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Problem solving in science technology and society learning improving junior high school students' scientific attitudes and process skills.

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Abstract

Problem solving research applied in the Science Technology and Society Learning aimed to improve students' science process skills and scientific attitudes. For this purpose, two complete classes of the same teacher were randomly assigned to the experimental and control groups. The research was conducted at a public school in Ambon City, beginning with a classroom placement test. The cognitive learning outcome test instrument was developed with a cognitive load that has been achieved according to the unit level, namely class IX and has met the prerequisite test of the instrument's quality. This research aimed to develop the instrument self assessment and peer assessment to assess the scientific attitude and the skill of process in studying science with scientific approach which is reliable, valid, useful, and easy to be used.The results showed that there was a statistically significant difference between the two groups related to process skills and attitudes towards science after the treatment. In the experimental group, mean scores were found to be consistently higher across all dimensions of process skills and scientific attitudes compared to the control group. Besides, the mean score showed an increase in the experimental group students'. The qualitative findings also reveal that students find problem solving fun. According to problem solving students, finding information and writing reports is one of the problem solving features that contributes the most to their learning.

Keywords: problem solving, technology and society, cognitive learning outcome

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1. Introduction

One of the essential goals of learning using a scientific approach is the birth of individuals who are always responsive and think critically to the development of science and technology (Kanbay & Okanlı, 2017). Students will be more motivated to construct knowledge and skills in conducting investigations to find facts of a phenomenon or event (Sansone et al., 2019). The Science Technology and Society (STS) approach in learning can undoubtedly accommodate this vital goal, because the problem solving-based STM approach has a significant relationship with the process skills and scientific attitudes of students.

Students are also taught to pay attention to the object of organic waste as a problem, which then arises as another impact of the use of new technologies in social life. The impact of the development of science and technology does not only mean negative impacts but also positively impacts and has a reciprocal relationship that affects each other (Abualrob & Daniel. 2013; Rollnick et al., 2015). By understanding the nature of science, technology, their development, and their impact on society, students will become individuals when they enter society and make the right decisions or policies to solve problems in their daily lives (Xiao & Sandoval 2017). Of course, the concepts and scientific processes that they learn in school are following the scientific concepts and processes they encounter in everyday life (Hacieminoglu 2016).

Very rapid technological advances have led to advances in all fields. Technological developments cannot be separated from developments in the field of science. The scientific development process that scientific scientists have carried out has a positive impact on technological development by creating equipment, which is a technology product. In turn, these technological products bring advances in science. It is hoped that locally based technology products can have a positive impact on society and the environment. Science education has a vital role in preparing students to enter the world of life where science underlies technological development. At the same time, technology supports the development of science (Hacieminoglu et al. 2016).

(Valladares, 2021) states that the STS approach attempts to present science through problems in everyday life. The technology and community science approach involves students in determining learning objectives, learning implementation procedures, and the scientific process to seek information on learning materials and even learning evaluation. The primary purpose of the technology and community science approach (STS) is to produce students who have scientific knowledge and attitudes to make decisions regarding society's problems (Servant-Miklos 2019). The application of the science-technology approach and society is based on three things: There are five learning domains contained therein, namely (1) the cognitive domain, (2) the affective domain, (3) the science process domain, (4) the creativity domain, and (5) the relationship and application domains (Alhashem & Agha, 2020)

The new education paradigm emphasizes students as active and creative humans who can always learn and develop following the times (Choi et al., 2019). The teacher no longer plays the highest authority in learning but as a facilitator and motivator who guides students to be more active in learning (Gordon 2020). It is hoped that students can be more creative in finding solutions to problems faced in everyday life. Batlolona et al. (2019) state that creativity manifests a scientific attitude to produce something fresh or new ideas in dealing with a problem. Zhu et al. (2020) states that they by asking students not only to focus on one solution but also several ways of solving that emphasizes the creativity of the students.

So far, teaching and learning activities in the classroom are still dominated by the view that knowledge is a set of facts that must be memorized. Classes still focus on the teacher as the primary source of knowledge. Lectures are the primary choice of learning strategies. For that, we need a 'new' approach that is more empowering for students (Deschênes et al., 2020). An approach that encourages students to construct knowledge in their minds. Contextual Teaching Learning (CTL) is `promoted 'to become an alternative to a new approach (Sung et al., 2019). Through the Contextual Teaching Learning (CTL)

strategy, students are expected to learn through experience,' not a set, not to memorize, but creating inspiring learning, motivating participation, providing learning freedom for students and increasing understanding of concepts by independent learning ((Baharuddin & Agustang, 2022; Boser et al. 2016).

