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The Impact of the RADEC Learning Model Oriented ESD on Students' Sustainability Consciousness in Elementary School

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Abstract

Sustainability consciousness is an outcome of Education for Sustainable Development, which was launched by UNESCO in 2014 to create a society with sustainable living behavior. The purpose of this research is to analyze the impact of the RADEC learning model oriented ESD on students' sustainability consciousness. This research involved 150 elementary students from 6 districts of Bogor city in Indonesia. The participants' age range was 10-11 years, while the study duration was 2 months and from the 5th grade. The sampling technique used was purposive random sampling. This study used a pre-experiment with pre-post test design. The data were collected by giving a development questionnaire of sustainability consciousness which was adapted from Gerick et al (2019). The questionnaire consists of 27 statement items. The results showed that (1) there was a difference in the sustainability consciousness of students before and after being given the RADEC learning model oriented ESD, this was indicated by sig (0.000) < (0.05); (2) The average sustainability consciousness of students after being given the RADEC learning model integrated ESD for sustainability knowingness, sustainability attitude and sustainability behavior (4.42, 4.72, 4.35) is higher than the average sustainability consciousness before being given the RADEC learning model integrated ESD for sustainability knowingness, sustainability attitude and sustainability behavior (3.24, 3.51, 3.18); (3) Aspect sustainability behavior having medium category and for aspect sustainability knowledge and sustainability attitude, same have high categories. Based on the results, we can see that RADEC learning model-integrated ESD can help students achieve a higher proportion of sustainability consciousness in all aspects. The recommendation for this research is that teachers can design and implement an ESD-oriented RADEC model that facilitates students to develop sustainable consciousness skills effectively.

Keywords: Education for sustainable development, elementary school, RADEC learning model, Sustainability consciousness.

Introduction

Indonesia, with its development progress in various sectors, has not escaped the problem of environmental damage (Ali, 2017; Hendriawan et al., 2019). The main problems that cause environmental damage are poverty rates and low levels of education. The Central Statistics Agency (BPS) in 2020 stated that the number of poor people was 26.42 million people and an increase of 1.63 million people every year. The results of Forest Watch Indonesia (2019) data show that 1.47 million hectares of forest in Indonesia are damaged every year. Forest exploitation (deforestation) occurs due to forest fires that continue to occur and cover almost 250.9 thousand hectares (Emilzoli et al., 2021). Therefore, the concept of sustainable development is very important to be applied. Human resources as development implementers play an important role in sustainable development, regarding policy, decision-making, and technical implementation, so that development does not only seek the maximum profit, but also the economic benefits and wisely considers the harm to the environment (Ellis et al., 2013; Shutaleva et al., 2020). The dimension of human resources is important to consider in the implementation and success of sustainable development. Factors that influence and are related to human resources are morality, integrity as a citizen, sustainable awareness, and environmental literacy. If these factors are owned by the community, it will realize good practice and good governance in implementing sustainable development (Mulyana et al., 2020).

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Educational intervention in implementing sustainable development is very much needed from the elementary school to tertiary level education to be able to improve quality human resources. Education imparts knowledge, skills, values, attitudes, and behaviors in preserving the environment with a measurable, directed, and systematic educational process (Laurie et al., 2016; Pauw et al., 2015). But the emphasis on protecting the environment as a form of developing sustainable awareness is not considered important; many students are starting to lose the development of awareness of sustainable living (Kurniasari et al., 2020). Schools have not made students work to reduce the impact of environmental problems (Olsson et al., 2016). Students have not gotten used to behaving in a more sustainable way of life. This is due to the absence of education in the form of sustainable practices that are directly implemented in the school environment (Fibonacci et al., 2020).

UNESCO created a forum to agree on sustainable development policies known as sustainable development goals to deal with the problem of the lack of sustainable education (Ali, 2017; Emilzoli et al., 2021). For the development goals to be realized and achieved in 2030, UNESCO initiated the concept of Education, for Sustainable Development or Education for Sustainable Development (ESD) (UNESCO, 2017). ESD is a follow-up to sustainable development goals to encourage achieving these goals in the field of education (Nguyen, 2019). ESD aims to shape students to acquire the knowledge and skills needed to familiarize themselves with sustainable living behavior. ESD is based on the underlying principles of sustainability to encourage the realization of human resources that can optimize the management, utilization, and conservation of natural resources (Ali, 2017; UNESCO, 2017).

