

Real action based on search solve create and share (SSCS) model to improve sustainability awareness of junior high school students

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Abstract: Water pollution from manufacturing waste and air pollution from forest and land fires are major environmental issues in the Siak district. This research aimed at gathering empirical data by implementing a real-action project based on SSCS learning to enhance sustainability awareness of Junior High School. This quasi-experiment was carried out in two groups of students in 7th grade of SMPN 1 Koto Gasib, Siak, Riau Province. The experimental class used the SSCS learning model with the ESD approach and the control class applied the scientific learning model. Indicators of sustainability awareness comprise: 1) Sustainability Practice Awareness; 2) Behavioral and Attitude Awareness; and 3) Emotional Awareness. Real-action project that is implemented by the teacher in this research is conducted to promote sustainability awareness in the form of a water purification model, planting pollution-absorbing plants, and creating Eco-brick flower pots. Data analysis uses inferential statistics, namely the T-test using SPSS-26 software. The analysis results of sustainability awareness indicate that students in the experimental class get a higher average of 76%, with the high category. Meanwhile, students in the control class get an average of 65% in the medium category. The T-test analysis of sustainability awareness gets a significance value of $0,002 \leq 0,05$, which indicates that there is a significant difference between experimental and control classes. The implementation of SSCS learning model using ESD approach can enhance the students' sustainability awareness through environmental problem-solving activities, as well as building knowledge, behavior, and attitudes of love for the environment.

Keywords: Real action; SSCS; sustainability awareness

Introduction

Education is a basic human necessity that plays a crucial role (Ismet, 2022; OECD, 2019). Since education is a source of national power and regeneration, many countries have adopted policies that

prioritize 4C skills (Critical thinking, Collaboration, Communication, and Creativity) in 21st-century, particularly in science learning (Redhana, 2019). Through science education, students are going to address the impact of science on daily life and their role in society (S. N. Pratiwi et al., 2019). Skills in 21st-century consist of critical thinking, communication, creativity, and collaboration (Atwa et al., 2022). In achieving students' 4C skills, it should be accompanied by a caring attitude towards the environment and having the awareness to contribute to the environmental sustainability (Hermawan et al., 2022). Attitude and skills are integrated into sustainability awareness (Alsaati et al., 2020; Debrah et al., 2021). Sustainability awareness is crucial to be possessed by the students so that they can solve issues and environmental problems which have become popular in recent years. Environmental degradation, such as global warming, rapid population increase, forest destruction, fires, and air pollution, are examples of national challenges that students frequently learn about and must solve (Hermawan et al., 2022; Nasrollahi et al., 2020). Pollution of the Siak River by manufacturing waste is one of the local environmental issues that students frequently encounter in Siak Regency, Riau Province. Factory waste is frequently discharged into rivers without being properly treated (Suprayogi et al., 2022). This pollutes rivers and endangers the environment and human health (Mardhatillah et al., 2020; Priyambada et al., 2023). By discovering the bad impacts of factory waste discharged into the rivers, the students will have a sustainability awareness in environmentally friendly waste management and promote a more sustainable lifestyle.

Skill of sustainability awareness can be possessed by the students thru problem-solving training of the environmental problems in the learning processes (Martins et al., 2019). Those activities can be integrated into Education for Sustainable Development (ESD) by means of problem-based learning (Damayanti & Surjanti, 2022; Ekamilasari & Pursitasari, 2021). Education for Sustainable Development (ESD) provides experiences for students in designing solution for environmental issues to support the sustainable lifestyle (Lasekan et al., 2023). Education for Sustainable Development (ESD) is forward-thinking, critical thinking and reflection, systematic thinking, collaboration development, and decision-making participation (Zhang et al., 2020). Education for Sustainable Development (ESD) is an effort to alter society's mindset in dealing with sustainable future (Matitaputty et al., 2022). The United Nations (UN) establishes 17 Sustainable Development Goals (SDGs) at the end of the decade in 2015, indicating the expansion of worldwide efforts to establish sustainable societies (Hallinger & Chatpinyakoo, 2019). Sustainable development is mentioned in both the 2013 curriculum and the independent curriculum in Indonesia. The key competencies of the 2013 Curriculum include religious and social attitudes, whereas one of the themes of the Project for Strengthening the Pancasila Student Profile (P5) in the autonomous curriculum is sustainable awareness (Kemdikbudristek, 2022). The aspect indicates that character education and sustainable development education are applied in Indonesia (Primasti, 2021). In the school's learning process, the teachers should be able to implement the strategy and proper learning model to achieve learning objectives and to support the students' sustainability awareness (Ghani et al., 2021; Owens & Hite, 2020).

Preliminary study thru questionnaire filling on the use of learning model used by Science teachers in Koto Gasib indicates that 42.9% of teachers utilize PBL, PJBL, and Inquiry learning models for explaining environmental pollution issues; 57.1% use the Discovery Learning model; and 28.6% use the conventional learning model. However, neither the SSCS learning model nor the ESD (Education for Sustainable Development) approach is used by any teachers. According to the results of the questionnaire, it is discovered that students' environmental awareness is 14.3% in the high category, 71.4% in the moderate category, and 14.3% in the low category. Indicators of student concern for the environment and students' skills to suggest environmental solutions are in the low category.

Based on these issues, the teacher's role is required in order to raise long-term awareness of the learning process. One option for teachers is to employ a paradigm that allows students to actively learn while focusing on problem-solving (Abidin, 2019).

