Students’ Problem Solving Skill on the Ecosystem Materials Through Somatic, Auditory, Visual, and Intellectual Model

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Abstract. The ability to problem solving is one of the higher order thinking skills so it is very important in biology learning. Based on observations, many students have low problem solving skills on the biology learning, especially in the ecosystem materials. This study aims to determine whether the somatic, auditory, visual, and intellectual (SAVI) model is effective to improve students’ problem solving skills on the concept of the ecosystem. This study used a quasi experiment, and research design of the matching only pretest-posttest design. This study’s population was all 10th-grade students MIPA of Senior High School of Prambanan in Sleman Regency, Indonesia. Sample selection using a random sampling technique from the entire population of class X MIPA, resulting in class X-4 MIPA being chosen as a control group and class X-2 MIPA as an experimental group. Data analysis in this study consisted of two, namely the N-Gain test and hypothesis testing using the independent samples t-test test. The results showed that the results of the N-Gain test in the experimental class were 0.73 (high category), while the control class is a score of 0.59 (medium category). Meanwhile, The results of the research on the independent samples t-test on problem solving skills are the sig value. 0.001, p< 0.05. Based on results, it can be concluded that the SAVI model was effectively used in biology learning to improve problem solving skills.

Keywords: SAVI model, problem solving skills, ecosystem.

Introduction

Education is widely perceived as a solution to solve social problems. Education cannot be separated from learning systems given by schools (Jumriani & Prasetyo, 2018). A correct learning is a strong base to create qualified human resources. Education is one aspect influenced by the era development. The influence gives direct impacts on the society. In this era, learning has reached the 21st century learning (Rahman, 2019). 21st-century learning requires various skills. These skills are termed 4C, which stands for critical thinking, collaboration (the ability to work well together), communication, and creativity (Scott, 2015). Students are required to solve problems in the learning process, while the task of the teacher is only to help students to achieve this by making the teaching and learning process more active and fun, including stimulating students’ thinking abilities and skills (Häkkinen et al., 2017). Therefore, teachers and schools must be able to develop all the potential that exists in students so that students have adequate provisions to overcome challenges and global competition in the Industrial Revolution 4.0 of the 21st century (Stehle & Peters-Burton, 2019).
The 21st century skill in the learning paradigm is that teachers and schools are required to be able to make students into superior human resources (Kurniawan et al., 2022). Therefore, a school must be able to develop all the potential that exists in students so that students have adequate provisions to overcome global challenges and competition in the industrial revolution 4.0 of the 21st century (Stehle & Peters-Burton, 2019). Problem solving skills is one of the skills that must be possessed by students in facing the 21st century Industrial Revolution 4.0 (Wibawa et al., 2019), in order to be able to participate in building a social and economic order that is aware of scientific knowledge as befits citizens of the world in the world. The 21st century that competes in the era of globalization (Piirto, 2011).

The ability to solve problems is one of the benchmarks for the quality of students in this modern era. Problem solving skills in learning biology has become a major subject, because learning biology is classified in the form of investigation and analysis (Kurniawan & Djukri, 2022). In addition, problem solving skills help students to construct new knowledge and facilitate learning biology (Nakano & Wechsler, 2018). Problem solving skills in biology learning are considered very important because with problem solving students can understand the causal relationship of any scientific phenomena that will later be faced in 21st century life (Supiandi & Ege, 2019). Teachers apply effective learning strategies and models to overcome these problems (Sobral, 2021). In addition, teachers as the main component in learning have a role to provide constructive motivation and are able to create a learning atmosphere that is in accordance with the characteristics of students (Tari et al., 2020). One solution to train students problem solving skills is to apply the somatic, auditory, visualization, and intellectual (SAVI) model.

The SAVI Model was first introduced by Dave Meier, he said that learning SAVI a learning model that combines physical movement with intellectual activity and uses all the senses that students have for learning activities (Meier, 2002). Additionally, suggests that learning involves more senses to enhance understanding of learners optimally (Purnama et al., 2020). The characteristics of SAVI can be seen from the elements: 1) somatic (learning by doing) practicing problem solving skills in students is the process of learning by doing something. 2) auditory (learning by hearing. 3) visualization (learning by seeing) is a learning process by seeing, observing and describing. 4) intellectual (learning by thinking) is in the process of learning to solve problems and think (Anggreini & Dewi, 2020). According to Iskandar et al., (2016), learning by combining physical movement and intellectual activity and using all the senses is aimed at influencing learning progress. SAVI model also emphasizes students to be actively involved by combining physical movement and intellectual activity so as to direct students to seek various alternative information from various sources obtained through the five senses in order to solve problems and express ideas or solutions to a problem (Anggreini & Dewi, 2020).

