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Infusing Learners' Problem-Solving Skills Through Problem-Based Learning Model Assisted Socio-Scientific Issues (SSI) Worksheet on Environmental Pollution

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ABSTRACT

Problem-solving skills are an essential part of science learning because these skills guide students in discovering science concepts to make learning more meaningful. ***Objectives:*** This study aims to test whether there is a significant difference in students' problem-solving skills before and after the application of the Problem-Based Learning Model assisted by the Socio-Scientific Issues (SSI) Worksheet and test whether there is a significant difference in the improvement of students' problem-solving skills between the experimental class and the control class. ***Method:*** This study applied the pre-test-post-test control group design on two classes (64 students) taken by cluster random sampling. Data collection techniques in this research used observation, interviews, tests, and documentation methods. Then, the data obtained was analyzed using the homogeneity test, normality test, dependent t-test, independent t-test, and N - Gain test. The instrument used was a problem-solving test in the form of an essay proven to have good psychometric characteristics. ***Results:*** The results showed a significant difference in students' problem-solving skills before and after applying the Problem-Based Learning Model assisted by the Socio-Scientific Issues (SSI) Worksheet. There was a significant difference in improving students' problem-solving skills between the experimental class (N-Gain high category) and the control class (N-Gain medium category). Thus, the SSI Worksheet integrated into the PBL model effectively improves students' problem-solving skills. ***Novelty:*** Previous research has not used SSI Worksheets integrated into the PBL model to train students' problem-solving skills.

INTRODUCTION

There are many 21st-century skills that students must master in learning science, one of which is problem-solving skills (Dewi et al., 2021). Problem-solving skills consist of four indicators: understanding the problem, planning a strategy, implementing the strategy, and checking again (Siburian et al., 2021). In general, the facts show that students' problem-solving skills in Indonesia are still low, as evidenced by the results of the Program for International Student Assessment (PISA) and Trends in International Mathematics and Science Study (TIMSS) (Simatupang & Ionita, 2020). Low problem-solving skills were also found in class VII of State Junior High School 1 Padamara. Based on the observations and initial tests, data was obtained that students' problem-solving skills were still relatively low (the average score for problem-solving skills was 38.18). One of the factors causing low problem-solving skills is the lack of appropriateness of the learning model applied (Dewi et al., 2021). The Problem-Based Learning (PBL) model is a learning model that can train problem-solving skills (Sugiarti et al., 2023; Artinta & Fauziah, 2021; Widyastuti & Airlanda, 2021) because it facilitates students to ask questions actively and have group discussions (Fitriyati et al., 2017) through five syntaxes that can guide students in identifying and understanding problems (Hasanah et al., 2021). The five syntaxes are student orientation towards problems, organizing students in learning, guiding group investigations, developing and presenting work results, and analyzing and evaluating the problem-solving process (Nasution & Oktaviani, 2020).

The effectiveness of PBL in training problem-solving skills is better when combined with appropriate learning media, for example, Worksheets (Swiyadnya et al., 2021). The worksheet developed in this research is integrated into one of the scientific approaches, namely the Socio-scientific Issues (SSI) approach, which has participatory, collaborative, and cooperative characteristics (Mudawamah, 2020). Learning in the context of social issues can be supported by applying the SSI approach, where learning examines facts, phenomena, and events that are still related to science (Kusumaningtyas et al., 2020). So far, no specific research has instilled problem-solving skills through a problem-based learning model assisted by the Socio-Scientific Issues (SSI) Environmental Pollution Worksheet. Previous research focused on applying PBL to improve problem-solving skills (i.e. Fitriana & Savitri, 2023; Mariana et al., 2022; Oktaviana & Haryadi, 2020; Ramadhani, 2021; Sampini et al., 2021), the application of PBL-SSI to hone problem-solving skills (Hestiana & Rosana, 2020), or the Effectiveness of E-worksheet on Problem-Solving Skills (Kusumaningrum et al., 2020; Khikmiyah, 2021; Rofihoh et al., 2022; Paramartha et al., 2020; Sari et al., 2022; Zulfah & Novita, 2023).