Search Solve Create and Share (SSCS) model in this problem can be chosen to enhance students' sustainability awareness and can be integrated thru Education for Sustainable Development (ESD) (Assidiqi, 2015; Jusman, 2021). The SSCS learning model enhances the students in solving and developing problem-solving skill so that the students are more active (Hermita et al., 2020). The SSCS model is developed based on the assumption that learning to use students' problem-solving skills through problem-solving experiences from scientific problem-solving experiences (Hatari et al., 2016). The SSCS model provides significant implication to encourage students to think critically, be creative and independent; the SSCS model using problem-solving approach is designed to encourage High Order Thinking Skill and conceptual understanding (Erlisiani et al., 2020). The benefits of the SSCS model include improved problem-solving skills and the development of sustainability awareness (Maskur et al., 2022).

Integrating the ESD to the SSCS learning model is expected to instill students' sustainable awareness through environmental problem-solving activities. Through ESD, the teachers are able to foster awareness, attitudes, and values so that they can improve their standard of living without sacrificing environmental sustainability (Saptaji et al., 2020). Another study related to environmental problem-based learning is conducted by Laksono and Wibowo (2022) which claim that It is efficient in promoting

character strengthening and environmental literacy through the establishment of student worksheet based on Socio Scientific Issue (SSI) on environmental pollution material. Suryawati continues that the findings of the LKS Implementation research, which focuses on local environmental issues, may assist students to have a better understanding of local and global environmental challenges (Suryawati et al., 2020). Meanwhile, Yen Sastri reveals that SSI based flip charts can improve science literacy and environmental attitudes of students (Sastri et al., 2021). Examples from this research show that immersing students in environmental issues in their surroundings and resolving environmental issues through problem-based learning can raise environmental awareness. Students can learn how to identify environmental problems, find appropriate solutions, create environmentally friendly innovations, and share knowledge and experience with the community by employing the Education for Sustainable Development (ESD) approach and the SSCS (Search Solve Create and Share) Model.

This study was aimed to determine the increase in sustainable awareness after having applied the SSCS learning model with the ESD approach to environmental pollution material. The SSCS model with the ESD approach is also expected to be used as an alternative in learning to increase students' continuous awareness and for educators it can be used as a reference or reference in continuous performance improvement.

Method

Research Design

This research was a quasi-experiment (quasi-experiment research). This research was conducted at SMPN 1 Koto Gasib, particularly in the even semester of academic year of 2022/2023. Pre-test post-test control group design was used as research design by using 1 experimental class and 1 control class. The pre-test and post-test were carried out in the experimental and control classes to quantify the students' sustainability awareness. In this research, the experimental group was treated (treatment) by the SSCS learning model using ESD approach in the material of environmental pollution while in the control group there was no treatment. Research design used was elucidated in the Table 1.

Table 1. Pre-test Post-test Control Group Design

Group	Pre-test	Treatment	Post-test
Experiment Group (X_1)	O_1	SSCS	O_2
Control Group (X_2)	O_3	Without SSCS	O_4

Description: X_1 = SSCS model experimental class; X_2 = Control class without SSCS model; O_1 = Pre-test score of experimental class; O_2 = Post-test score of experimental class; O_3 = Pre-test score of control class; and O_4 = Post-test score of control class.

Sample and Population

Population of this research was all students of 7th grade in SMPN 1 Koto Gasib, consisting of 119 students in four classes. Research samples were determined by using simple random sampling technique thru an online randomization website (picker well). Based on these findings, two sample classes of 63 students were formed.

Data Sources

Students' sustainability awareness was quantified by using a questionnaire consisting of 15 items. The questionnaire was arranged based on the indicators of sustainability practice awareness (conscious efforts to implement sustainability), behavioral and attitude awareness (behavior and attitudes that cared about the environment), and emotional awareness (Emotional concern for the environment). Item details were questions consisting of 6 items in the Behavioral and Attitude Awareness category, 4 item statements in the Emotional Awareness category, and 5 Sustainability Practice Awareness questions. The questionnaire of sustainability awareness was adopted from a study conducted by Clarisa et al., (2020). Data results of students' sustainability awareness were also reinforced by using the observation sheet. Observers of this research were the researchers and 1 Science teacher of SMPN 1 Koto Gasib. The observation aimed at discovering the implementation of students' environmental caring attitude when the SSCS model using ESD approach was implemented. Observed indicators of environmental care included: (1) Indicator 1: Working hard to protect nature, the observed aspect was cleaning the laboratory environment; (2) Indicator 2: Respecting health and cleanliness, the aspects observed were cleaning hands after practicing and throwing rubbish in the right place; (3) Indicator 3: Being wise in using Natural Resources, the observed aspect was using project-making materials as necessary; and (4) Indicator 4: Responsibility towards the environment, the aspect observed was cleaning the materials for making the project.

Data Analyses

The inferential data analysis used Independent Sample t-test in SPSS Software version 26 for windows. The data was regularly distributed as a preparatory test in the normality test, which was followed by the homogeneity test. Proceed with the T-test if the data was normally distributed and the variance was homogeneous. Table 2 depicted how the percentage score of the sustainability awareness questionnaire results was assessed (Lasekan et al., 2023).