STS learning is combined with problem solving using technology as a link between science and society, so a lecturer or teacher needs to have a learning strategy that combines the understanding and use of science, technology and society with the aim that science concepts can be applied through skills that are beneficial to students and public (Oliveros Ruiz et al. 2010). The development of social technology science in this research raises local plant fruit waste from the genus Lansium, Nephelium and Durio, which are very abundant in Ambon city, to improve the process skills and scientific attitudes of junior high school students. This development refers to the learning flow of community technology science with material that is very close to students' everyday life.

Organic waste can be environmentally friendly, and even waste can be reprocessed into something useful if it is appropriately managed. However, suppose waste is not managed correctly. In that case, it will cause disease and unpleasant odors because of the rapid decomposition of organic waste (Ayilara et al. 2020). The quantity of fruit waste found in the Ambon city environment continues to increase every year along with the increase in population and the quality of life of the people themselves, which tends to be more consumptive. Several factors that affect the level of waste hazard are the volume of waste, the frequency of waste disposal, and pollutants (Yang et al. 2018). Organic waste in the form of seeds and fruit peel from the genus *Lansium, Nephelium,* and *Durio* are very abundant in Ambon City. This organic waste is considered to have a higher level of safety because it is readily biodegradable so that it does not cause a heavy residue hazard and is undoubtedly more selective by not poisoning living things and other environments that are not targeted (Song et al. 2009).

There is a need for innovation in organic waste management by involving students to overcome this problem so that organic waste can be used as products of economic value. Based on the facts in the field about the issue of fruit waste abundant in the city of Ambon, it is necessary to develop community technology science that is adapted to the local environmental conditions and scientific attitudes through problem solving by students.

2. Theoretical Background

Problem solving (PS) is deemed necessary for students because these abilities can help students make decisions that are correct, careful, systematic, logical, and consider various points of view (Chu et al. 2016). The challenge for the development of the Indonesian nation in the 21st century, especially in education, is to prepare young generations who are flexible, creative, and proactive. The younger generation needs to be formed to be skilled in problem solving (problem solver), wise in making decisions, think creatively, like to deliberate, communicate their ideas effectively, and work efficiently both individually and in groups (Sukmayadi & Yahya, 2020). Knowing knowledge is proven to be not compelling enough to successfully deal with life and life, which is increasingly complex and can change rapidly (Vegt et al., 2017). Problem Solving and Scientific Operation Skills help to learn in science. Students become active, develop initiatives, improve learning continuity, and provide basic skills in carrying out research. Students must have several mental patterns such as being able to relate observed events to concepts discussed in class, the ability to investigate scientifically, determine alternative solutions, design experiments based on proposed hypotheses, collect evidence and use them in the process of scientific investigation.

2.1 Problem Solving in Science and Technology Society

Maluku, especially the island of Ambon, has local fruit food availability, such as durian, langsat, duku, mangosteen, Gandaria, and other local fruits, which are quite abundant in its season. Organic vegetable and fruit waste is a significant problem found in almost all traditional Ambon Island markets. So far, most traditional markets in managing waste still rely on the end of the pipe, where waste is collected, transported, and disposed of to the final waste processing site (TPA).

STS is proposed as a new conceptual organization that equips students with real-world connections between the classroom and society (Mai et al., 2012). Today, science and technology (IPTEK) are developing rapidly through the use and utilization of technology products in various aspects of life to meet daily life needs (Yu et al., 2015). However, these technological products can have a detrimental impact on humans and the environment as a whole (Kelley et al. 2020). To overcome and control the negative impacts caused, quality human resources who can master science and technology are needed so that they can keep up with the development of scientific and technological advances (Twiningsih 2020). The teacher's role is vital to select essential concepts and train students in Ambon to think, analyze and solve the problems they face. Teachers need to raise issues or problems of organic waste that develop in everyday life related to the technology around them or those related to student needs (Darmawan & Dagamac 2021).