According to research conducted by Pujiastuti et al., (2018), the application of learning model SAVI and its modifications effective in supporting the growth of problem-solving abilities of the students. Another study stated that SAVI model has the meaning of learning by utilizing student body movements, so that it can actualize analytical skills in solving problems. For example, practicum activities are carried out by students at laboratorium by following the instructions on the student worksheets (Fajriah et al., 2020). This is in line with research conducted by Rinendah (2015), practicum activities in the SAVI model make students use sensory devices (visual and auditory) and students use thinking skills (intellectual), thus requiring students to concentrate on learning to solve problems in order to remember the material being studied (somatic). Based on this explanation, the purpose of this study is to prove whether the SAVI model is effectively used in the ecosystem materials to improve problem solving skills.
Methods

The research method used is quasy experiment and the matching only pretest-posttest design research design, so there are two classes, namely the experimental class and the control class. Both classes were given a pre-test and post-test treatment of problem solving skills. The population in this study were all 10th-grade students MIPA of Senior High School 1 of Prambanan in Sleman Regency, Indonesia that the school has four classes in the academic year of 2022/2023 and implements the Indonesian National Curriculum of 2013. Sample selection using a random sampling technique because each element of the entire population has the same characteristics or full homogeneous (Siregar & Harahap, 2019). The chosen samples were X-2 MIPA class as an experimental class consisting of 34 students, and X-4 MIPA class as control class consisted of 34 students. The first class was chosen as an experimental class implementing a SAVI model. The second class was chosen as a control class, implementing a 5M model.

The data collection of problem solving skills in this study is a essay tests. The instrument test of problem solving skill consists of five questions about the ecosystem topic. The test instrument of problem solving skill in this study adopted indicators from Nitkol & Brookhart (2011). The instrument of problem solving skills consisted of five questions. Each question represents one aspect of problem solving skills. Aspects of problem solving skills used in this study are identifying problems, formulating problems, organizing information, finding solutions, and choosing solutions. The instrument test consisted of pre-test and post-test. The instrument of problem solving skills has doing with validity and reliability test. The validity of the problem solving instrument test was obtained by measuring the sensitivity index of the items. The indicators of the problem solving skills test are presented in Table 1.

Table 1. The Indicators of The Problem Solving Skills Test.

<table>
<thead>
<tr>
<th>Question Number</th>
<th>Indicators</th>
<th>Sub Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Identifying Problems</td>
<td>The ability of students to receive information contained in the questions and the ability of students to choose important and unimportant information.</td>
</tr>
<tr>
<td>2</td>
<td>Formulating Problems</td>
<td>The ability of students to relate existing information so that they can formulate problems</td>
</tr>
<tr>
<td>3</td>
<td>Organizing Information</td>
<td>The ability of students to process information</td>
</tr>
<tr>
<td>4</td>
<td>Finding Solutions</td>
<td>The ability of students to apply solutions</td>
</tr>
<tr>
<td>5</td>
<td>Choosing Solutions</td>
<td>The ability of students in choosing methods solution</td>
</tr>
</tbody>
</table>

The result of measuring the items' sensitivity index on the problem solving skills items obtained an average value of the sensitivity index of the pre-test items at the experimental class was 0.72 categorized as high. In contrast, in the control class, the mean score was 0.50, categorized as enough. Meanwhile, the mean score of the
The sensitivity index of the post-test items at the experimental class was 0.76 categorized as high. In contrast, in the control class, the mean score was 0.48, categorized as enough. The item test, which has a sensitivity index of 1.0, will not be answered by the students who have not studied yet. However, those who have studied can do the test well (Subali, 2019). It can be concluded that the students in the experimental class were better in answering the item test compared to the students in the control class. The instrument’s reliability test using a Cronbach Alpha was that the value was 0.687, then the question is declared reliable or consistent, so that the items of the test distributed to the students have high reliability. The item problem solving distributed to the students has met the reliability requirements.

This research procedure consists of four stages, namely (1) measurements were carried out before being given treatment, so that they were given a pre-test of problem solving skills to the experimental class and control class to determine the initial conditions related to the dependent variable; (2) the experimental class, namely giving a treatment by applying an SAVI model, while the control class was treated by applying a 5M model; (3) measurement after being given treatment, namely giving a post-test of problem solving skills. Both classes were given the same weight of problem solving skills questions. It aims to see the difference in student scores before and after applying the interactive SAVI model, and; (4) the data is analyzed using N-Gain, and inferential statistical analysis consists of prerequisite test and hypothesis testing. The prerequisite testing and hypothesis testing in this study used the IBM SPSS Statistics 26 application. Statistical analysis is carried out by first conducting a prerequisite test analysis to determine whether the data obtained will be processed using parametric or non-parametric statistics. The prerequisite test in this study consisted of a normality test using kolmogorov smirnov test, while the homogeneity test used the lavene test. Statistical test using independent sample t-test, and using a significance level of 5%. Hypothesis testing in this study assumes that there is an effect of the SAVI model on the improvement of students' problem solving skills on the topic of ecosystems.

The data analysis technique of the problem solving skills was carried out in two ways, namely as follows: (1) descriptive statistical analysis was carried out by describing the data from the test results of problem solving skills. Furthermore, the analysis of problem solving skills was carried out using the N-Gain test. The use of the normalized gain (N-Gain) score test can describe the extent of the influence of the SAVI model in improving students’ problem solving skills. The N-Gain value refers to the interpretation of the data which can be seen in Table 2; (2) inferential statistical analysis consists of prerequisite test and hypothesis testing. Analysis of problem solving skills through qualitative data converted to quantitative data.