Table 2. Sustainability awareness intervals

Obtained Percentages (%)	Description
$85 \leq p < 100$	Very High
$71 \leq p < 85$	High
$56 \leq p < 70$	Medium
$41 \leq p < 55$	Low
$0 \leq p < 40$	Very Low

Hypotheses

The following statistical hypotheses were tested: (1) $H_{02} : \mu_1 = \mu_2$ (There is no significant difference in sustainable awareness between the group that applies the SSCS learning model with an ESD approach and the control group that applies scientific approach learning at SMPN 1 Koto Gasib); (2) $H_{a2} : \mu_1 \neq \mu_2$ (There is significant difference in sustainable awareness between the group that applies the SSCS learning model with an ESD approach and the control group that applies scientific approach learning at SMPN 1 Koto Gasib)

Results and Discussion

SSCS Model Implementation Using an ESD Approach

The implementation of SSCS model using ESD approach is carried out in four meetings, specifically in the environmental pollution material. Syntaxes of SSCS model in each meeting consist of four stages, namely Search (seek), Solve stage (problem-solving), Create (produce), and Share (display) (Diani et al., 2019). Students' activities in each learning stage are discovering information (search) based on the information or problems given by the teacher; in problem-solving stage (Solve), the students create hypotheses based on the given problems; in producing stage (Create), the students create a project based on the sustainability awareness; and the last stage is sharing (Share), in this stage the students present their group discussion results on the Student Worksheet or the project that has been created by each group.

Students' activities in in the process of growing sustainable awareness starting from stage 1 and 2, namely search (discovering information) and solve (problem-solving). Knowledge is the starting point for changing student attitudes and behavior. Involving students in the search for information about environmental issues will build a caring attitude and make them aware of the need of environmental protection (Wulandari et al., 2021). Students in SSCS learning stages 1 and 2 will be exposed to a variety of environmental issues, including water pollution caused by factory waste or household garbage, air pollution caused by factory waste, and land pollution caused by waste. Stimulating images of pollution in student worksheet attracts students to seek information about the various types of pollution that exist and the causes of pollution. Additionally, students and group members are going to discuss the possible solutions to these problems. The problem-solving stage pertains to the ESD concept, in which students will provide solutions for the present and future. This project teaches students the significance of their role in environmental protection initiatives. According to Stonebraker and Howard (2018), learning activities that raise contextual issues can raise student awareness and encourage them to join in problem-solving efforts. Students that are familiar with environmental issues will be more committed to enhancing environmental conservation and avoiding environmental pollution (Otsuka et al., 2018; Yasin et al., 2020).

The actions of producing projects (create) and communicating project findings (share) are referred to as stage 3 and 4 learning activities. The teacher's problem-solving method for environmental challenges extends through the project production stage. Students will participate in environmental pollution learning activities by creating two projects: simple water purification and an eco-brick flower pot project, as well as planting plants that can absorb air pollution. This project intends to directly involve students in efforts to avoid and resolve environmental pollution issues. Students' skill of sustainability awareness in the higher category is expected to be able to generate ideas and solution for sustainable life (Martins et al., 2019). Students in the learning process are trained to be able to generate solutions in the form of ideas, products, and projects for environmental conservation based on the context of environmental pollution challenges. The project's outcomes will then be presented in the form of a class exhibition as part of an environmental protection campaign. Onurlubaş (2019) in his

study claims that Building positive environmental attitudes among students at school will affect their environmental behavior in their daily life. The implementation of the SSCS model using an ESD approach in four meetings demonstrates the total learning stages. At every stage of learning, indications of long-term awareness are created.

Analysis of Student's Sustainability Awareness

The students' sustainability awareness is assessed using a questionnaire in order to determine the ability of the experimental group's and the control group's sustainability awareness after treatment. [Figure 1](#) depicts the average findings of sustainable awareness for the experimental and control classes based on indicators.