This research is vital because SSI is a representation of problems in social life that are contextually closely related to science, so students will be trained in evaluating various information, processing scientific data, feeling caring, moral sensitivity, and empathy (Zikra & Muttaqiin, 2023). Apart from that, SSI is something new for Indonesia, so SSI teaching materials are still limited, even though SSI is important because it stimulates students to discuss and solve problems that are given based on experiences or events in the real world (Nazilah et al., 2019). The topic of environmental pollution was chosen because the issue of environmental pollution is very worrying, is being discussed and highlighted by the wider community (Kirana et al., 2022). So, it is considered suitable to be studied through the SSI approach. Based on the importance of students' problem-solving skills and the factors that hinder problem-solving skills, learning innovations are carried out that aim to improve students' problem-solving skills by applying appropriate models, teaching materials, and approaches.

RESEARCH METHOD

Research Design

This research is quasi-experimental with a pre-test-post-test control group design as follows in Table 1.

Table 1. Research design

Group	Pre-test	Treatment	Post-test
Experimental	O_1	X	O_2
Control	O_3	Y	O_4

Note :

O_1 : Experimental class pre-test — O_2 : Experimental class post-test

O_3 : Control class pre-test — O_4 : Control class post-test

X : Learning uses PBL assisted by SSI-based Worksheet — Y : Learning uses Direct Instruction

Research Place/ Sample/Participants

The research was carried out at State Junior High School 1 Padamara, Purbalingga, Central Java, with the research population being all students in class VII of State Junior High School 1 Padamara in the 2023/2024 academic year. The research sample was 64 students consisting of 32 students in VII H and 32 VII F taken using cluster random sampling technique.

Instrument and Procedures

Data was collected using a test technique in the form of a limited description containing four indicators of problem-solving ability. Initially, the test instrument that was prepared consisted of 15 items, but only 9 items were proven to have good psychometric characteristics in the form of content validity, which was assessed by five expert judges ($\bar{x}_{\mathrm{VI}} = 0.949$), difficulty index ($\bar{x}_{\mathrm{DI}} = 0.652$), discrimination power ($\bar{x}_{\mathrm{DP}}$ ==0.271), and Cronbach's Alpha reliability (α=0.725). All samples were given pre-test questions before treatment and post-test questions after treatment because the pre-test aims to determine students' initial skills before being given treatment. In contrast, the post-test aims as an evaluation tool after they received treatment.

Data Analysis

The data analysis technique used is adjusted to the proposed hypothesis. The two hypotheses tested in this research are:

- H_1: There are differences in students' problem-solving skills before and after implementing PBL assisted by SSI Worksheets in the experimental class.
- H_2: There is a difference in the increase in students' problem-solving skills between the experimental and control classes.

H_1 was tested using the dependent t-test technique, and H_2 was tested using the independent t-test technique followed by N-Gain (0.70 ≤ n ≤ 1.00 as high; 0.30 ≤ n ≤ 0.70 as medium; ≤ n ≤ 1.00 as low). H1 dan H2 are accepted if sig ≤ 0.05. Both techniques are used after the parameter statistical assumptions for the difference test have been met. Apart from these two statistical tests, response analysis was also carried out for each indicator of problem-solving ability in both the control and experimental classes.

RESULTS AND DISCUSSION

Results

Differences in Students' Problem-Solving Skills Before and After Implementing PBL assisted by SSI Worksheets in the Experimental Class

In the experimental class, the results of data analysis provide a pre-test score ($\bar{x}$ = 35.00) and post-test ($\bar{x}$ = 86.50), which was shown to be normally distributed (sig>0.05) based on Shapiro Wilk statistics (see Table 2) and proven to have significant differences (H_1 is accepted, sig<0.05) after implementing PBL assisted by the SSI Worksheet (see Table 2).

Table 2. Normality test results and dependent t-test of experimental class

	Normality test		**Dependent t-test**
Data	**Shapiro Wilk Statistics (df)**	**Sig**	**Sig**
Pre-test	0.962 (32)	0.032	0.000
Post-test	0.942 (32)	0.088	

Visualization of pre-test and post-test scores on each indicator of the problem-solving ability of class VII students at State Junior High School 1 Padamara after implementing PBL assisted by SSI-based worksheets on environmental pollution material is presented in Figure 1.