ESD is a lifelong educational effort by empowering humans to be responsible for creating a sustainable future in the context of environmental integrity, sustainable economic development, and a just community for present and future generations (Ali & Hayat, 2019; Kopnina, 2012). Indonesia, like other countries in the world, includes the concept of sustainable development as one of the principles of national education development, that education is an effort to spread and inculcate values to open horizons of knowledge and understanding of self and the environment and improve the quality of human resources so that they can be useful in making changes for the better (Ali, 2017; Eilks, 2015).

Indonesia participates in realizing sustainable development goals through the Adiwiyata school program. Adiwiyata schools in Indonesia currently reach 434 schools, consisting of 58 private schools and 376 public schools from 164 cities/districts in 32 provinces (MENLHK, 2019). Regulation of the State Minister of the Environment Number 02 of 2009 concerning Guidelines for implementing the Program of the State Minister of the Environment Article 1 states that the Adiwiyata Program is implemented to develop student behavior regarding responsibility in managing and protecting the environment through school governance that supports sustainable development. The Adiwiyata school program is pursued through an environment-based curriculum that supports ESD in action competencies. The curriculum is adapted to the 2013 curriculum, which emphasizes not only cognitive, but psychomotor and affective aspects, so that in the learning process it is certainly easy to integrate ESD to develop environmental responsibility, but can behave in that responsibility (Rosyidatun, 2018). Implementing ESD focuses on the cognitive aspect. Education for environmental improvement is more in line with knowledge; there is the habituation of students to act less often (Prabawa-Sear, 2018). Therefore, school efforts are needed in developing sustainable development education programs that can solve these problems. Of course, adapted to the 2013 curriculum and the challenges of life in the 21st century (Wahyudin, 2018).

In implementing ESD, each country including Indonesia, must set its priorities, goals, and action programs that must be adapted to real local environmental, social, and economic conditions (Ali, 2017). ESD must be carried out in a complex and comprehensive manner both locally, nationally, and globally, with a holistic, interdisciplinary approach and developing life (Ahmed, 2010; Nordén, 2018). A holistic approach to learning by integrating sustainable development goals that include the three pillars of ESD, namely environmental, social and economic, to develop understanding, thinking skills, and awareness, and comprehensively (Badjanova & Drelinga, 2014). It is carried out in an interdisciplinary manner, which is integrated into themes (thematic curriculum) from an economic, social and environmental perspective and does not become a separate subject (Ali, 2017). Implementing ESD is also under accepted learning principles which consist of: (1) Skills and processing of information, media, and technology; (2) Learning and innovation skills; (3) Life and career skills (Cebrián & Junyent, 2015). The third approach in implementing ESD is the key to the success of implementing ESD which is carried out in learning with real experiences, creative, critical learning processes, solving problems, making decisions, growing and developing attitudes, values, and sustainable awareness with behaviors and actions in achieving sustainable development goals (Huckle & Wals, 2015).

Implementing ESD through the three approaches has not been optimal in the learning process in schools. The three approaches are expected to be integrated with learning, especially in thematic learning in elementary schools. Thematic learning at the elementary school level emphasizes the integrative learning process between subjects linked to the theme. Elementary school education is the most appropriate level in the formation of awareness of the values of sustainability. Habituation of sustainable behavior cannot

