by providing an overview of the ESD-oriented RADEC learning process in the basic concepts of biology and science for prospective elementary schoolteachers. The research subjects were 33 prospective elementary schoolteacher students who contracted courses. The instruments used were observation sheets, documentation and a questionnaire. The results showed that lectures using the ESD-oriented RADEC model could be an alternative for online learning during the COVID-19 pandemic. In addition, the ESD-oriented RADEC model may allow universities to instil the concept of ESD related to knowledge, attitudes and values that can support sustainable development.

Keywords: RADEC, prospective teacher, ESD, COVID-19.

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1. Introduction

The COVID-19 pandemic status declared by the World Health Organisation impacted all fields (Downing, 2021), including the closure of all educational institutions globally and shifting in their learning process (Mukhtar et al., 2020; Sahu, 2020). In response, every educational institution had to develop online learning strategies (Sahlberg, 2020; Schnider & Council, 2021). Indonesia's online learning policies are regulated in the circular letter of the Ministry of Education and Culture Number 4 of 2020 regarding education during the coronavirus disease (COVID-19) emergency period, where the learning process changed to learning from home through online learning (Kemendikbud, 2020).

Online learning demands teacher creativity and technology that can support the learning process. At the beginning of the pandemic, schools and universities in Indonesia used only WhatsApp for learning (Gunawan et al., 2020). Over time, the learning process began to adapt by using various online platforms such as WhatsApp groups, email, video conferences (Google and Zoom meetings), Google Classroom and Moodle (Gunawan et al., 2020; Khasani et al., 2019; Rizaldi & Fatimah, 2020).

Universities conducted online learning research through the learning management system (LMS). Lecturers are given the flexibility to determine appropriate learning strategies and models to support online learning. Suitable learning models, both offline and online, are required to achieve learning objectives. In addition, it will increase student learning motivation during education. In addition, lecturers are expected to choose online meeting applications such as Zoom, Skype, Google Hangout meeting, Cisco Webex meeting and GoTo Meeting (Pratama et al., 2020).

The read, answer, discuss, explain and create (RADEC) model is a learning model developed in Indonesia. RADEC stands for reading, answering, discussing, explaining and creating, which shows the learning process stages (Sopandi, 2017). The RADEC model has been widely studied (Anggraeni et al., 2021; Pratama et al., 2020; Rahayu et al., 2021; Sopandi et al., 2020). This model can improve the students' critical and creative thinking. However, several previous studies that analysed the RADEC learning model had not expressly raised the concept of sustainability and were carried out offline. Therefore, the researchers tried the RADEC model oriented towards education for sustainable development in this paper.

The education for sustainable development-oriented RADEC model was developed with steps to achieve the learning objectives of lecture materials and acquire the education dimension for sustainable development. Education for sustainable development is a part of the Sustainable Development Goals (SDGs) for achieving sustainable development (UNESCO, 2016). The SDGs are a global action plan agreed upon by world leaders, including Indonesia, to end poverty, reduce inequality and protect the environment. The SDGs contain 17 goals expected to be achieved by 2030 (Griffiths, 2020; Sato et al., 2020).

Education for sustainable development (ESD) is essential as a global education paradigm (Laurie et al., 2016) to help develop attitudes, skills and knowledge (Anyolo et al., 2018; Rieckmann, 2019; Waltner et al., 2018) (Anyolo et al., 2018; Rieckmann, 2019). Implementing education for sustainable development at universities is necessary (Meesuk et al., 2021). However, it has not been conducted in a particular course in the curriculum, and only a few studies examined ESD in secondary schools and universities (Kwon, 2019). Ssossé et al. (2021) stated that a new approach or method to achieve ESD goals is needed. Given the importance of ESD in higher education, it is necessary to integrate ESD into learning (Anyolo et al., 2018; Fekih Zguir et al., 2021; Gunamantha, 2010). In this case, the researchers integrated ESD content into learning the basic concepts of biology and science for prospective elementary schoolteachers (PGSD). During the COVID-19 pandemic, offline learning could not be carried out, so researchers taught online with the help of LMS, face-to-face using Zoom meetings or WhatsApp groups.