Teachers in science learning in the classroom are more oriented towards the quantity of learning, namely completing the subject matter contained in the curriculum. The teaching model applied is still direct. The teacher uses relevant and general literature and does not conceptualize concepts before the learning process begins (Müller et al., 2016). Many students use technology products but cannot explain the relationship between the scientific concepts they have learned and the technology products they use (Wahab et al., 2011). Learning in schools provides material concepts and adds value in the form of life skills that students in everyday life can use. The description above shows how important it is to find alternatives to improve learning outcomes. One way to realize this learning is by applying the community technology science learning model (Rao & Aithal 2016). Innovations that take advantage of environmental issues in the learning process are theoretically able to form individuals who can think critically, creatively, and innovatively. One of the impacts of students learning with community technology science is that students can identify problems and be more creative in finding solutions to solve them (Gökçearslan et al., 2019). Students who have problem solving skills can apply the knowledge they have in the context of the problems they face.

2.2 Scientific Attitude and Process Skills

Understanding the concept will be more meaningful if students find their concepts learned through the scientific process. One of the activities carried out in the scientific process is conducting experiments. Experimental activities carried out during the learning process can train science process skills (SPS) and develop students' scientific attitudes. The scientific attitude contains two meanings, namely: attitude to science and the attitude that is inherent after studying science (attitude of science). This study's scientific attitude is the attitude that is inherent after studying science (attitude to science) and includes several aspects of positive behavior such as curiosity, critical thinking, open thinking, and honesty.

SPS consist of basic process skills and integrated process skills. In general, assessment of science process skills in schools is still rarely carried out. Who revealed that learning emphasizes more on the lower cognitive dimensions while the higher cognitive processes are rarely touched.

The science learning process requires students to carry out experiments and observations to practice science process skills and generate scientific attitudes. Characteristics of science learning demand a balance between process skills, scientific attitudes, and scientific products. Science process skills elaborated in science learning can involve various intellectual, manual, and social skills. With the formation of knowledge products through scientific work processes, scientific attitudes are formed. Science learning in these schools takes place without a scientific process in real observations and experiments so that students do not develop scientific attitudes such as curiosity and critical thinking. This fact indicates that the scientific attitude of students in the science learning process has been lacking.

2.3 Research Problem

SPS and scientific attitudes are abilities that students must possess to apply the scientific method in understanding, developing, and discovering science. SPS and scientific attitudes are essential for every

student to use scientific methods in developing science and are expected to acquire new knowledge / develop the knowledge they already have.

The questions that arise to be answered through this research are as follows:

1. Is there any effect of PS in the science and technology of society on student learning outcomes?.
2. Is there any effect of PS in STS on students' science process skills?.
3. Is there any effect of PS in the STS on students' scientific work?.

3. Methodology

3.1 Research design

The type of research used in this research is quasi-experimental to determine the effect of treatment on the characteristics of the subjects studied. It is not possible to control everything relevant. The research design used was the pretest-posttest (P-P) non-equivalent control group design, as shown in Table 1.

Table 1. Research Design

Group	Pre-Test	Treatment	Posttest
$E1$	XEI	$X1$	$YE1$
$E2$	$XE2$	$X2$	$YE2$

The independent variable is the learning model, which consists of 2 levels, namely Problem Solving and conventional learning. The dependent variable, in this case, learning, is a cognitive achievement. The research procedure consisted of several stages. The first step was taken to determine the experimental group and the control group. The second step was to give the same pretest to the experimental and control groups. The questions given have been categorized as valid, totalling 40 questions consisting of 35 multiple-choice questions and five essay questions and tested on 50 grade IX students in Ambon City. The experimental group applied Problem Solving in learning science technology society. The control group was given conventional learning as a learning treatment that teachers often use in schools. The material taught to students is environmentally friendly technology and its applications. Then, both groups were given the identical posttest.

3.2 Participants

This research was conducted at SMP Negeri 6, Ambon. Sampling was carried out randomly by taking samples in the form of classes that had the opportunity to be sampled. A sampling at school could only be done by selecting classes, which are then used as an experimental group. Based on this technique, the samples are randomly selected, namely two classes. The samples chosen were class IX_9 and IX_{13}, with 32 and 34 students (Male: 26, Female: 40).

3.3 Instrument

The main instrument used in this study was a cognitive learning outcome test instrument. Other supporting instruments were student worksheets validated and used to measure student activity at each meeting, problem solving and STAD learning outcomes sheets, student response sheets to problem solving and control, and interview instruments to confirm student answers.