be developed in a short time. It must be cultivated from an early age and continues consistently so that sustainable awareness is formed (Fredriksson et al., 2020). Sustainability Consciousness is an ESD competency that must be mastered by students. Olsson, et al., (2016), suggest that sustainable awareness is a concept of ESD competence that develops knowledge, attitudes, and behavior based on consciousness of environmental, social, and economic dimensions to develop a more sustainable life. Sustainability consciousness is an outcome of Education for Sustainable Development (ESD) which was launched by UNESCO in 2014 to create a society with sustainable living behavior (UNESCO, 2017). Sustainability consciousness refers to then to the experience or awareness of the phenomenon of sustainability. This encompasses ideas, attitudes, and behaviors, as well as the experiences and impressions we normally identify with ourselves (Hendriawan et al., 2019; Komarudin et al., 2019). Sustainability consciousness is a concept that incorporates environmental, social, and economic elements. Besides, certain characteristics of sustainability knowledge, attitude, and conduct in each of the three dimensions are explained (Gericke et al., 2019; Olsson et al., 2016).

In its implementation, to be able to increase the competence of sustainable consciousness, there are various challenges. Students have difficulty understanding problems and developing problem-solving plans related to the ESD context (Manni et al., 2013). Students tend to already have knowledge related to the ESD context, but students' habituation to action has not occurred. For example, to explore the desired use of plastic in the future, students have not been invited to achieve this at school (Nikmah et al., 2019). The results of Listiawati's research (2011), suggest that implementing the 2013 national curriculum in schools currently does not explicitly state a commitment to ESD; it is still limited to understanding, yet emphasizing the habituation of sustainable behavior. This is in line with the research of Birdsall (2015), that the lack of understanding and skills of teachers in implementing ESD, so that implementing ESD has not developed sustainable consciousness in students. Borg et al., (2014), explained that most teachers implement ESD by focusing on students' knowledge and understanding. Esd is not taught in a complex and comprehensive manner. Therefore, to develop this ESD competency, it is necessary to have a teacher's understanding of ESD, so that teachers can design and implement models, methods, teaching materials, media, and evaluation of ESD-oriented learning (Kandangama, 2018).

One of the innovative learning models that can be oriented towards ESD goals is the Read-Answer-Discuss-Explain-and Create (RADEC) learning model. The RADEC learning model is a learning strategy with the stages of reading, answering, discussing, explaining, and creating. This learning model was created by Sopandi (2017) by considering maximally the typical conditions that exist in Indonesia, both regarding the curriculum, and the characteristics of teachers, and students. The RADEC learning model is a learning model that stimulates students to learn actively, not only mastering the learning concepts learned but skills and attitudes comprehensively, so that it can facilitate students to develop not only understanding concepts about sustainable development, but attitudes and behaviors that are based on consciousness to develop life more sustainable.

Several research results suggest that the RADEC model develops learning based on constructivism theory, where children's cognitive abilities are developed in the Zone of Proximal Development (ZPD) which is the area between actual abilities (students' ability to learn independently) and potential abilities (students' ability to learn with teacher guidance and peers) (Lestari, Sopandi, et al., 2021). The RADEC model stimulates students to learn actively, maximize their potential, and improve their understanding of concepts (Dadan Setiawan et al., 2020; Sopandi & Handayani, 2019), improving 21st century skills such as critical thinking and creative thinking (Pratama et al., 2019), as well as instilling the social and spiritual character of students (Sukardi et al., 2021). This can be seen from each stage of the RADEC model. At the read stage, students are guided independently to explore information from various learning sources such as books, modules, teaching materials, and other sources of information such as the internet related to problems and issues related to the ESD context. In the answer stage, students will answer pre-learning questions based on the information obtained from the Read stage. Pre-learning questions are questions that stimulate students to understand problems related to the ESD context. At the discuss stage, students can develop and discuss a problem-solving plan. At the explain stage, students can explain the design of the problem-solving plan and at the create stage, students can apply the plan in the form of project activities or products.

Based on several research results that have been presented, the RADEC learning model can be developed oriented towards sustainable development goals; facilitate students to develop not only a conceptual understanding of sustainable development but attitudes towards sustainable consciousness; learning stages are based on learning indicators that are oriented towards ESD goals, and ESD dimensions include environmental, economic and social, sustainability and holistically. The ESD-oriented RADEC learning model itself has not been carried out by Sopandi or other researchers so that it becomes the direction of a new pedagogical approach to solve in solving various obstacles to ESD implementation in elementary schools. The ESD-oriented RADEC learning model in this study was developed in thematic learning. Thematic learning is the right place to implement ESD to achieve sustainable development goals, because ESD is an educational

effort as an approach to learning that supports sustainable development, aiming to empower humans to have knowledge, skills and sustainable awareness shown by responsible behavior for sustainable development activities, where development is carried out while preserving and preserving the environment. Thematic learning packages at the elementary school level can provide opportunities while implementing ESD in a holistic and comprehensive manner covering environmental, economic and social dimensions.