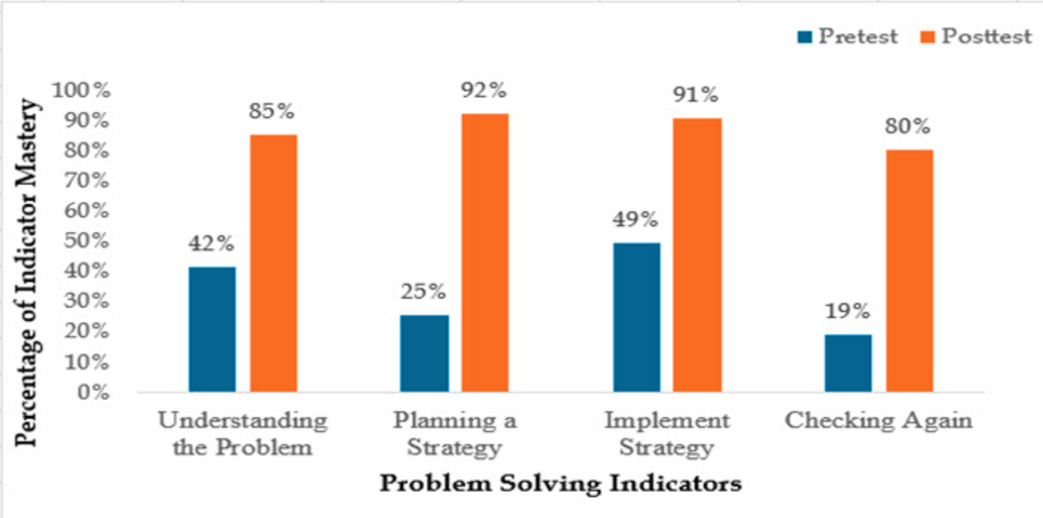


Figure 1. Distribution of data on the percentage of mastery of indicators on problem-solving skills in the experimental class

Differences in Increasing Problem-Solving Ability in the Experimental Class and the Control Class

In the control class, the results of data analysis provide a pre-test score ($\bar{x}$ = 41.90) and post-test ($\bar{x}$ = 65.30), which was shown to be normally distributed (sig>0.05) based on Shapiro Wilk statistics (sig > 0.05) and proven to have a significant difference in improvement when compared to the experimental class (H_2 is accepted, sig<0.05) (see Table 3).

Table 3. Independent t-test of experimental class and control class

Std. Error Difference	95% Confidence Interval of The Difference	t	Sig (Mean Different)
2.891	22.534	9.795	0.000 (28.313)

Based on the Independent t-test, which has proven a significant difference in improvement in the two classes, it is necessary to carry out an N-Gain test to determine how much improvement has occurred (see Table 4). Visualization of the increase in each indicator of problem-solving skills is also presented in Figure 2.

Table 4. N- Gain test results for students' problem-solving skills

Experiment		N – Gain	Control		N – Gain
Pre-test	Post-test		Pre-test	Post-test	
35.00	86.53	0.79 (High)	41.90	65.31	0.39 (Medium)

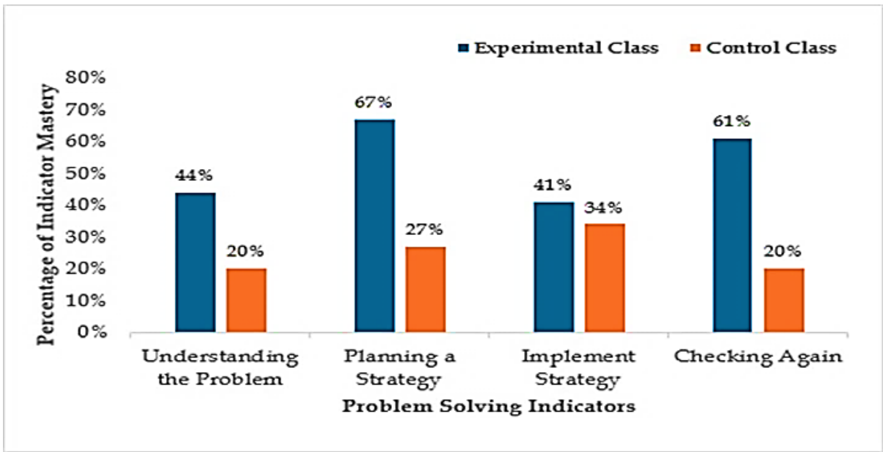


Figure 2. Percentage increase in problem solving ability indicators for experimental class and control class

Discussion

Differences in Students' Problem-Solving Skills Before and After Implementing PBL Assisted by SSI Worksheets in the Experimental Class