Education for sustainable development (ESD) or Education for Sustainability is a concept developed to systematically understand and transform education systems that promote and instil sustainability in the minds, hearts and actions of the future generation (Fekih Zguir et al., 2021). ESD

is one of the goals in the SDGs, called Goal 4: Quality Education, stating that it is necessary to promote ESD (Sato et al., 2020). ESD helps encourage people to be constructive and creative in facing global challenges and create a resilient and sustainable society. As an organisation at the forefront globally, UNESCO coordinates the Global Action Programme (GAP) on ESD as a follow-up to the United Nations Decade of ESD (2005–2014). Education for sustainable development enables every human to acquire the knowledge, skills, attitudes and values needed to shape a sustainable future (Sossé et al., 2021; Waltner et al., 2018). Education for sustainable development incorporates critical issues of sustainable development into teaching and learning, for example, climate change, disaster risk reduction, biodiversity, poverty reduction and sustainable consumption (UNESCO, 2016).

ESD aims to educate and train students for future sustainable decision-making through social learning, a particular form of transformative learning (Anyolo et al., 2018; Wals & Kieft, 2010). Educators have a responsibility to help students develop and address the knowledge and skills needed to understand complex sustainable development issues and the sustainability challenges they face (Hungerford, 2010; Wals & Kieft, 2010). Therefore, the success of learning in ESD is closely related to the methods used by teachers and students (Olsson et al., 2016).

According to Laurie et al. (2016), ESD contributes to quality education. For example, the curriculum includes sustainability content delivered in local, social, economic and environmental contexts. In addition, according to Indrati and Hariadi (2016), through studying biology, the teacher's role in ESD can invite students to be more familiar with sustainable development.

The RADEC learning model originated in Indonesia and was developed by Sopandi (2017) with an easy-to-remember syntax – read, answer, discuss, explain and create. The RADEC learning model has been widely studied in Indonesia and has improved learning outcomes (Sukmawati et al., 2019), the ability to write explanatory texts for elementary school students (Setiawan et al., 2019), students' higher thinking skills (Agustin et al., 2021), students' critical thinking skills (Anggraeni et al., 2021; Sopandi et al., 2020) and creative thinking (Pratiwi et al., 2018; Sopandi et al., 2020). In addition to improving learning processes and outcomes, the RADEC model increases students' mastery of concepts (Pratiwi et al., 2018; Setiawan et al., 2020; Siregar et al., 2020). Therefore, the researchers would like to integrate development education sustainability to achieve sustainable quality education in stages (Sopandi, 2017).

Table 1 *Stages of the RADEC Learning Model*

RADEC stages	Learning process
Read (R)	Students explore information from various sources (print and Internet). As guidance, students answer pre-learning questions given before class begins.
Answer (A)	Students answer pre-learning questions related to the essential cognitive aspects that they must master after learning the topic based on their comprehension during the reading stage. These questions require students to apply low-level thinking skills to higher-level thinking skills. This 'answer' stage is carried out independently, without the help of others, and is completed outside the classroom before face-to-face learning.
Discuss (D)	Students form groups (for example, each group consists of 24 students) to discuss the answers to the preview questions. At this stage, teachers play a role in determining the diversity of student needs.
Explain (E)	At this stage, students elect representatives as speakers to show the results of their discussions on their respective topics and teachers as guarantors of the content. The teacher also guides students to refute, criticise and refine the speaker's explanation.
Create (C)	Students develop ideas and reach consensus through problem

formulation in problem-solving surveys and upcoming projects. Creativity must be consistent with the materials learned and suitable for daily life. Teachers use examples to motivate students to come up with creative ideas.

The ESD-oriented RADEC learning model is a model in addition to adjusting the content of the lecture material and it also integrates the critical issues of ESD. According to UNESCO (2016), the pressing issues of ESD include handling climate change, biodiversity, natural disaster reduction and sustainable consumption production. This learning model is packaged and taught in basic concepts of biology and science for prospective elementary schoolteachers in the first semester of the elementary schools of South Sumatra, Indonesia.

This study aims to provide an overview of implementing lectures during the COVID-19 pandemic using the ESD-oriented RADEC model in the basic concepts of biology and science for prospective elementary schoolteachers. The research question in this study is how to carry out lectures during the COVID-19 pandemic using the ESD-oriented RADEC model. The results helped support sustainable development in terms of human resources and provided an alternative one of the online learning models applied in universities.