The purpose of this research is to see the impact of RADEC learning model-integrated ESD on student sustainability consciousness. Some specific research aims are mentioned analyze participants' sustainability consciousness, including their three constructs in the three dimensions of sustainable development (environment, socio-cultural and economic) and analyze the impact of the ESD-oriented RADEC model on students' sustainability consciousness to Improve Students Sustainability Consciousness.

Method

Research Design

This study uses quantitative research with pre-experimental methods, pre-post one group design (Creswell, 2014). This method is used to obtain data on the sustainability of elementary school students' consciousness before and after the treatment. The treatment in this study used the ESD-oriented RADEC learning model with 18 meetings. Before being given treatment, a pretest (initial test) was given, then treatment was given by learning using the ESD-oriented RADEC model, and at the end of the lesson given a posttest (final test).

Participants

This research involved 150 elementary students in the districts of West Bogor, East Bogor, North Bogor, Central Bogor, South Bogor and Tanah Sareal in Indonesia. The survey respondents were selected using the purposive sampling technique, in which respondents are selected intentionally to be able to achieve the purpose of the research. Respondent involved in this study consist of 46 % male and 54 % female. The participants' age range was 10-11 years, while the study duration was 6 months and from the 5th grades

Data Collection

The survey data collection uses a questionnaire. This pre-test data is used to get the initial abilities of students of sustainability consciousness. Post-test data were obtained after treating with the the ESD-oriented RADEC learning model during the learning process.

Research Procedure

The purpose of this research is to determine the impact of the ESD-oriented RADEC model on students' sustainability consciousness. This research was conducted on 5th-grade thematic learning theme 8 "the environment of our friends", as many as 3 sub-themes for four weeks with a total of 18 meetings. Details of the activities of the ESD-oriented RADEC model can be seen in Table 1.

Tabel 1. The ESD-oriented RADEC model

Syntax	*Information*
Read	In the first stage, namely the reading stage, the teacher provides instructions for students to read textbooks and various references according to concepts that are studied independently at home. Instructions for reading are given by the teacher before the learning process is carried out, and usually carried out 1 week before theme 8 is taught; namely at the end of the learning process on theme 7. Reading activities can stimulate students to familiarize themselves and develop literacy skills related to environment, socio-cultural and economic dimensions. The activity of reading various texts, both fiction and non-fiction, which depict examples of sustainable behavior regarding environment, socio-cultural and economic, for the present and the future, stimulates students to tend to act like what is exemplified in the reading material.
Answer	After the reading exercises, students go on to the second level, which involves them answering pre-learning questions provided by the teacher. The pre-learning questions produced include concepts about sustainability consciousness in the aspects of sustainability knowledge, attitude, and behavior, which are given in student reading materials.
Discuss	The third stage is the discussion stage. Students discuss and agree on the answers to the pre-learning questions given by the teacher so that students agree on the correct answer. The platforms used by the teacher in the Discussion stage are face-to-face learning in the class (offline) or Google Meet (online). Therefore, the teacher divides students into small groups and stimulates all group members to be involved in the discussion. The teacher distributes students with various kinds of cognitive abilities, so that there are students who are intelligent, active, passive, and need tutoring in one group. The teacher ensures that all students in the group are involved in the discussion and ultimately understand the concept of environmental, socio-cultural and economic sustainability. Some teachers carry out these stages synchronously through the Google meet platform because they can meet face-to-face virtually with students (online) or face-to-face learning in the class (offline) so students can discuss more actively in discussions. However, some teachers carry out this stage asynchronously through the Google Classroom platform, where students discuss through the comments column to agree on the answers to pre-learning questions as group answers.