The PBL model is appropriate for problem-solving skills, especially in science learning, because it can increase creativity and stimulate students' knowledge to solve problems through process skills (Suari, 2018). In this research, PBL is combined with learning media in the form of worksheets based on the SSI approach because it can improve intellectual, ethical, and moral skills (Winarni et al., 2021) and can make students more active in discussing and interpreting learning because of the connection between student needs and teaching materials that link learning with life (Sofiana & Wibowo, 2019). The difference in problem-solving skills in the experimental class before and after the implementation of the SSI-based LKS-assisted PBL model was proven based on the results of the dependent sample t-test (see Table 2). This finding is in line with Rahmawati et al. (2022), that the PBL model has a significant effect on students' problem-solving skills, and Juhaeriah et al. (2021), who succeeded in proving that the problem-solving skills of the group of students who were treated with the PBL model with the help of worksheets obtained higher scores compared to the group of students who were given the PBL model treatment without help. from the worksheet.

Learning activities in the experimental class consist of three stages: introduction, core activities, and conclusion. The preliminary stages consist of conditioning the class, apperception, and motivation. At the classroom conditioning stage, the teacher opens the lesson by praying and reminding students constantly to maintain cleanliness. After praying, the teacher provides apperception by asking students questions regarding what they learned in the previous meeting. The final stage of preliminary activities is the motivation stage. The core activities consist of five phases: orienting students towards problems, organizing students, guiding group investigations, developing and presenting work, and analyzing and evaluating the problem-solving process. The phases in the PBL model syntax are as follows.

Student orientation towards problems

At the first meeting in this phase, students were still reluctant to respond to the pictures or videos shared by the teacher. The teacher must several times provoke students to be willing to answer questions. The first material is about types of environmental pollution.

The teacher displays a picture of air pollution caused by factory chimneys, and students are asked to analyze the type of pollution. Although most students are still passive in learning, some are starting to express their opinions actively. Most students appeared to be getting used to two-way learning at subsequent meetings. In this phase, the problems studied have various and often contradictory correct answers and solutions (Astuti, 2019), so students will be encouraged to ask questions. The teacher will assist, but students must try to continue working independently or with peers.

Organizing students in learning

In this phase, students are divided into six heterogeneous groups (five to six students) to make it easier for students to solve problems given by the teacher (Maryati, 2018). Studying in groups is proven to provide a good learning experience because it can increase students' understanding, knowledge, and thinking skills through sharing thoughts (Aprilianti et al., 2018).

Guide group investigations

The students were less enthusiastic at the first meeting in the third phase because students were not used to studying in groups. It appears that some members do not want to participate in thinking about solving the problems in the worksheet, so the teacher gives directions so that they can work together and be responsible for answering questions before the results of their discussion are presented through a presentation. The teacher observes students carrying out group investigations by going around the class and helping them if students encounter difficulties. The classroom atmosphere becomes more conducive after getting used to studying in groups. In general, the investigation phase trains students to become active investigators and find out how to use appropriate methods to solve the problems being studied so that they can develop thinking skills and problem-solving skills, gain essential conceptual knowledge from the learning material, and become successful learners. Independent and independent (Suryaningsih & Koeswanti, 2021), obtain enough information to develop your ideas or ideas (Bandaso, 2023), and better understand the material being taught and will remember it for a more extended period (Mareti & Hadiyanti, 2021).

Developing and presenting work results

Initially, students were not used to presenting the results of their thoughts in front of the class, they felt embarrassed. Some students did not want to pay attention during the presentation, so the class atmosphere became less conducive. However, through teacher direction and familiarization with PBL learning, students become accustomed to it, and class conditions become more conducive. Students become more active in asking and answering questions because they compete for activity points. In the PBL model, students are trained to be fully involved in solving problems through learning activities by expressing opinions and various thoughts (Nuraini & Kristin, 2017). This phase ends with students responding to the presentation, appreciating it, and making conclusions based on the results that have been presented.

Analyzing and evaluating the problem-solving process

In this phase, most students were quite good at answering questions from other group and even looked more confident, so there was an improvement from previous meetings.

Student responses to group presentations are part of evaluation activities that aim to determine the effectiveness and efficiency of learning activities with the leading indicators of success or learning activities in achieving the objectives implemented (Suardipa & Primayana, 2020). At this stage, the teacher's role is to make clarifications based on students' opinions regarding the problem being discussed; in this research, the topic is environmental pollution.