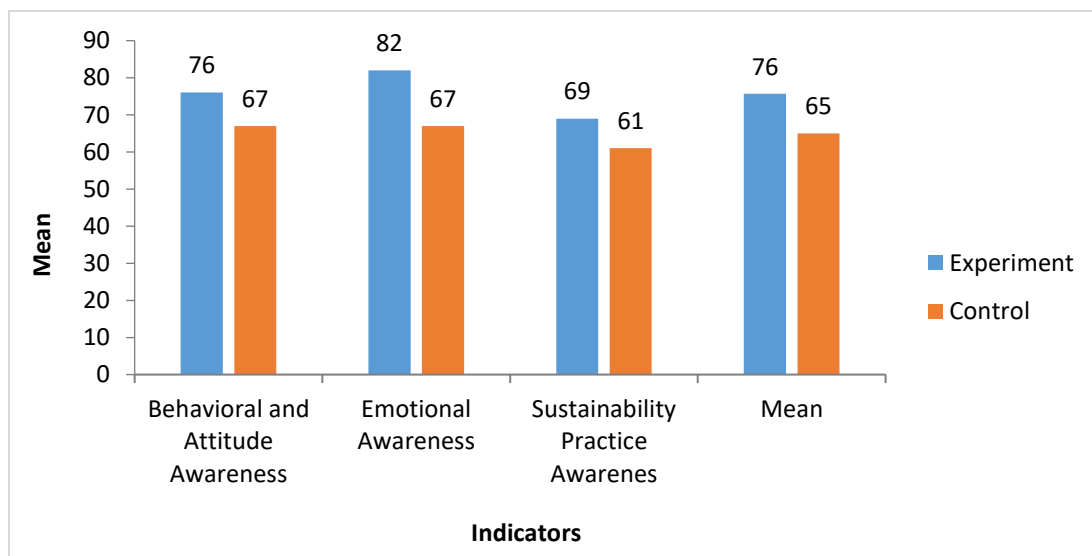


Figure 1. The Analysis Results of Students' Sustainability Awareness

Assessment in [Figure 1](#) shows the percentages of students' sustainability awareness in the experimental class, in which the experimental is higher than the control class. The experimental class obtains a percentage of 76% in a high category and the control class obtains a percentage of 65% in moderate or medium category. The students' sustainability awareness in the experimental class is higher due to the existence of different treatment in the groups, specifically with the implementation of SSCS model using ESD approach. This treatment can improve the students' participation in practice activities sustainably, developing attitudes and daily habits towards environmental problems, as well as training students emotionally to deal with environmental pollution problems ([Debrah et al., 2021](#); [Zhang et al., 2020](#)). The results of this research are in line with [Clarisa et al., \(2020\)](#) who claim that the students' sustainability awareness can be improved by using ESD approach. Student behavior differs between the experimental class, which employs the SSCS learning model with an ESD approach, and the control class, which employs a scientific approach ([Ekamilasari & Pursitasari, 2021](#)).

According to the indicators, the sustainability awareness that will be measured is sustainability practice awareness, behavioral and attitude awareness, and emotional awareness. The results of this research will be elucidated as follows:

Behavioral and Attitude

In the experimental class, caring behavior and attitudes toward the environment obtain a percentage of 76% in the high category, while in the control class, the percentage is 67% in the medium category. Students receive more caring experience instilling a caring attitude toward the environment in the experimental class using the SSCS learning model with an ESD approach. This attitude is encouraged by teachers providing reinforcement materials and instilling the notion of ESD through the creation of initiatives related to sustainable awareness. Lesson plans and worksheets have been created to incorporate the notion of ESD into learning. The concept of sustainable awareness is not instilled in the control class, which employs a scientific learning approach.

Habit formation can reveal changes in students. behavior and attitudes toward environmental care: 1) Reading about environmental issues on social media; 2) Appreciating biodiversity in the educational setting; 3) Students are increasingly worried about decreasing their usage of motorized vehicles; 4) Students begin bringing tumblers from home; and 4) Do not turn on the lights in the classroom during the day to save money on fans. Some of these instances demonstrate that instilling a caring attitude for

the environment by learning in the experimental class causes students to get accustomed to environmental protection (Zapata et al., 2018). This condition is different with the control class, where the students are not accustomed with the instilling an environmentally caring attitude. This is supported by the study of Pratiwi et al., (2019) thru the implementation of PBL with ESD approach, it is found that behavioral and attitude awareness indicators for experimental class students are in the high category. A study of Clarisa et al., (2020), through the flipped classroom in the context of ESD also explains the development of sustainability awareness with an approach that can improve attitudes and behavior of environmental care in students.

Emotional Awareness

Emotional awareness or emotional concern for the environment includes attitudes or behavior that are always carried out by all students. The percentage of emotional awareness in the experimental class was 82% in the high category and the control class was 67% in the medium category. Emotional awareness in the experimental class obtained a higher percentage because in the learning process students were emotionally directed to have high concern for their environment. The experimental class's emotional concern for environmental circumstances is fostered at each stage of the SSCS model. Involving students in environmental problems, developing long-term solutions, and developing environmental initiatives gradually raises students' emotions, causing them to recognize the importance of the environment (Pratiwi et al., 2019).

The research's sustainable learning initiatives include one to address water pollution by creating water filters and another to combat air pollution in the classroom by planting plants that absorb pollutants. Students emotional awareness is established throughout project work through group activities in which students are imbued with an attitude of responsibility, cooperation, mutual respect, and tenacity. Students will also write down the project development stages, project obstacles and reflect on the results of the project. These activities are carried out by the teacher so that students can involve themselves in the project as a whole, in this case the students do not only carry out the assignments of the teacher but are also aware that the projects undertaken will be useful for environmental preservation. Salsabila et al., (2019) explain that students' emotional awareness is developed by integrating them in all learning activities, including discussions, projects, presentations, and assignments. Students that are emotionally aware will recognize the significance of studying information in their lives (Reichl & A., 2019).

Sustainability Practice Awareness

Practice awareness or conscious efforts to carry out sustainability obtains a percentage of 69% in the moderate category for the experimental class and 61% in the control class. Among the three indications, the Practice Awareness indicator has the lowest percentage. This is due to the fact that students' intentional activities to demonstrate environmental preservation efforts have not yet been fully formed. Students already have empathy for environmental concerns, and they have been able to solve environmental problems, but for long-term action, students still require habituation at school. Discussing environmental issues with peers, grouping food waste into fertilizer, acquiring environmental knowledge to family members, and participating in mutual cooperation activities to clean up the school environment are all conscious attempts to carry out sustainability (Alm et al., 2022). To establish programs that can train students to be environmental awareness movers, all of these activities require continuing habituation and participation from teachers and other school members. This is in line with Clarisa et al., (2020) and Pratiwi et al., (2019) who get a mean on indicators of sustainability practice awareness in low category; thus, the teachers should improve it. Diani et al., (2019) postulate in his study that conscious effort can be grown slowly to students and the teacher should assist students through the habituation of positive behavior that leads to the growing awareness.

The accomplishment of an attitude of caring for the environment during the learning process also contributes to the development of students' sustainable awareness skills. Table 4 summarizes the findings of the research on students' environmental attitudes.