Syntax	*Information*
Explain	In the fourth stage, namely the explaining stage, students convey their group answers in the class forum through the google meet platform synchronously (online) or face-to-face learning in the class (offline). The teacher stimulates students to ask questions, argue, respond to, or add to what other students said during the presentation. At this stage, the teacher acts as a moderator to determine which group will present, ask questions, or other things to clarify the material. In addition to being a moderator, the teacher can act as a presenter if in this activity all students cannot answer questions asked by other students, and provide reinforcement regarding the concept of the material being discussed, and respond to student opinions.
Create	In the last stage, namely the making stage, students are encouraged to think about creative ideas. Student activities at this stage include approving, realizing, and reporting product ideas.

Research Instrument

The instrument used in this study was a Sustainability Consciousness Questionnaire (SCQ). The SCQ is formed of 27 Likert-scale items that are intended to measure sustainable development knowledge, attitude, and behavior (in all three dimensions: environmental, social, and economic) on a Likert scale ranging from 1 to 5, 1 means "strongly disagree" and 5 means "strongly agree," participants received a mixed bag of items to answer on a Likert scale ranging from 1 to 5.

Data analysis techniques for instrument validity using the Rasch Model approach. The item validity test of the instrument items uses validity testing based on the Rasch Model with the criteria of Outfit Mean Square (MNSQ) accepted: 0.5 < MNSQ < 1.5 to test the consistency of the answers with the difficulty level of the statement items; Outfit Z-Standard (ZSTD) value accepted: -2.0 < ZSTD < +2.0 to describe how much (measure result column) is an outlier item, not measuring or too easy, or too difficult; Accepted Point Measure Correlation (Pt Measure Corr) value: 0.4 < Pt Measure Corr < 0.85 to describe how good (SE), the statement items are not understood, responded differently, or confused with other items.

The results of the validity test showed 27 items that met the requirements of two values from the three values of Outfit MNSQ, Outfit ZSTD, and Pt Measure Corr and the unidimensionality test show the raw variance value of 50.1% which is in the good category based on the unidimensionality criteria in Rasch modeling (Rasch Model). This means that the test instrument is declared valid (Sumintono et al., 2015). The reliability test was carried out using the Rasch model based on the Cronbach's Alpha criteria and the Person Reliability and Item Reliability values. Interpretation of Instrument reliability is based on the Person Reliability and Item Reliability values, which is > 0.94 = excellent, 0.91 to 0.94 = very good, 0.81 to 0.90 = good, 0.67 to 0.80 = fair and < 0.67= poor (Ali, 2017; Creswell, 2014; Sumintono et al., 2015). Based on the results of the reliability test, a person reliability value of 0.94 is included in the very good category and a 0.85 item reliability value is included in the good category. The Cronbach Alpha value of 0.95 is included in the very strong category, meaning that the interaction between respondents and items is good so that the instrument can be trusted to be used as a data collection tool.

Data Analysis

The analysis used in this research is descriptive statistic and the paired-sample t test with a significance level of 5% and 1% ($\alpha = 0{,}05$ and $\alpha = 0{,}01$). All statistical analysis was carried out using SPSS 22 for Windows.

Findings

Items from the SCQ may be modeled into three latent variables related to sustainability knowledge, attitudes, and behavior, according to the findings of a factorial analysis (of these pupils). This factorial model was considered acceptable since it had a sample adequacy score of 0.788 and a proportion of variance explained of higher than 50%. (namely, 59 percent). Cronbach's alpha, which was typically more than 0.6 and was greater than 0.7, was also significant. The Cronbach's Alpha values suggest that the survey instrument is reliable. The lower numbers in the economic component might imply that students had a difficult time identifying the economic topics addressed by our survey. Analysis of SCQ items revealed that pupils were assigned higher scores to items related to sustainability knowledge, attitude and behavior (means of 4.42; 4.72; and 4.35) (Figure 1).

The data were analyzed descriptively, and the data obtained on the average Sustainability Consciousness of students, before and after the ESD-oriented RADEC learning is shown in Figure 2 below.