2. Methods

This research is descriptive. The descriptive analysis provides knowledge about the status quo, often the first step in improving educational practice (Gall et al., 2010). This study describes the learning process during the COVID-19 pandemic using the ESD-oriented RADEC learning model in the basic concepts of biology and science for prospective elementary schoolteachers.

The research subjects were prospective elementary schoolteacher students at a state university in Palembang, South Sumatra, Indonesia. The research subjects involved 33 people who contracted the basic concepts of biology and science in elementary school in the odd semester of class 2021/2022. The process of collecting and analysing data was to obtain data in this study. It collected data through observation sheets, documentation and student response questionnaires. The observations involved four observers. In addition to direct observations, indirect observations were also carried out through recording Zoom meetings. Comments on online learning activities included the stages of RADEC learning, namely read, answer, discuss, explain and create. After the learning process, students were given a questionnaire in several statements about the learning model. Questionnaires were distributed via Google Form after the learning process. The questionnaire contains 15 statements with assessment provisions on a scale of 1–4. The assessment provisions are 4 = Strongly Agree, 3 = Agree, 2 = Disagree and 1 = Strongly Disagree. The data obtained were analysed descriptively by describing research findings related to the lecture process during the COVID-19 pandemic using the ESD-oriented RADEC model and the responses of prospective elementary schoolteacher students to the model used.

3. Results

This study describes the lecture process during the COVID-19 pandemic using the ESD-oriented RADEC model in the basic concepts of elementary science and biology and the responses of prospective elementary schoolteacher students to the ESD-oriented RADEC model.

3.1. Lectures during the COVID-19 pandemic using the ESD-oriented RADEC model

With the results of in-depth literature studies, the researchers integrated critical ESD contents such as handling climate change, biodiversity, natural disaster reduction and sustainable production–consumption into an ESD-oriented RADEC model. The ESD-oriented RADEC model is taught in the basic concepts of elementary science and biology courses to prospective elementary schoolteacher students.

Lectures during the COVID-19 pandemic require every university, including Indonesia, to conduct online learning. The online learning implemented the LMS provided by the campus, teleconference through Zoom meetings and WhatsApp, while technical lectures related to information on meetings, attendance, assignments and evaluations used the LMS provided by the campus. This learning was carried out so that the campus records related learning conducted face-to-face and online using the Zoom meeting application and for smooth communication using the WhatsApp group. The basic concepts of biology and science in elementary school is a three-credit compulsory subject in the PGSD FKIP study programme. Learning implemented the ESD-oriented RADEC model through Zoom, and the six meetings were held with a duration of 150 minutes for each session.

The researchers chose three essential topics: biodiversity, ecosystems and sustainable healthy food. Each subject was taught in two meetings. The researchers chose topics based on the basic concepts of biology and science for prospective elementary schoolteacher students. After analysing several syllabuses at universities in Indonesia, this topic was taught in these courses.

Lectures were carried out as many times as comfortable meetings. Each meeting began by asking students to read as much information as possible related to the topic to be studied. Then, to guide students in reading, students were asked to answer pre-learning questions on Google Form. Table 2 presents an example of the pre-learning questions answered by students.

Table 2 Example of Pre-Learning Questions on the Topic of Biodiversity Given via Google Form

Indicator	Number	Question
Obtain information about the classification of living things	1	To know that living things are diverse. First, scientists do the classification (classification). Then, through reading sources and observations around you, write down the names of living things that you find at least nine types. How is the category of living things separated: two kingdoms, three kingdoms, four kingdoms, five kingdoms and six kingdoms?
	2	In an area, there are doves, lions, earthworms, forest people, mosquitoes and leeches in a room. Classify these animals based on their food!
	3	There are many kinds of living things on earth. To make it easier to study diversity, it is necessary to study the science of classification. Identify the diversity of animal and plant species around you by writing the names of living things, habitats and characteristics!
Obtaining information on the sustainable use of biodiversity	4	Indonesia is a country that has the second-highest level of biodiversity after Brazil. What do you think are the benefits of this biodiversity?
	5	If you are asked to use biodiversity sustainably, explain what that means, and then give an example.