The final stage of the learning process using the PBL model is closing. The closing consists of reflection and prayer. In reflection activities, the teacher reinforces the material students have studied and asks questions about the learning objectives. When implementing this PBL model, at the end of the lesson, students take quizzes with the help of the Kahoot or Quiziz application. Students are very enthusiastic about taking the quizzes given; at each meeting, they are most looking forward to reflection. Reflection aims to help students develop awareness of their skills to understand, do, and know what difficulties they experience during the learning process (Fauziah et al., 2022). The presentation of learning activities with PBL, assisted by the SSI Worksheet above, shows that all PBL syntax can help students develop their problem-solving skills, so the first hypothesis in this research is accepted.

Differences in Increasing Problem-Solving Skills in the Experimental Class and the Control Class

In the experimental class, PBL is used combined with SSI-based worksheets. This combination benefits students because they are trained to optimize their physical and cognitive potential through activities that involve critical thinking, problem-solving, and formulating basic information and ideas from subject matter by applying problems from the real world (Widuri, 2023). Students in the experimental class also appear enthusiastic, active, and independent in every stage of learning because the learning system is student-centered. The statistical analysis results (see Table 3) show a significant improvement in problem-solving skills between the experimental and control classes.

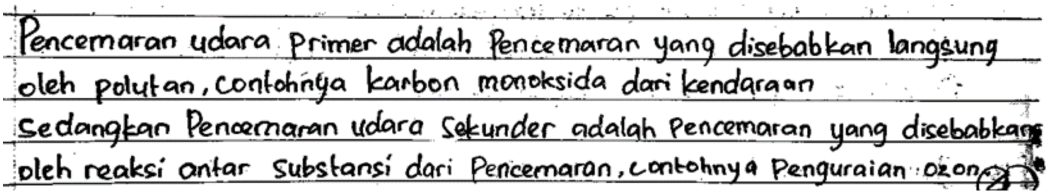
This finding is in line with Hasanah et al. (2020), who revealed that the problem-solving skills of students who used the PBL model obtained an average score of 87.50 higher than students who used the Direct Learning model, who only obtained an average score of problem-solving skills amounting to 72.40. Apart from that, Hidayati et al. (2021) stated that learning that actively involves students allows students to understand and use their reasoning to solve a problem because the Direct Learning model activities were focused on textbooks, so student activities were limited. The discussions usually did not facilitate the development of students' problem-solving skills. Therefore, it can be concluded that the PBL model effectively improves students' solving skills. The use of PBL assisted by SSI-based worksheets is the main factor that causes the average problem-solving skills score of students in the experimental class to be higher than the average problem-solving skills score in the control class (see Table 5). Descriptions of student responses showing mastery of problem-solving skills indicators in the experimental and control classes are presented as follows.

Understanding the problem

The indicator of understanding the problem is divided into two sub-indicators: (1) understanding what is known in the problem and (2) understanding what is asked in the question given. The average increase in problem-solving skills on this indicator for the experimental and control classes was 44% and 20%, respectively (see Figure 2). Indicators of problem understanding in the pre-test and post-test questions are located in item 1 (students can analyze the effect of air pollution on living things), item 2 (students can explain and give examples of types of air pollution), item 3 (students can analyze the lousy impact of factory smoke on the environment), and item 7 (students can analyze the relationship between environmental pollution and population density). It presents question number 2 (see Figure 3) and responses from ACI as a sample of experimental class students (see Figure 4) and RNA as a sample of control class students (see Figure 5).

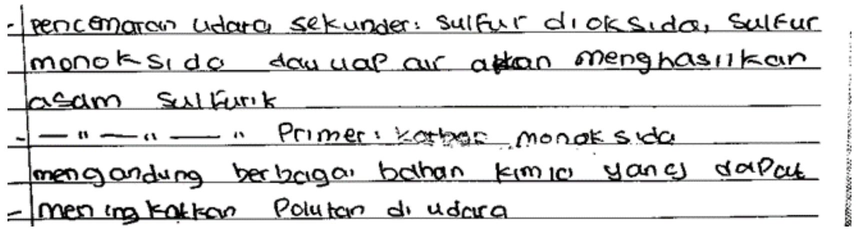
> There are two types of air pollution, namely primary air pollution and secondary air pollution. Explain the differences between the two and give 1 example of each type of air pollution!

Figure 3. Question item number 2


Pencemaran udara Primer adalah Pencemaran yang disebabkan langsung oleh polutan, contohnya karbon monoksida dari kendaraan sedangkan Pencemaran udara Sekunder adalah Pencemaran yang disebabkan oleh reaksi antar substansi dari Pencemaran, contohnya Penguraian ozon

> Primary air pollution is pollution caused directly by pollutants, for example carbon monoxide from vehicles, while secondary air pollution is pollution caused by reactions between pollutant substances, for example the decomposition of ozone.