Figure 2 shows that there is an increase in students' Sustainability Consciousness between before and after

Fig. 1: Mean of the items of the different dimensions (environmental, social and economic) of sustainability consciousness constructs (knowledge, attitude and behavior) in primary students.

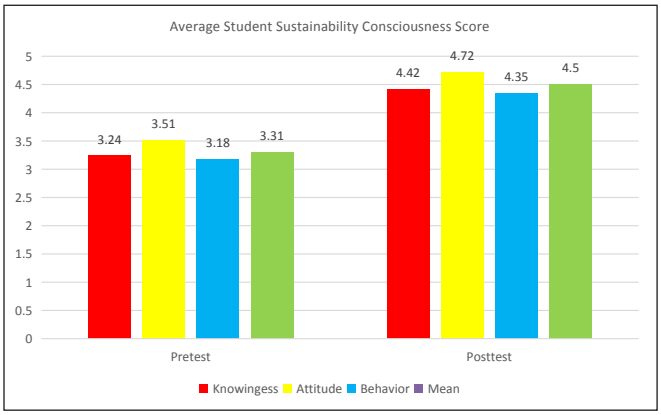

Fig. 2: Mean of the Sustainability Consciousness of students, before and after the ESD-oriented RADEC learning

ESD-oriented RADEC learning. Before giving the ESD-oriented RADEC model, the average Sustainability Consciousness of students was 3.31, while after the ESD-oriented RADEC model was given it was 4.50. So it can be concluded that there are differences in the sustainability consciousness of students before and after giving the ESD-oriented RADEC model, meaning that there is an effect of the ESD-oriented RADEC learning model on increasing the Sustainability Consciousness of elementary school students. To determine whether there is a significant difference in the Sustainability Consciousness of students before and after giving the ESD-oriented RADEC model, the data was tested using a paired sample t-test using SPSS 22 software at (0.05) and (0.01), and the following output was obtained:

The output of the data normality test (Shapiro wilk) with a probability (sig) of 0.276 (pretest) and 0.308 (posttest) is greater than (0.05), it can be concluded that the population data is normally distributed. After the data was known to be normally distributed, a paired sample t-test was conducted to find out whether there was a difference in the sustainability consciousness of students before and after being given the ESD-oriented RADEC model. The output with a probability (sig) of 0.00 is greater than (0.05) and (0.01), meaning that the results of the study indicate that there is a significant difference in the sustainability of students' consciousness in the pretest and post-test. The average value of the students' sustainability consciousness showed that the post-test score was higher than before. Therefore, these findings indicate that the sustainability of students' consciousness, after the intervention in the form of ESD-oriented RADEC learning has increased so that it can be concluded that learning with the ESD-oriented RADEC model is effective in increasing the sustainability of students' Consciousness.

The RADEC learning approach was used to implement ESD-oriented theme learning in this study. The findings of this research demonstrate a significant impact of the ESD-oriented RADEC model on students' sustainability consciousness.

Table 2: Paired sample t-test

	N	*Mean*	*Standar Deviasi*	*Paired sample t-test Sig (2-tailed)*	*Shapiro Wilk Sig (2-tailed)*
Pretest	150	3.32	0.53	0.00*	0.276*
Posttest	150	4.50	0.81	0.00**	0.308*

*α= 0.05 dan ** α= 0.01

The RADEC model, which has five stages: Read, Answer, Discuss, Explain, and Create, can encourage students to actively acquire, not just concepts but also skills and attitudes that promote environmental, socio-cultural and economic sustainability.