The data obtained were analyzed based on data analysis techniques, including descriptive analysis, assumption test or analysis prerequisite test, and hypothesis testing. After being tested for normality and homogeneity, the mean difference was made for each experimental group's initial achievement. This was done to determine whether there is a difference in the average for the first achievement of the two groups. The test used is covariance analysis (ANCOVA).

4. Results

Before carrying out the learning process in class, the first thing that must be done was to do a placement test to find out whether the two classes were the same or not. The results of the placement test indicated the normality of the data that is shown in Table 2.

Table 2. Normality Analysis

Variable	Kolmogorov-Smirnov value	Significance
Final cognitive test	1.617	.111
Student Process Skills	1.603	.092
Student Scientific Attitude	1.852	.062

The data in Table 2 provides an understanding of the test data that is normally distributed. Meanwhile, the homogeneity test in table 3 shows the data tested is homogeneous

Table 3. Homogeneity Analysis

Variable	Levene's value	Significance
Final cognitive test	2.579	.310
Student Process Skills	.015	.904
Student Scientific Attitude	2.681	.060

The prerequisite test, namely the normality and homogeneity test of the data, had been fulfilled. The normality test was used to determine whether the test result data were normally distributed or not using One-Sample Kolmogorov Smirnov. A homogeneity test was carried out to prove whether the P-P data are homogeneous or not, using Leven's Test of Equality of Error Variances in SPSS 18.00 Software. The results of the prerequisite test data are presented in Table 2. The normality and homogeneity tests of the data were carried out in two groups: the experimental and control groups. After proving that the data were normal and homogeneous, the ANOVA test was carried out to ensure equality in the two groups, namely problem solving and control. ANOVA results showed the value of Sig (0.00) <alpha (0.05), which means there is a difference in learning achievement between the two groups of students at IX_9 and IX_{13}, or both are equivalent.

Hypothesis testing can use the post-test / covariate value of students' cognitive achievement in the experimental group with the problem solving learning model treatment and the control group with the learning model that teachers in schools often used. The results of the statistical analysis of the ANCOVA variable related to cognitive achievement can be seen in Table 4.

Table 4. Ancova Test Results on Differences In Cognitive Achievement In Problem Solving and Control Learning

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
post_test	79.943	1	79.943	.861	.357
Learning_Models	4129.503	1	4129.503	44.476	.000
Error	5849.439	63	92.848		
Total	488688.000	66			
Corrected Total	15570.667	65			
a. R Squared = .624 (Adjusted R Squared = .612)					

Based on the data obtained, there are differences in cognitive achievement in problem solving and control learning (conventional learning). The Least Significant Difference Advanced Test (LSD) or T-test was unnecessary because there were only two treatment groups. However, information about the differences in the results of process skills and scientific attitudes toward treatment between the two types of problem solving and control learning was shown in Table 4 and Table 5.

Table 5. ANOVA Test Results of Differences in Process Skills Achievement In Problem Solving and Control Learning

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	12029.894	1	12029.894	719.665	.000
Within Groups	1069.821	64	16.716		
Total	13099.715	65			

The ANOVA test results in table 4 show the alpha significance value of 0.000 <0.05 so that Ho is rejected, and Ha is accepted. This means that there are differences in the achievement of students' process skills using Problem solving and control learning (conventional learning).

Table 6. ANOVA Test Results of Scientific Attitudes Achievement Differences in the problem solving and control learning

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7481.077	1	7481.077	151.811	.000
Within Groups	3153.850	64	49.279		
Total	10634.926	65			

The ANOVA test results in table 5 show the alpha significance value of 0.000 <0.05 so that Ho is rejected, and Ha is accepted. This means that there are differences in students' scientific attitudes using problem solving and control learning. The N-Gain result, as in Figure 1, shows that the highest cognitive increase in achievement from pretest to post-test can be seen in problem solving learning.