According to Table 3, it is known that mean value based on the assessed indicators from the work on two projects, it ranges between 75-80 in the good category. From project 1 to project 2, students environmental awareness grows. These findings indicate that the SSCS model combined with an ESD approach can assist students in increasing their sustainability awareness. The observer explains that in the second project, students are more proficient at organizing project components, cleaning up after the project, caring about the environmental conditions around them, and working well as a group to finish the project. Students' environmental basics and attitudes differ due to changes in learning between the experimental and control classes. The involvement of experimental class students in environmental issues and problem-solving activities demonstrates the development of an ecologically sensitive mentality. This shift in attitude can be noticed in every learning meeting, such as students who are initially unconcerned with classroom cleanliness becoming more worried in the last two

meetings. Students are also passionate about activities including water filter projects and the cultivation of plants that absorb air pollution.

Table 3. Data from Descriptive Observations on Students' Environmental Concern

No	Group	Project 1		Project 2		Mean Total	Category
		O1	O2	O1	O2		
1	Group 1	75	80	80	85	80	Good
	Mean		77.5	82.5			
2	Group 2	80	75	80	85	80	Good
	Mean		77.5	82.5			
3	Group 3	70	75	75	80	75	Good
	Mean		72.5	77.5			
4	Group 4	70	75	80	80	76.3	Good
	Mean		72.5	80			
5	Group 5	70	75	80	80	76.3	Good
	Mean		72.5	80			

Description: O1 = observer 1; O2 = observer 2

Analysis of the SSCS Model's Influence on Student's Sustainability Awareness Using the ESD Approach

Inferential analysis on this research aims to discover the influence of SSCS model using ESD approach towards students' sustainability awareness. The inferential analysis results are the results of T-test by implementing the Normality and Homogeneity Test prerequisites.

Normality Test and Data Homogeneity

Normality test is carried out in both experimental and control classes in order to discover whether the post-test data results are normally distributed or not. The *Kolmogorov-Smirnov* test is used to determine the normality of students' sustainability awareness data. Terms of a data is said to be normal if the significance ≥ 0.05 . Table 4 exhibits the results of the post-test data normality test for the two research samples.

Table 4. Normality Test Results of Sustainability Awareness for Experimental Class and Control Class

Variable	Significance Value		Conclusion
	Experiment	Control	
Questionnaire of Sustainability Awareness	0.060	0.184	Normal

According to the above table, it is obtained that *post-test* data of sustainability awareness in the experimental and control classes are normally distributed; the significance value of experimental class is $0,060 \geq 0,05$ and the control class is $0,184 \geq 0,05$. These results indicate that results data of sustainability awareness in both experimental and control classes are normally distributed.

Homogeneity test is conducted in both experimental and control classes to discover the variance between two classes, whether it is similar or homogeneous. The data tested for homogeneity is the data from the sustainability awareness post-test. This homogeneity test uses Levene's Test by comparing the value of $\text{sig} \geq 0,05$. The homogeneity test results of post-test data from the two samples of this research are elucidated in Table 5.

Table 5. Homogeneity Test of Sustainability Awareness for Experimental Class and Control Class

Variable	F Count	Sig	Conclusion
Sustainability Awareness	0,227	0.636	Homogeneous

Table 5 reveals the findings of the post-test data homogeneity test, which shows that the sustainable awareness data has a F count of 0.227 with a significance of 0.636. The Levene value is ≥ 0.05 , implying that the post-test data on sustainable awareness in the research has a homogeneous variance. After the assumptions are met, the hypothesis test, especially the Independent Sample T-Test, is performed.

Hypotheses Test Results of T-test

Hypotheses testing is carried through parametric statistical calculation, namely Independent Sample T-Test (T-Test). Calculation process uses SPSS 26 software. Analysis of Independent Sample T-Test towards *post-test* of the sustainability awareness of students uses SSCS learning model with ESD approach and scientific learning model to discover whether there is a significant difference between the

post-test scores of students in the experimental class and the control class. If $p \leq 0.05$, the withdrawal of the research conclusions is considered significant. Table 6 summarizes the t-test findings on SPSS 26.

Table 6. T-test Results of Sustainability Awareness

Variable	Sig.(2-tailed)	Decision
Sustainability Awareness	0,002	Ho is rejected, Ha is accepted

According to the above table, it can be known that the t-test score of sustainability awareness gets a significance score of $0,002 \leq 0,05$; thus, the H_0 (There is no significant difference in sustainable awareness between the group that applies the SSCS learning model with an ESD approach and the control group that applies scientific approach learning at SMPN 1 Koto Gasib) is rejected and H_a is received/accepted; it means that the sustainability awareness of experimental class is different significantly with the sustainability awareness in the control class. This indicates that there is an influence on the SSCS learning model using ESD approach towards the students' sustainability awareness in the environmental pollution of Middle School.

The model stage and the provision of SSCS student worksheet with the ESD approach reveal differences in learning between students in the experimental class and students in the control class. At the SSCS model stage, activities in student worksheet follow the teacher's instructions. Students follow the process of solving problems from environmental issues offered by the teacher in a systematic manner through this learning. According to ESD research, studying problem solving in the context of ESD can increase student learning outcomes and profiles of sustainability awareness (Ekamilasari & Pursitasari, 2021; Pratiwi et al., 2019), in which it is starting with improving environmental attitudes until students are able to act to overcome environmental problems (Lasekan et al., 2023). The presentation of environmental issues on the student worksheet is varied and raises topics closest to students such as environmental issues on the Siak River, forest fires in Riau, air pollution in Pekanbaru and several local issues that students usually encounter in their environment. Local issues addressed on student worksheet train students' attitudes and emotions to be aware of the high amount of environmental degradation in their immediate surroundings (Rahmadiani et al., 2021; Sastri et al., 2021); hence, the students can be involved directly in the solution search of the problems. Providing contextual examples in environmental pollution material according to Kinslow et al., (2019), besides providing knowledge with real examples, it can also increase students' sense of concern for the nature that is nearby. Gökmen (2021) adds that observation of environmental problems can actually change students' perspectives and increase contributions in efforts to solve these problems. The SSCS learning model using ESD approach leads the students to express ideas related to efforts to prevent pollution in a sustainable manner. In this research, the teacher sets the sustainable project for the students to develop their emotional awareness and environmental care actions. Thru various activities, it is desired that students will understand that as persons who live beside nature, they have a duty to take care of nature/the environment (Runhaar et al., 2019).