The results of observing, teaching and learning activities were found at the Read stage. Reading sources presented by the teacher and used as discussion material included socio-eco-scientific issues. In the Read stage, students are invited to look for background problems related to the learning material being studied with the problem of sustainable development. The ESD themes that are read are themes related to environmental, social, and economic dimensions. Environmental problems related to the water crisis and climate change; social problems related to cultural diversity, and economic problems related to Poverty reduction. Students are directed to find data on the problems raised by digging for various information from various learning sources. At the answer stage, it was found that students answered pre-learning questions based on the information obtained from the Read stage. The answer is an alternative solution to the problem to be solved and the project target. In this way, students can independently see where they have difficulty learning a material. Besides, students themselves can assess whether they are diligent or lazy to read, difficult or easy to understand the contents of the reading, like or dislike, reading the lesson text, and so on. Based on the results of observations, the teacher provides appropriate assistance for each student, both students who have completed all pre-learning questions, and students who have difficulty doing them. The teacher will likely find out about the different needs of students from one another.

The findings at the discussion stage, students discuss in groups the answers to questions or the results of the work they have done outside the classroom before the class meeting is held. Students discuss the project objectives that are explored related to alternative solutions regarding the context of sustainable development problems. For example, the problem of the dirty Ciliwung river, making it difficult for the surrounding environment to use. Students are guided by the teacher to dig up data and test the Ciliwung river water which will be used for project activities and to gain knowledge about the feasibility of river water. Then the students discussed the project to be made, namely making a water filter to treat Ciliwung river water for direct consumption.

The findings at the explain stage, students communicated the results of discussions related to alternative solutions for solving sustainable development problems that were raised. The teacher ensures that what the students explain is scientifically correct and that all students understand the explanation. In this activity, the teacher stimulates other students to ask questions, respond to, or add to what their friends from other groups have said. This stage is used as an opportunity for the teacher to explain important concepts that have not been mastered by all students based on observations at the discussion stage. When explaining the passage, the teacher explains the form of lectures, and demonstrations to overcome the difficulties of all students. The solutions offered are then realized in the form of projects.

The findings of observations about the RADEC model's application in the ESD-oriented thematic learning process show the five stages of this model can help and encourage students to develop sustainability consciousness, to find solutions to environmental problems, and habituation of attitudes and behaviors.

Discussion

Implementing the ESD-oriented RADEC Model uses the ESD Adding Sustainable Science as content in the science and technology curriculum implementation model. This model can be seen from the process carried out in the classroom. Each learning achievement includes several indicators of sustainable development goals that are integrated with learning materials (Gericke et al., 2019). The RADEC learning model can facilitate students to develop not only understanding concepts about sustainable development, but attitudes and behaviors that are based on consciousness to develop life more sustainable.

Reading activities have a positive impact on students because through reading activities students will have constructed their knowledge and understanding independently so that during the learning process students already have the provision of understanding to be explored more deeply, and provide habituation to students to behave as exemplified in-text learning (Lestari et al., 2020; Siti, 2016). This activity is guided by pre-learning questions which contain a lot of questions intended for students to be answered, because the answers are essential cognitive concepts that must be mastered by students after studying a subject matter (Sukardi et al., 2021). A lot of pre-learning questions are given containing questions with varying levels of thinking from low-level to high-level thinking (Sopandi & Handayani, 2019). This pre-learning question is given to students before the learning process is carried out and is carried out independently by students outside the learning process in class. By Vygotsky's theory, through independent reading activities, children can explore information on their own without the help of others (actual abilities), and when students cannot understand information by just reading, they can be asked to other students (peer tutors) or explained by the teacher at a meeting. In class (potential ability), so that the child's cognitive development will be in the Zone of Proximal Development (ZPD) (Lestari, Sopandi, et al., 2021). If students are in that zone, students can develop their knowledge to think at a higher level to be able to provide alternative solutions to the sustainable development problems that are being studied (Sopandi & Handayani, 2019).

The teacher encourages student's to answer pre-learning questions depending on their reading comprehension (Dhawan, 2020; Xiaoqiao, 2020). The pre-learning questions given by the teacher are used to stimulate students to understand the reading and the concepts to be studied (Lestari, Sopandi, et al., 2021). Through this pre-learning question, the teacher can collect and classify the level of difficulty of concepts based on students 'answers, so that they can see the extent of students' sustainability consciousness. So that the teacher can select all concepts to choose which concepts will be discussed further, namely difficult questions and those that deserve to be discussed. At this stage, students also practice building the character of initiative or independence to find answers based on the sources of information they read (Rahmadani et al., 2021; Dadan Setiawan et al., 2020). Furthermore, this answer activity is to show that before learning begins, students have understood the material well. So that the next learning process can be focused on things that have not been understood by students, and this is what is called effective learning (Pratama et al., 2019).