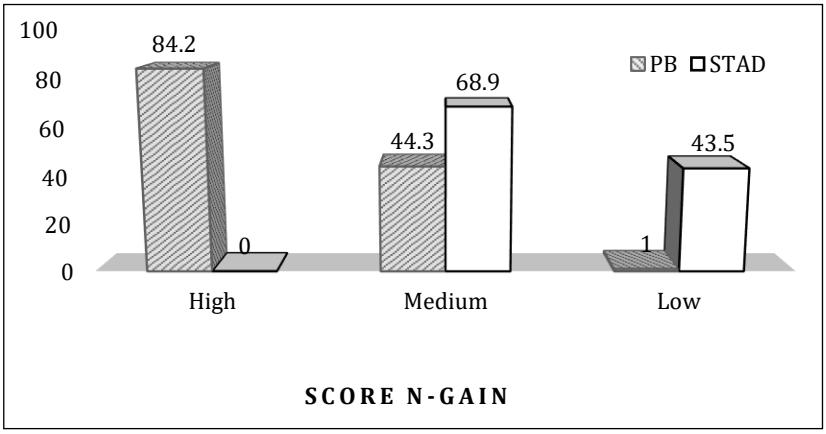

Figure 1. Student N-gain in Problem solving and Control Learning Model

The study results inform that the cognitive of students in the PS group is significantly more than the control group because students had many opportunities to express ideas, improved understanding and communication skills in the problem solving group. Students were required to think creatively to

express scientific issues and analyze the relationship with the material being taught. Meanwhile, students in the control model of learning were not included in the model's syntax. Students were not active or did not have confidence in expressing opinions in front of their friends and teachers. The results that the PS learning model have a more significant effect on the cognitive aspects of achievement, compared to the control class can be assessed through the work of students in the PS group in Figure 1.

Based on the hypothesis testing results, there are differences in PS abilities and scientific attitudes of students between groups of students who are taught using the STS learning approach and the direct learning model. Students who are taught using the STS learning approach show better PS abilities and significantly higher scientific attitudes than those taught using the direct learning model. This is based on the results of statistical analysis, which means that there are significant differences in students' PS abilities and scientific attitudes between groups of students who are taught PS and control.

Science learning for grade IX in junior high school with an emphasis on indicators: 1) presenting the definition, principles, and application of environmentally friendly technology in accordance with science process skills in presenting environmentally friendly technology processes and products for the sustainability of life: and 2) presenting works on simple technological processes and products environmentally friendly. Especially for questions to answer indicator 1). What is contained in the durian fruit peel and langsat peel causes mosquitoes to die; 2). What is the smell released by the durian rind ; 3) Does the amount of durian peel affect the number of mosquitoes that die? 4). How is the relationship between the number of durian peels and the number of mosquitoes that die?.

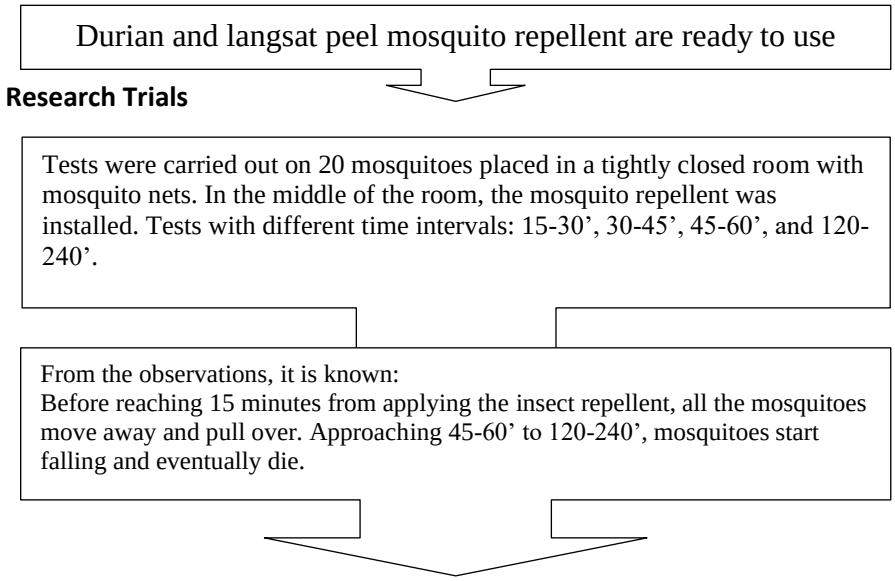

Figure 2. Snippets of Student Work Result in the Problem solving Group

Listen to student explanations!

These studies and observations indicate that the solution in durian fruit is effective in repelling and eradicating mosquitoes. The behavior of mosquitoes that stay away from mosquito repellents is because the fruit and peel of durian contain essential oils, which are very stinging and are not liked by mosquitoes. The effect of durian essential oil can affect the nerves of mosquitoes, resulting in mosquitoes experiencing instability. The unstable condition of the mosquitoes was known when touching them with a pencil. The 30-45th minute trial shows that it did not immediately fly when the mosquito was touched and only flew a few moments later. However, after that, the mosquito fell and died.