Figure 4. ACI response (experimental class)


- pencemaran udara sekunder: sulfur dioksida, sulfur monoksida dan uap air akan menghasilkan asam sulfurik
- — " — " — " Primer: karbon monoksida mengandung berbagai bahan kimia yang dapat meningkatkan polutan di udara

> - Secondary air pollution: sulfur dioxide, sulfur monoxide and water vapor will produce sulfuric acid - primary air pollution: carbon monoxide contains various chemicals that can increase pollutants in the air

Figure 5. RNA response (control class)

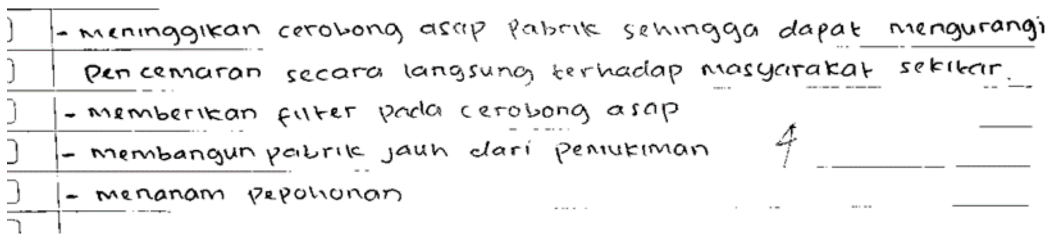
Figure 4 and Figure 5 show that at the stage of understanding the problem, ACI could identify problems according to the questions presented. He can identify the differences between primary and secondary air pollution and mention examples of each pollution. In contrast, RNA is still unable to identify the problem, so she cannot explain the differences between primary and secondary air pollution. RNA only mentioned examples of air pollution, and the answers were inappropriate.

Planning strategy

The strategy planning indicator consists of one sub-indicator, namely that students can determine the formula/way/method that can be used to solve the problem given. At this strategy planning stage, the problem-solving skills expressed are that students can formulate various solutions to the problems presented. The average problem-solving skills increase on this indicator for the experimental and control classes was 67% and 27%, respectively (see Figure 2). The indicators for planning a strategy are located in point 4 (planning a strategy to overcome the problem of air pollution caused by factory chimneys) and point 8 (determining the strategy to be implemented to overcome the impact of industrial waste). It presents question number 4 (see Figure 6) and responses from ENS as a sample of experimental class students (see Figure 7) and TDC as a sample of control class students (see Figure 8).

Based on the picture to the side, analyze 3 solutions that can be done to deal with this problem!

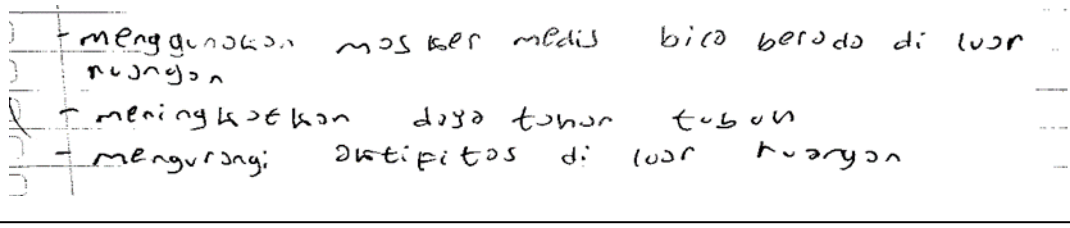
Figure 6. Question item number 4



- meninggikan cerobong asap pabrik sehingga dapat mengurangi pencemaran secara langsung terhadap masyarakat sekitar.
- memberikan filter pada cerobong asap
- membangun pabrik jauh dari pemukiman
- menanam pepohonan

Raise the factory chimney so that it can reduce direct pollution to the surrounding community, provide a filter on the chimney, build factories far from settlements, and plant tree

Figure 7. ENS response (experimental class)



- menggunakan masker medis bila berada di luar ruangan
- meningkatkan daya tahan tubuh
- mengurangi aktifitas di luar ruangan

Use a medical mask when outdoors, increase body resistance, and reduce outdoor activities.