Students answered questions independently at their homes via Google Form. Students who answered pre-learning questions would be seen as the respondents. In addition, small group discussions and class discussions were held online, with face-to-face meetings using Zoom. Discussions related to pre-learning questions were outlined in student worksheets – small group discussions utilising the breakout room feature. Previously, students were divided into eight groups and each group consisted of four people. Figure 1 shows the student discussion process in online learning during the COVID-19 pandemic.

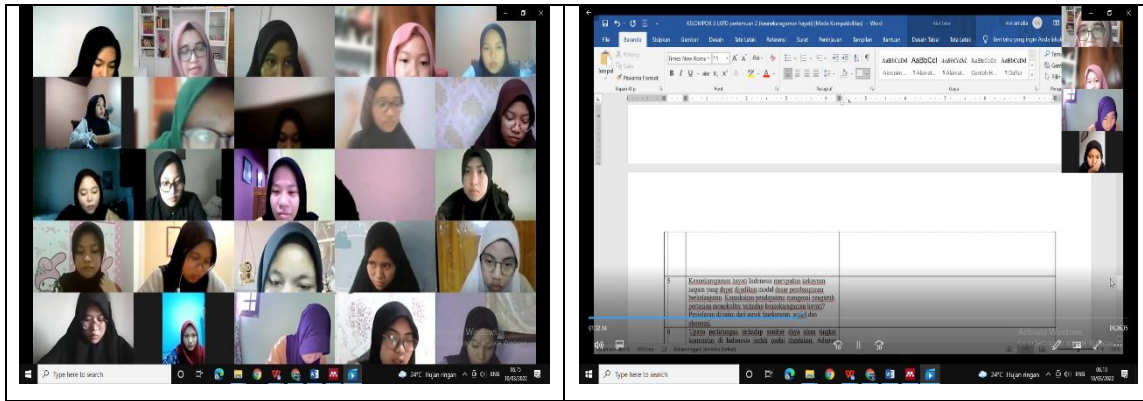


Figure 1 The ESD-Oriented RADEC Learning Process at the 'discuss' Stage Through Zoom
The results of student group discussions were answers to group members' agreement questions. Initially, it was an individual answering a group answer. The group discussions would be presented classically in front of other groups. One group member presented the group discussion results, and the other group responded to the group's answers. Figure 2 shows a display of the 'explain' stage through Zoom.

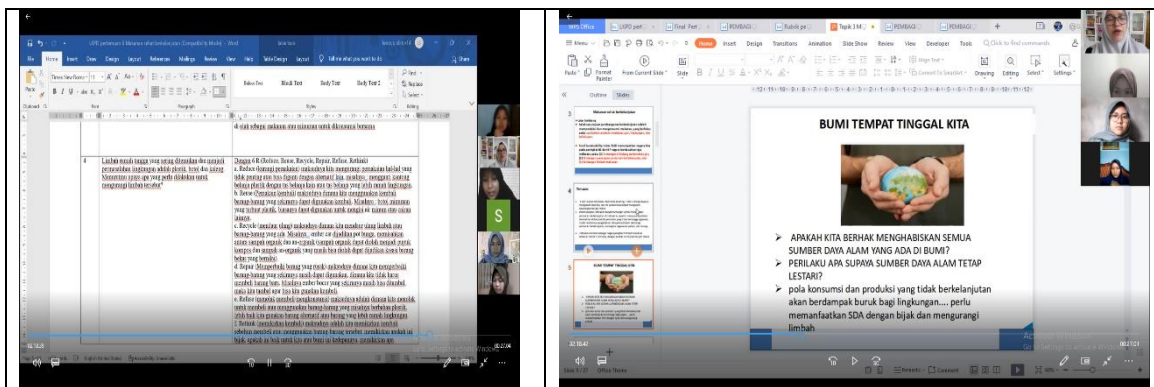


Figure 2 The ESD-Oriented RADEC Learning Process at the 'explain' Stage
At the last stage of creation, students are expected to find creative ideas. Creative ideas related to materials were conducted independently after the group agreed on innovative ideas that would be realised as innovative products. Figure 3 shows an example of statements and creative products made by the group.