It turns out that there are still efforts to eradicate mosquitoes naturally and healthy, which means we do not have to worry about side effects / bad effects caused by the presence of

harmful residues. Apart from that, students' research results in Public Junior High School 6 Ambon are more effective, efficient and environmentally friendly, and pocket-friendly than the electric mosquito repellent made in the factory. So why don't we try it from now on?

4. Discussion

Students' understanding based on the answers to these questions is mosquitoes' behavior away from mosquito repellents because the durian fruit and peel contain essential oils, which are very stinging and are not liked by mosquitoes. Students understand the relationship with durian (*Durio zibethinus Murr*) as one example of a plant that has the potential to be a natural insecticide that is safe for the environment. Hamdani (2019) stated that durian peel contains essential oils, flavonoids, saponins, cellulose, lignin, and starch content, that has a very strong odor and is disliked by mosquitoes, because the effect of these ingredients can affect the nerves in mosquitoes, which causes mosquitoes to experience instability and eventually die. At a concentration of 25%, it is effective for killing mosquitoes. Stated that increasing the number of essential oils will further increase the ability to repel mosquitoes, because mosquitoes inhale more and more essential oils (M. Y. Lee 2018).

The group discussed the following question using langsat fruit peel as an ingredient for making mosquito repellents. Emphasizing is on several indicators, among others: 1) what substances do mosquitoes dislike?; 2). What is contained in the peel of langsat fruit that causes mosquitoes to die?; 3) What smell does langsat fruit peel produce?; 4). Does making the extract of langsat peel into several concentrations, namely 35%, 30%, 25%, 20%, and 15%, affect the number of mosquitoes that die?. Students' understanding based on the answers to these questions is to reduce the impact of excessive use of insecticides, it is necessary to research on substances that mosquitoes do not like so that they can function as natural vegetable pesticides so that they do not damage nature and are not harmful to humans.

Students answer this question according to their habits carried out in daily life at home. Whereas during the harvest season for langsat or duku in the city of Ambon in particular and Maluku in general, there is an abundance of rubbish from langsat and duku fruit peel. People often dry the peel and langsat seeds dry; then, they are burned at the house's side. The smoke from burning langsat peel waste causes the mosquitoes that nest to be expelled. Based on the facts in this field, it becomes a problem for students to do research.

The natural mosquito repellent ability of langsat peel in killing the Aedes aegypti mosquito is thought to be caused by active compounds in the dominant secondary metabolites. It can be larvicides and insecticides in the form of terpenoids, flavonoids, alkaloids, saponins, and other compounds, mostly found in the leaves, seeds, and peel of the langsat fruit that cause the death of Aedes aegypti larvae at various concentrations (Fidiana 2020). Question number 4 has been proven by students by conducting experiments with various concentrations of langsat fruit peel extract. This step is in line with the results of research conducted by Januariana et al. (2018), the number of Aedes aegypty mosquitoes that died in a mechanical gauze box trap using three different concentrations of langsat peel extract, namely 25gr / l, 30gr / l and 35gr / l with three replications for 4 hours of observation every day at different exposure times and different concentrations obtained varying results according to the concentration of duku peel extract against the number of mosquitoes that died in the gauze box mechanical mosquito trap. There were already dead mosquitoes in the gauze box mosquito trap in the langsat peel extract with a concentration of 25 gr / l. At a concentration of 30 g / l there was an increase in the number of mosquitoes that died until at a concentration of 35 g / l. The langsat peel extract was more effective at killing Aedes aegypty mosquitoes. This is because the higher the concentration, the higher the concentration of acetone produced, which can interfere with the mosquito inhalation system.

The teacher allows students to ask another question regarding environmentally friendly technology. The students asked, "Can environmentally friendly insect repellent be made from fruit peels or other plant parts?". This question contains motivation that allows students to ask questions to hone critical

thinking skills, problem solving, and science literacy. Because one of the functions of teaching science is to help students develop HOTS by encouraging students by asking questions. This shifts the teacher's role as a provider of information to facilitators and guides in the learning process. Asking questions is an essential strategy for effective communication in an academic environment (Carroll and Harris 2020) and is a crucial activity in the teaching and learning process (Jarvis & Baloyi, 2020). Therefore, increasing the questioning strategy can improve the quality of interaction in the learning process (Roets & Maritz, 2017).