Figure 8. TDC response (control class)

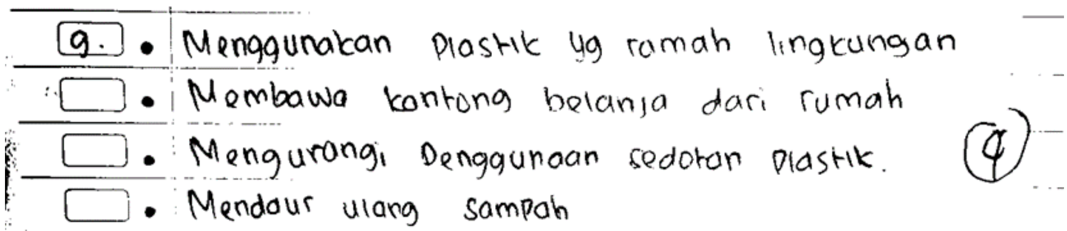
Students must master this second problem-solving indicator because determining and developing the right strategy for solving problems can help students find the right solution (Hermawati et al., 2021). Figure 7 and Figure 8 show that at the strategy planning stage, ENS could plan strategies well because they could create alternative solutions by providing strategic planning to overcome the air pollution problem caused by factory chimneys. In contrast, TDC could not create alternatives; his answers were to overcome the impact of pollution on health, not to overcome the problems presented in the question.

Implement the strategy

The indicator for implementing a strategy consists of one sub-indicator: students can carry out the formula/method/method planned to solve the problem given. The indicator for implementing the strategy lies in question number 9, and an average score of increasing problem-solving skills in the experimental class was obtained by 41% and in the control class by 34%. The increase in this indicator aligns with research by Novianti et al. (2020) that the stage of implementing a strategy depends on the student's experience to be more creative in planning problem-solving strategies if students make many mistakes in planning problems then. The results of solving the problem will also be less appropriate. It presents question number 9 (see Figure 9) and the responses from AFK as a sample of experimental class students (see Figure 10) and AMF as a sample of control class students (see Figure 11).

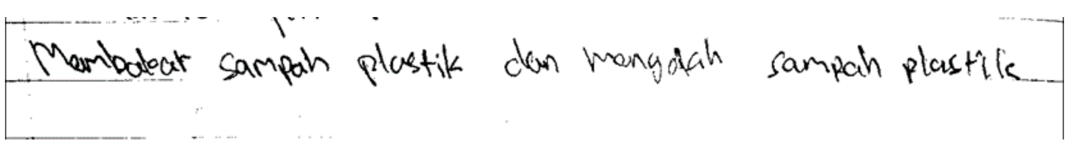
Soil pollution is caused by waste, especially plastic waste. What can be done to tackle plastic waste pollution?

Figure 9. Question item number 9



Use environmentally friendly plastic, bring shopping bags from home, reduce the use of plastic straws, and recycle waste

Figure 10. AFK response (experimental class)



Burning plastic waste and processing waste

Figure 11. AMF response (control class)

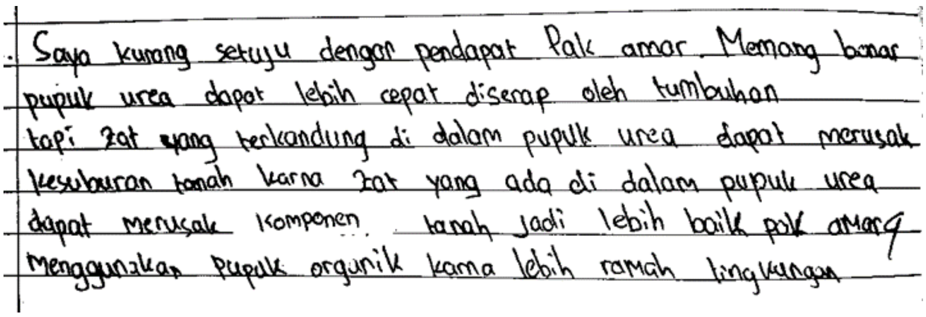
Figure 10 and Figure 11 show that at the stage of implementing the strategy, AFK was able to formulate appropriate actions to overcome plastic waste pollution. At the same time, AMF responded not to the existing problems. The problem-solving steps written by AMF students cause other environmental pollution problems, such as air pollution.