Conclusion

Departing from the research findings, it can be concluded that: 1) The implementation of SSCS model using ESD approach can be implemented based on stages in four meetings; 2) The SSCS model using ESD approach can enhance the awareness skills on experimental and class with the mean value of 79 (High Category). The student's sustainability awareness skill may improve thru environmental issue distribution in learning and project works to solve environmental problems; and 3) The hypotheses test (T-test) indicates that the students' sustainability awareness skill is different significantly between the experimental class and the control class; thus, it is possible to infer that there is an influence on the use of SSCS model using ESD approach on the improvement of students' sustainability awareness. It is intended that the findings of this research will provide teachers with updated information on how to implement the SSCS model in learning activities in order to build 21st-Century competencies. It is hoped that future studies will focus on developing learning resources to increase students' sustainable awareness and critical thinking.

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Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

Author Contributions

E.S: corresponding author, prepares work plans and coordinates the production of research articles; S.R.A: Field data collection; Y.Y: Data processing; P.R.D: Literature review; S.S: Analysis and interpretation of data.

References

- Abidin, A. M. (2019). Kreativitas guru menggunakan model pembelajaran dalam meningkatkan hasil belajar siswa. *DIDAKTIKA*, 11(2), 225. <https://doi.org/10.30863/didaktika.v11i2.168>
- Alm, K., Beery, T. H., Eiblmeier, D., & Fahmy, T. (2022). Students' learning sustainability – implicit, explicit or non-existent: A case study approach on students' key competencies addressing the SDGs in HEI program. *International Journal of Sustainability in Higher Education*, 23(8), 60–84. <https://doi.org/10.1108/IJSHE-12-2020-0484>
- Alsaati, T., El-Nakla, S., & El-Nakla, D. (2020). Level of sustainability awareness among university students in the Eastern province of Saudi Arabia. *Sustainability (Switzerland)*, 12(8), 1–15. <https://doi.org/10.3390/SU12083159>
- Assidiqi, H. (2015). Membentuk karakter peserta didik melalui model pembelajaran search, solve, create and share (SSCS). *Jurnal Pendidikan Matematika*, 1(1), 45–55.
- Atwa, Z., Sulayeh, Y., Abdelhadi, A., Jazar, H. A., & Eriqat, S. (2022). Flipped classroom effects on grade 9 students' critical thinking skills, psychological stress, and academic achievement. *International Journal of Instruction*, 15(2), 737–750. <https://doi.org/10.29333/iji.2022.15240a>
- Clarisa, G., Danawan, A., Muslim, M., & Wijaya, A. F. C. (2020). Penerapan flipped classroom dalam konteks ESD untuk meningkatkan kemampuan kognitif dan membangun sustainability awareness siswa. *Journal of Natural Science and Integration*, 3(1), 13. <https://doi.org/10.24014/jnsi.v3i1.8953>
- Damayanti, F. A., & Surjanti, J. (2022). Penerapan model PBL dengan konteks ESD dalam meningkatkan hasil belajar dan sustainability awareness peserta didik. *Buana Pendidikan*, 18(1), 93–105.
- Debrah, J. K., Vidal, D. G., & Dinis, M. A. P. (2021). Raising awareness on solid waste management through formal education for sustainability: A developing countries evidence review. *Recycling*, 6(1), 1–21. <https://doi.org/10.3390/recycling6010006>
- Diani, R., Herliantari, H., Irwandani, I., Saregar, A., & Umam, R. (2019). Search, solve, create, and share (SSCS) learning model: The impact on the students' creative problem-solving ability on the concept of substance pressure. *Jurnal Penelitian Fisika Dan Aplikasinya (JPFA)*, 9(1), 65. <https://doi.org/10.26740/jpfa.v9n1.p65-77>
- Ekamilasari, E., & Pursitasari, I. D. (2021). Students' critical thinking skills and sustainability awareness in science learning for implementation education for sustainable development. *Indonesian Journal of Multidisciplinary Research*, 1(1), 121–124. <https://doi.org/10.17509/ijomr.v1i1.33792>
- Erlistiani, M., Syachruji, A., & Andriana, E. (2020). Penerapan model pembelajaran SSCS (search, solve, create and share) terhadap kemampuan berpikir kritis siswa. *Jurnal PGSD: Jurnal Ilmiah Pendidikan Guru Sekolah Dasar*, 13(2), 161–168. <https://doi.org/10.33369/pgsd.13.2.161-168>
- Ghani, A. S. A., Rahim, A. F. A., Yusoff, M. S. B., & Hadie, S. N. H. (2021). Effective learning behavior in problem-based learning: A scoping review. *Medical Science Educator*, 31(3), 1199–1211. <https://doi.org/10.1007/s40670-021-01292-0>
- Gökmen, A. (2021). The effect of gender on environmental attitude: A meta-analysis study. *Journal of Pedagogical Research*, 5(1), 243–257. <https://doi.org/10.33902/jpr.2021167799>
- Hallinger, P., & Chatpinyakoo, C. (2019). A bibliometric review of research on higher education for sustainable development, 1998-2018. *Sustainability (Switzerland)*, 11(8). <https://doi.org/10.3390/su11082401>
- Hatari, N., Widyamoko, A., & Parmin, P. (2016). Keefektifan model pembelajaran search, solve, create, and share (SSCS) terhadap keterampilan berpikir kritis siswa. *Unnes Science Education Journal*, 5(2), 70805795–70850229. <http://journal.unnes.ac.id/sju/index.php/usej>
- Hermawan, I. M. S., Suwono, H., Pariniti, A. A. I., & Wimuttipanya, J. (2022). Student's environmental literacy: An educational program reflections for sustainable environment. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 8(1), 1–9. <https://doi.org/10.22219/jpbi.v8i1.16889>
- Hermita, N., Alpusari, M., Mulyani, E. S., Paura, A., & Herlina. (2020). Enhancing science process skills through conceptual teaching and learning related to water-savings and natural events concept.