Answering the questions posed by students, "Can environmentally friendly mosquito repellents be made from fruit peels or other plant parts?" All plants can be alternative insecticides that are environmentally friendly and relatively resistant to resistance. Insecticides that can meet these criteria include insecticides derived from plants, or what are commonly known as vegetable insecticides. Vegetable insecticides are easily broken down in the environment not to cause heavy, dangerous residues. Synthetic antioxidants are carcinogenic in a certain period. They can cause toxins in the body, so we need safer natural antioxidants. Natural antioxidants can be found in vegetables that contain phytochemicals, such as flavonoids, isoflavins, flavones, anthocyanins, and vitamin C (Sumartini et al. 2020).

Problem solving emphasizes determining the source of the problem and finding practical solutions. Effective problem solving skills (PSS) require specific scientific work. For example, requiring active listening and communication skills when interacting requires effective technical knowledge related to the problems discussed (Wu et al., 2019). Students' ability to solve problems is still influenced by memory and experiences gained from daily experiences, often not well structured (Lee and Lee 2020). PSS are classified into scientific approaches, plug and chug (structured and unstructured ways), memory-based approaches, and vague approaches. Students have problem solving with unstructured methods, memory-based approaches, and unclear approaches, which then affect students' PSS. Thus, students' problem solving skills are influenced by the type of approach used in problem solving (Burkholder et al., 2021). In learning activities in the classroom, the classroom atmosphere feels fun because students feel confident when treated as scientists who provide an overview of students' scientific attitudes towards investigations and their perceptions of ways or actions in solving problems (Ritter & Mostert, 2018).

The step that the teacher must take is to guide students in solving problems is to analyze the situation. These analytical skills will help students understand problems and develop process skills effectively. Thus the dominance of teachers will be reduced, so students must respond to these changes quickly and the need for teachers to prepare them to become longevity learners to follow the evolution of technology (Saputro et al., 2019). Students in making decisions to solve problems that arise, need teacher guidance. This will form students' scientific attitudes in vital research and analytical skills to help them have new experiences (Dori et al., 2018). There may also be times when the teacher can take the time to work out a solution or pass on a problem to help students solve it.

When students identify solutions to solve problems, teachers need to direct students, so they need to know how to communicate with others. Once students have found solutions, communicating them clearly will help students reduce confusion and make implementing solutions easier, shaping student attitudes shaping personal life experiences, and education. A scientific attitude is an attitude that students must have in studying science, such as being honest, curious, responsible, conscientious, and disciplined. In contrast, science's attitude is just an attitude that students like or dislike toward science learning (Guven et al., 2020).

5. Conclusion

Based on the discussion on the research results, it can be concluded that the science technology and society model has an effect on students' social problem solving skill. The Science Technology Model and Sociality are significant and positive in terms of process skills and student participation. The results of the study showed that there was significant effect of STS model on scientific literacy and scientific

attitude of students.This can be seen from the difference in the average cognitive achievement of the posttest and pretest experiments (learning using problem solving) and the control group (conventional learning). Likewise, there are differences in the learning outcomes of students' process skills and scientific attitudes who are taught using PS in the experimental class and the control class. This shows that applying science, technology, society, and science to life sciences are explicitly developed. Our findings show that in this context, the ability of students to process skills and scientific attitudes to use PS is more accurate, especially process skills and scientific attitudes of science, and students' interest and attitudes towards STS increased.

6. Recommendations

Some recommendations that need to be put forward include: It is necessary to develop students' PSS and the skills to integrate learning to meet the goals of National Education to form students' full potential. It is necessary to integrate problem solving skills in science learning to prepare students to move quickly into the future. Governments, education policymakers, and each stakeholder must go forward to transform our education systems to create individuals as "problem solvers.".

7. Limitations

Some of the limitations faced in this study include 1) students can remember very varied concepts; 2) the ability of students' cognitive strategies, about how to analyze problems, thinking techniques, problem approaches, requires much practice; 3) teacher skills are required in determining a problem whose level of difficulty is in accordance with the level of thinking of students, school and class levels, as well as student knowledge and experience; 4) Changing students' learning habits by listening to and receiving information from the teacher into learning by thinking a lot to solve problems alone or in groups, which sometimes require various learning resources, is a difficulty for students; and 5) The teaching and learning process using the problem solving model often requires a considerable amount of time and is often forced to take other lessons.

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