Checking again

The checking again indicator consists of one sub-indicator, namely that students can re-correct the answers they have given in solving questions to confirm the answers. Amaliah et al. (2021) state that rechecking the process and results shows that students are checking whether their work is correct and can conclude the desired solution. In the test prepared, this indicator is presented in item 5 (students can provide opinions, reasons, and solutions to overcome problems regarding triggers of dangerous gas concentrations) and item 6 (students can provide opinions regarding the use of urea fertilizer on plant quality and its impact on the soil). It presents question number 6 (see Figure 12) and the responses from KAZ as a sample of experimental class students (see Figure 13) and RPB as a sample of control class students (see Figure 14).

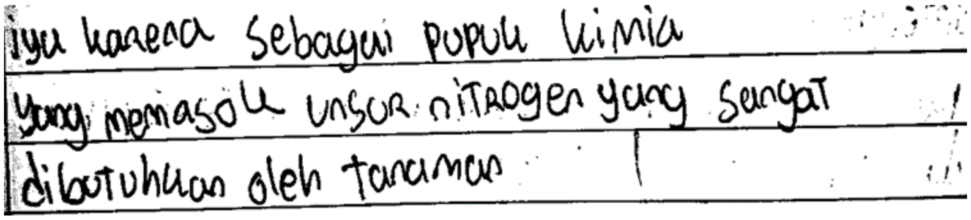
> Mr Amar is a farmer. He thinks that urea fertilizer is the most appropriate fertilizer to use to improve plant quality. This is because the macronutrient content in urea fertilizer is absorbed more quickly by plants, so Mr Amar always uses urea fertilizer rather than organic fertilizer. What can you conclude based on this question, do you agree with Mr Amar? Also include logical reasons

Figure 12. Question item number 6


Saya kurang setuju dengan pendapat Pak amar. Memang benar
pupuk urea dapat lebih cepat diserap oleh tumbuhan
tapi zat yang terkandung di dalam pupuk urea dapat merusak
kesuburan tanah karna zat yang ada di dalam pupuk urea
dapat merusak komponen. tanah jadi lebih baik pak amar
menggunakan pupuk organik karna lebih ramah lingkungan

> I don't agree with Mr Amar's opinion. It is true that urea fertilizer can be absorbed more quickly by plants, but the substances contained in urea fertilizer can damage soil fertility because the substances in urea fertilizer can damage soil components, so it is better for Mr Amar to use organic fertilizer because it is more environmentally friendly.

Figure 13. KAZ response (experimental class)



Yes, because it is a chemical fertilizer that contains nitrogen elements which are really needed by plants

Figure 14. RPB response (control class)

At the stage of re-checking the correctness of the solution, the problem-solving skills revealed are that students can conclude what they have done. Figure 13 and Figure 14 show that KAZ has been able to answer questions correctly and can provide opinions regarding the impact of using urea fertilizer on soil and plant fertility, while RPB has not been able to make conclusions from what is asked in the questions and only make answers from fragments of the questions. which is presented without being reinforced by the theory that has been studied. Exposure to the samples of student responses above further strengthens the study's results, indicating that treatment with PBL assisted by SSI-based worksheets can train students' problem-solving skills. In contrast, students in the experimental class show better problem-solving skills than the problem-solving skills of the control class (the second hypothesis in this study is accepted). Experimental classes that use PBL have trained students to develop problem-solving skills, increase understanding and knowledge, and be active in gaining knowledge so that students find it easier to solve problems according to previously acquired strategies (Handayani & Koeswanti, 2021). Apart from that, SSI-based media support further stimulates students' skills because the environmental problems raised are issues that are close to students, so it can motivate and encourage their critical thinking process to plan appropriate strategies for solving problems (Solbes et al., 2018).

CONCLUSION

Fundamental findings: Implementing PBL assisted by SSI-based worksheets effectively improves students' problem-solving skills. All phases in the PBL syntax (student orientation towards problems, organizing students in learning, guiding group investigations, developing and presenting work results, and analyzing and evaluating the problem-solving process) and the SSI approach integrated into the worksheet can facilitate problem-solving skills as evidenced by increasing problem-solving skills score after treatment in the experimental class. There is a difference in the increase in problem-solving skills scores between the experimental class (N-Gain high category) and the control class (N-Gain medium category). **Implications:** The PBL model assisted by the modified SSI Worksheet can be applied by teachers to other science materials to improve students' problem-solving skills. **Limitations:** This research only focuses on science material related to environmental pollution. **Future research:** Further research needs to be carried out for wide-scale trials on other science materials or other education levels.

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