At the discussion activities, it was seen that the students were active and enthusiastic because the previous students already had sufficient material to discuss problems (Rahmatsyah & Dwiningsih, 2021; Zhao, Nan et al., 2020), for example, discussing the project of making a water filter for the Ciliwung river. This activity trains and develops students' competence in the realm of knowledge and thinking skills (Satria & Sopandi, 2019; D. Setiawan et al., 2020). An active discussion process like this certainly encourages students to ask questions and learn to use problem-solving strategies (Murphy et al., 2014). This activity provides an opportunity for students to create conditions for critical thinking and considering solutions when dealing with sustainability issues. Critical thinking is one of the competencies that can be developed through ESD. By thinking critically, students can discuss the gap between the problem and what it should be and form challenges by providing solutions related to these problems in the form of sustainability actions (sustainability consciousness) (Cebrián & Junyent, 2015). In addition to developing critical thinking skills, students are instilled in the character of cooperation, and respect for the opinions of friends (Lestari, Ali, et al., 2021).

Explaining activities makes students able to have communicative thinking skills so that students can

communicate the results of group discussions that have been carried out at a later stage (Sukardi et al., 2021). Activities at this stage foster student character to be confident in delivering the results of the discussion. Furthermore, the last stage contained in the RADEC learning model is the stage of creating. The creative stage stimulates students to develop creative ideas related to environmental preservation and development goals to be achieved (Duran & Dökme, 2016; Eilks, 2015). Students in creative activities can learn how to analyze sustainability, work on decision making, and apply knowledge into actual practice (Lestari, Ali, et al., 2021). The creative ideas presented by the students varied greatly, starting from making recycled portable trash cans; making pictures telling stories about clean water and proper sanitation, to making bicycle services from home to school for students located at homes near the school. Activities at this stage stimulate students to come up with ideas to be able to find solutions to environmental problems that occur, these ideas will foster environmentally friendly behavior that will be applied in everyday life (Maurer et al., 2020). In addition to environmentally friendly behavior, social behavior is also developed, where students' sensitivity is built regarding social phenomena that exist in the surrounding community. A sustainable consciousness on the economic dimension is also formed; if the project is successful and can be socialized to the school community and the wider community, it can be one type of business that can increase income. For example, a water filter can be developed into a drinking water refill business; bicycle services from home to school can be a shuttle business, and portable trash cans can be traded and make a profit. Thus, this activity can elaborate on the three dimensions of sustainable development, namely environmental, social and economic.

Conclusion

Based on the findings obtained from the five stages, the RADEC learning model encourages to improve students sustainability consciousness (knowledge, attitude and behavior) and develop various 21st-century skills such as critical, creative, collaborative, and communicative thinking, and foster environmentally friendly attitudes and behaviors in everyday life day. These sustainability consciousness are ESD competencies that are developed for students so that students can apply the principles of sustainable development in everyday life from an early age. Habit from an early age, it is expected that sustainability Consciousness will be internalized in students. These attitudes and values will encourage everyone to live a life with the principles of sustainable development so that they can overcome various environment, socio-cultural, economic problems. The recommendation for this research is that teachers can design and implement an ESD-oriented RADEC model that facilitates students to develop sustainable consciousness skills effectively.

Limitation

A limitation of this study, during the learning process with the ESD-oriented RADEC model, students provided the same or limited examples from their daily lives during most of the activities. Therefore, incorporating out-of-school activities such as field visits and observations into activities can be useful for students to provide more actual examples from everyday life related to sustainable development issues. In addition, it takes a lot of time for students to develop critical and creative thinking skills to develop ideas and products to be able to become alternative solutions related to the socio-eco-scientific issues being studied. So that careful planning and good time management are needed to be able to implement this ESD-oriented RADEC model.

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