- Journal of Educational Sciences*, 4(1), 146–152.
- Ismet, I. (2022). Penerapan model pembelajaran search solve create share (SSCS) untuk meningkatkan motivasi belajar matematika siswa SMPN 6 Pasaman. *Jurnal Pendidikan Dasar Dan Sosial Humaniora*, 1(10), 2027–2035. <https://bajangjournal.com/index.php/JPDSH>
- Jusman, J. (2021). Penerapan model pembelajaran search, solve, create, and share (sscs) untuk meningkatkan keterampilan berpikir kritis siswa. *Primary: Jurnal Pendidikan Guru Sekolah Dasar*, 10(2), 401–409. <https://doi.org/10.33578/jpfkip.v10i2.8259>
- Kemdikbudristek. (2022). *Dimensi, elemen, dan sub elemen profil pelajar pancasila pada kurikulum merdeka* (Issue 021).
- Kinslow, A. T., Sadler, T. D., & Nguyen, H. T. (2019). Socio-scientific reasoning and environmental literacy in a field-based ecology class. *Environmental Education Research*, 25(3), 388–410. <https://doi.org/10.1080/13504622.2018.1442418>
- Laksono, R. K. S., & Wibowo, Y. (2022). Pengembangan bahan ajar berbasis socio-scientific issues untuk meningkatkan higher order thinking skill. *Jurnal Pendidikan Sains Indonesia*, 10(4), 752–765. <https://doi.org/10.24815/jpsi.v10i4.25719>
- Lasekan, O. A., Méndez-alarcón, C. M., Mathew, B. S., & Campos, E. S. (2023). *Exploring the potential of a popular EFL textbook to foster both sustainability awareness and competencies among ESD learners: A content analysis approach*.
- Mardhatillah, W., Amiruddin, E., & Taer, E. (2020). Composition modification of iron oxide particles using activated carbon for adsorption of copper-polluted water from Siak River Water Pekanbaru, Riau. *Journal of Physics: Conference Series*, 1655(1). <https://doi.org/10.1088/1742-6596/1655/1/012159>
- Martins, V. W. B., Rampasso, I. S., Anholon, R., Quelhas, O. L. G., & Leal Filho, W. (2019). Knowledge management in the context of sustainability: Literature review and opportunities for future research. *Journal of Cleaner Production*, 229, 489–500. <https://doi.org/10.1016/j.jclepro.2019.04.354>
- Maskur, R., Suherman, S., Andari, T., Anggoro, B. S., Muhammad, R. R., & Untari, E. (2022). The Comparison of STEM approach and SSCS learning model for secondary school-based on K-13 curriculum: The impact on creative and critical thinking ability. *Revista de Educación a Distancia*, 22(70). <https://doi.org/10.6018/red.507701>
- Matitaputty, J. K., Ufie, A., Ima, W., & Pattipeilohy, P. (2022). Implementasi Education for sustainable development (esd) melalui ekopedagogi dalam pembelajaran di SMN Negeri 8 Ambon. *BUDIMAS: Jurnal Pengabdian Masyarakat*, 4(1), 1–8. <https://doi.org/10.29040/budimas.v4i1.3532>
- Nasrollahi, Z., Hashemi, M. sadat, Bameri, S., & Mohamad Taghvaei, V. (2020). Environmental pollution, economic growth, population, industrialization, and technology in weak and strong sustainability: Using STIRPAT model. *Environment, Development and Sustainability*, 22(2), 1105–1122. <https://doi.org/10.1007/s10668-018-0237-5>
- OECD. (2019). PISA 2018 insights and interpretations. *OECD Publishing, Paris*.
- Onurlubaş, E. (2019). The mediating role of environmental attitude on the impact of environmental concern on green product purchasing intention. *EMAJ: Emerging Markets Journal*, 8(2), 5–18. <https://doi.org/10.5195/emaj.2018.158>
- Otsuka, K., Nakamura, K. W., Hama, Y., & Saito, K. (2018). The creation of learning scales for environmental education based on existing conceptions of learning. *Sustainability (Switzerland)*, 10(11), 1–21. <https://doi.org/10.3390/su10114168>
- Owens, A. D., & Hite, R. L. (2020). Enhancing student communication competencies in STEM using virtual global collaboration project based learning. *Research in Science and Technological Education*, 00(00), 1–27. <https://doi.org/10.1080/02635143.2020.1778663>
- Pratiwi, I., Wijaya, A. F. C., & Ramalis, T. R. (2019). Penerapan PBL dengan konteks ESD untuk meningkatkan hasil belajar kognitif peserta didik. *Prosiding Seminar Nasional Fisika (E-Journal) SNF2019, VIII*. <https://doi.org/10.21009/03.snf2019.01.pe.01>
- Pratiwi, S. N., Cari, C., & Aminah, N. S. (2019). Pembelajaran IPA Abad 21 dengan Literasi Sains Siswa. *Jurnal Materi Dan Pembelajaran Fisika*, 9, 34–42.
- Primasti, S. G. (2021). Implementasi program education for sustainable development di SMA Tumbuh. *Spektrum Analisis Kebijakan Pendidikan*, 10(3), 80–100. <https://doi.org/10.21831/sakp.v10i3.17465>
- Priyambada, G., Kurniawan, B., Sitompul, R. G., & Darmayanti, L. (2023). The abundance of microplastics in Siak tributary sediments in the watershed area, Pekanbaru City, Riau (Case Study Sago River). *Materials Today: Proceedings*, 87, 272–277. <https://doi.org/10.1016/j.matpr.2023.03.207>
- Rahmadianti, P., Suryawati, E., Natalina, L. M., & Feniwati, F. (2021). Strengthening reflective thinking ability of junior high school students using weblog media. *Bioedukasi: Jurnal Pendidikan Biologi*, 14(1), 9. <https://doi.org/10.20961/bioedukasi-uns.v14i1.53158>
- Redhana, I. W. (2019). Mengembangkan keterampilan abad Ke-21 dalam pembelajaran kimia. *Jurnal*