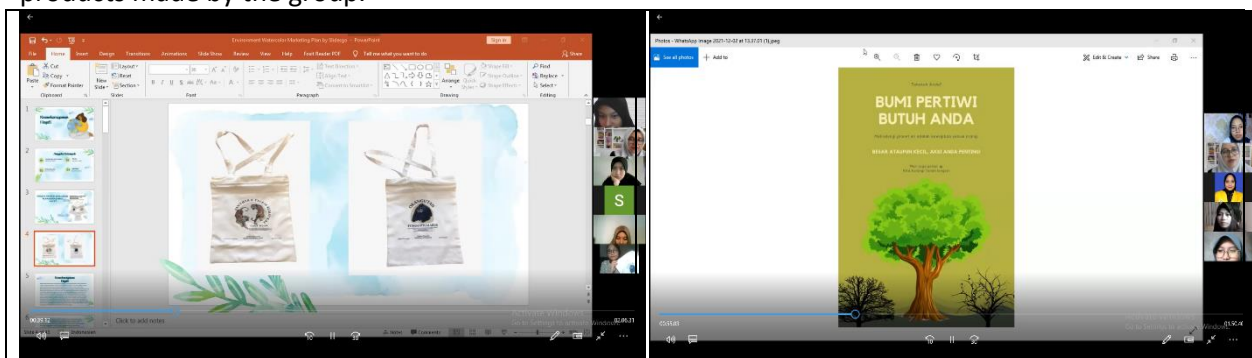


Figure 3 Creative Ideas and Products Made by Groups on the Topic of Ecosystems (Climate Change)

3.2 Student responses to ESD-oriented RADEC learning

After using the ESD-oriented RADEC learning process, students were given a questionnaire to determine their response to the teaching that had been carried out. Students' responses to the learning model carried out are shown in Table 3.

Table 3 Students' Responses to the ESD-Oriented RADEC Learning Process

No	Statement	M (n = 33)	%
1	I read the book with these pre-learning questions before the learning activities started.	3,28	82
2	I am motivated to learn by having activities to answer pre-learning questions.	3,44	86
3	I am more prepared to follow the lesson after answering pre-learning questions.	3,41	85,25
4	I have difficulty assessing the questions and writing the answers through Google Form.	1,66	41,5
5	I think the quality of the pre-learning questions is good.	3,44	86
6	I have difficulty understanding the redaction of sentences about pre-learning questions.	3	57,75
7	In my opinion, the types of pre-learning questions require critical and creative thinking skills.	3,50	87,5
8	I have difficulty accessing the learning resources/teaching materials provided.	1,88	47
9	In my opinion, the teaching materials provided help answer pre-learning questions.	3,31	82,75
10	In my opinion, the quality of the teaching materials produced is good.	3,38	84,5
11	To answer pre-learning questions, I use more than three learning resources.	2,88	72
12	Having pre-learning questions trains me to access information from various sources	3,44	86
13	Pre-learning questions make me read the learning material first before learning begins.	3,31	82,75
14	Answering pre-learning questions can practice my independence in learning.	3,50	87,5
15	In my opinion, answering pre-learning questions will make me more ready to engage in class.	3,56	89

Based on Table 3, RADEC learning positively impacts prospective elementary schoolteacher students. Before learning begins, students who read books/learning resources are motivated to attend lectures and are more prepared to learn. What is lacking is the difficulty in accessing questions and writing answers in Google Forms and accessing learning material resources.

4. Discussion

Learning during the COVID-19 pandemic using the education for sustainability (ESD)-oriented RADEC learning model is an alternative. The learning model with reading, answering, discussing, explaining and creating stages is learning to remember the steps. Therefore, educators will find it easier to carry out lessons with a clear learning syntax (Sopandi, 2017). In addition, the RADEC learning model with its stages can be carried out online. For example, the 'explain' step is carried out synchronously. The 'discuss' and 'create' steps are carried out asynchronously and synchronously (Sukardi et al., 2021). The study results align with Al-Naabi and Al-Abri (2021), revealing that universities must adapt their learning during a pandemic by changing the curriculum. In addition, online learning with the readiness of lecturers with selected learning models and adequate Internet facilities will facilitate the online learning process (Febrianto et al., 2020).