- Inovasi Pendidikan Kimia*, 13(1).
- Reichl, S., & A., K. (2019). Advancements in the landscape of social and emotional learning and emerging topics on the horizon. *Educational Psychologist*, 54(3), 222–232. <https://doi.org/10.1080/00461520.2019.1633925>
- Runhaar, P., Wagenaar, K., Wesselink, R., & Runhaar, H. (2019). Encouraging students' pro-environmental behaviour: Examining the interplay between student characteristics and the situational strength of schools. *Journal of Education for Sustainable Development*, 13(1), 45–66. <https://doi.org/10.1177/0973408219840544>
- Salsabila, E. R., Wijaya, A. F. C., & Winarno, N. (2019). Improving students' sustainability awareness through argument-driven inquiry. *Journal of Science Learning*, 2(2), 58. <https://doi.org/10.17509/jsl.v2i2.13104>
- Saptaji, A. H., Chandra, D. T., Fany, A., & Wijaya, C. (2020). Pengembangan instrumen untuk mengukur sustainability awareness siswa SMA pada materi suhu dan kalor. *Prosiding Seminar Nasional Fisika*, 6.0, 11–21.
- Sastri, Y., Suryawati, E., L. M. N., & Hatta, M. (2021). The use of flip chart as a tool to strengthen scientific literacy at junior high school student. *Proceeding Biology Education ...*, 17(1), 91–97. <https://jurnal.uns.ac.id/prosbi/article/view/54045>
- Stonebraker, I., & Howard, H. A. (2018). Evidence-based decision-making: Awareness, process and practice in the management classroom. *Journal of Academic Librarianship*, 44(1), 113–117. <https://doi.org/10.1016/j.acalib.2017.09.017>
- Suprayogi, I., Fauzi, M., Alfian, A., Suprasman, S., Nurdin, N., & Zulkifli, Z. (2022). Strategi Pengendalian pencemaran sungai Siak yang berkelanjutan menggunakan pendekatan multi criteria decision making (MCDM). *Dinamika Lingkungan Indonesia*, 9(2), 144. <https://doi.org/10.31258/dli.9.2.p.144-152>
- Suryawati, E., Suzanti, F., Zulfarina, Putriana, A. R., & Febrianti, L. (2020). The implementation of local environmental problem-based learning student worksheets to strengthen environmental literacy. *Jurnal Pendidikan IPA Indonesia*, 9(2), 169–178. <https://doi.org/10.15294/jpii.v9i2.22892>
- Wulandari, I. A. I., Muhdhar, M. H. I. Al, Mardiyanti, L., Triani, L., & Purwanti, W. C. (2021). The relationship between knowledge and attitude towards students' behaviour in environmental literacy. *AIP Conference Proceedings*, 2330(030007). <https://doi.org/10.1063/5.0043110>
- Yasin, M., Fakhri, J., Siswadi, Faelasofi, R., Safi'i, A., Supriadi, N., Syazadi, M., & Suardi, I. (2020). The Effect of SSCS Learning Model on Reflective Thinking Skills and Problem Solving Ability. *European Journal of Educational Research*, 9(2), 743–752. <https://doi.org/10.12973/euler.9.2.743>
- Zapata, S., Alfredo, W., Osorio, R., Alberto, L., Arias, C., & Antonio, J. (2018). Knowledge, attitudes and practices of sustainability: Systematic review 1990-2016. *Journal of Teacher Education for Sustainability*, 20(1), 46–63. <https://doi.org/10.2478/jtes-2018-0003>
- Zhang, T., Shaikh, Z. A., Yumashev, A. V., & Chlad, M. (2020). Applied model of E-learning in the framework of education for sustainable development. *Sustainability (Switzerland)*, 12(16), 1–15. <https://doi.org/10.3390/SU12166420>