The ESD-oriented RADEC learning guides students in understanding the content or critical issues related to sustainability. The essential matters discussed were climate change, biodiversity, natural disaster reduction and sustainable production–consumption (UNESCO, 2016). The topics discussed are integrated into the syllabus for the basic concepts of biology and science in elementary school. This topic is relevant to sustainability issues. According to Singh-Pillay (2020), studying sustainability issues will increase one's capacity to address environmental and development issues. In addition, ESD in the education curriculum for prospective elementary schoolteachers is crucial. The performance of ESD in elementary schools heavily depends on the knowledge, competencies and attitudes acquired during the education process (Rieckmann, 2019). Instilling ESD values for prospective teachers will foster the social dimensions of teacher education in character education, such as mutual respect, participation, empathy, flexibility and the ability to change related to globalisation and technology-driven change (Jurgena et al., 2021).

The ESD-oriented RADEC learning process at the 'read' stage allows students to explore as much information as possible. So far, when students are allowed to read in the learning process, many do not read. However, after being given reading assignments and pre-learning questions for each meeting, students read independently according to the topics taught. Based on the result, 82% of the students read the lecture topic before learning began. Students' reading activities independently develop the character of independence (Sukmawati et al., 2019). In addition, reading activities coincide with the task of answering pre-learned questions. Activities to answer pre-learned questions can train students' cognitive abilities. Besides answering the knowledge aspect in learning questions, they were also asked about analysis, evaluation and creation. Questions in learning can be used as a high-level cognitive strategy for learning students (Davoudi & Sadeghi, 2015).

The students were active in the discussion stage in small group discussions (breakout room Zoom meeting) and large groups (central room of Zoom meeting). Students could speak and provide opinions; students actively discussed in group discussions and were more prepared (89%) because they had read the learning materials beforehand. Likewise, at the 'explain' and 'create' stages, students could present and convey their group's ideas about making products that would be realised. In this study, the creative pictures raised were related to solving environmental problems, reducing waste, sustainable healthy eating, preventing climate change and saving energy. The results are similar to previous research that RADEC learning could train students' critical and creative thinking skills (Anggraeni et al., 2021; Handayani et al., 2019; Karlina et al., 2020; Pratama et al., 2019; Rahayu et al., 2021; Satria & Sopandi, 2019).

The ESD-oriented RADEC learning process with the read, answer, discuss, explain and create stages could grow learning motivation (86%) and student readiness to attend lectures (85.25%). Motivation and willingness to attend courses can be seen during learning; all students collected pre-learning questions and are present and active during classes. Students' learning motivation is closely related to conceptual change (Hynd et al., 2000). However, based on students' responses to the questionnaire, most students still had difficulty answering questions using Google Forms and finding varied learning resources and challenging to answer questions because students were not used to online learning. Learning resources that could be accessed only from the Internet and books provided by the researchers were still incomplete. According to the study results (Sutiah et al., 2020), FKIP students who studied online during COVID-19 were more accustomed to face-to-face learning than online learning (Hassan, 2020). Online learning has many obstacles, including the Internet network (Febrianto et al., 2020).

5. Conclusion and implication

Lectures in the basic concepts of biology and sciences for prospective elementary schoolteachers using the ESD-oriented RADEC model are an alternative for online learning during the COVID-19 pandemic. The use of the ESD-oriented RADEC model can train thinking and reading skills

through the pre-learning questions given. Besides, it can train the discussion and creative thinking skills of prospective teacher students related to ESD issues.

The use of the ESD-oriented RADEC model is a form of implementing learning in universities to instil the concept of ESD related to knowledge, attitudes and values that can support sustainable development. The issue of sustainable development can be internalised in higher education through a good understanding of lecturers and student–teacher candidates. The results of this study support the need to instil the attitudes, knowledge and values contained in ESD. The knowledge, attitudes and values contained in ESD are related to addressing global issues regarding climate change, disaster risk reduction, biodiversity and sustainable consumption.

The use of the ESD-oriented RADEC model during the COVID-19 pandemic can be applied to learning in universities. This learning model can also be used to implement hybrid learning (online and offline) under the independent learning curriculum. To implement the ESD-oriented RADEC model, training for teaching staff is still needed so that all parties have the knowledge, skills and attitudes that support the application of this model. In addition, the results of this study are still very limited, including the availability of learning resources related to ESD which are difficult to access by students and learning in only one class. Therefore, it is necessary to carry out further research in the form of developing ESD-oriented teaching materials and learning using comparison classes.

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