Table 2. Interpretation of N-Gain Value.

<table>
<thead>
<tr>
<th>Large N-gain Value</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-gain &lt; 0.3</td>
<td>Low</td>
</tr>
<tr>
<td>0.3 &lt; N-gain &lt; 0.7</td>
<td>Medium</td>
</tr>
<tr>
<td>N-gain ≥ 0.7</td>
<td>High</td>
</tr>
</tbody>
</table>

The prerequisite test in this study consisted of a normality test using kolmogorov smirnov test, while the homogeneity test used the lavene test. The results of the normality of problem solving skills for the N-gain in the experimental class obtained the value of sig. 0.078, and the control class obtained a sig value of 0.098 from Kolmogorov-Smirnov of > 0.05. Meanwhile, the results of the homogeneity test used the lavene test obtained the value of sig. 0.603 from the homogeneity test of > 0.05 can be concluded that the data is homogeneous. The results of the normality test and homogeneity test
data is normally distributed and homogeneous, so it was continued to the parametric testing stage using the independent sample t-test, and using a significance level of 5%.

Results and Discussion

The measurement of problem solving skills is carried out using a problem solving skills test. Measurement of problem solving skills is given to students at the beginning and end of learning to determine improvement. The results of students’ problem solving skills before and after learning can be seen in Table 3.

**Table 3.** The Statistical Descriptive Results of Problem Solving Skills

<table>
<thead>
<tr>
<th>Description</th>
<th>Experimental Class</th>
<th>Control Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pretest</td>
<td>Posttest</td>
</tr>
<tr>
<td>Amount Sample</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>Total Score</td>
<td>1790</td>
<td>2960</td>
</tr>
<tr>
<td>Average</td>
<td>52,64</td>
<td>87,05</td>
</tr>
<tr>
<td>Std. Deviasi</td>
<td>8,45</td>
<td>8,71</td>
</tr>
<tr>
<td>Max. Score</td>
<td>70</td>
<td>100</td>
</tr>
<tr>
<td>Min. Score</td>
<td>30</td>
<td>65</td>
</tr>
</tbody>
</table>

Based on Table 3, shows that in the results of the problem solving skills pretest there is no significant difference in scores between the experimental class and the control class. In the experimental class, the pretest score got 52,64 (very low), while the control class got a score of 45,58 (very low). This can be interpreted that the initial ability of students in problem solving skills is still relatively very low because it has not been prioritized. The very low pretest in the experimental class and control class is caused by several factors, including students’ lack of focus in participating in biology learning, students rarely doing practicum, and students who are not accustomed to working on analytical questions such as problem solving problems in biology learning. In addition to the pretest, a posttest was also conducted to see the improvement of problem solving skills after being given treatment in the form of an SAVI model. In the posttest, there is a difference between the experimental class and the control class (Table 5). The experimental class scored 87,05 (very high), while the control class scored 77,79 (high), so it can be interpreted that the SAVI model conducted in the experimental class is more helpful for students in mastering problem solving skills compared to using 5M model conducted in the control class. The SAVI model allows students to generate many ideas and ideas from pictures, graphics, and learning videos provided by the teacher. This gives students the opportunity to use the senses of various activities designed in biology learning so as to make students seek their own information, discuss and present the results of their discussions. This is in accordance with the results of research conducted Taneo (2017), Learning activities using the SAVI model are a process to improve students’ problem solving skills through a contextual approach. The learning activities carried out make students more active in learning because students take advantage of all the five senses in process (Rahayuningtyas et al., 2022).

Meanwhile, there is a comparison of the pre-test scores for the indicators of problem solving skills between the experimental class and the control class. The comparison of the pre-test scores of indicators of problem solving skills in the experimental class and control class is presented in Figure 1.
Based on Figure 1, shows that students in the experimental class and control class already have problem solving skills. However, the problem solving skills possessed by the two classes are categorized as very low so they have met the requirements to be treated with the application of an SAVI model. In addition, there are differences in the post-test scores of indicators of problem solving skills in the experimental class and the control class. The comparison of the post-test scores of indicators of problem solving skills in the experimental class and control class is presented in Figure 2.

Figure 1. The Pre-test Scores of Problem Solving Skills

Figure 2. The Post-Test Scores of Problem Solving Skills
Based on the data on the comparison of the post-test value of the problem-solving indicators between the experimental class and the control class in Figure 2, it can be explained that the posttest score for each indicator of problem solving skills in the experimental class is higher than the posttest value for each indicator of problem solving skills in the control class. In addition, there is the highest post-test score for the problem solving indicator in the experimental class, namely the problem organization indicator is 90.44 (very high), while the post-test score of the problem organization indicator for the control group is 77.21 (high). This shows that students in the experimental class have excellent analytical skills in processing information to find solutions to problems because the SAVI model makes students active and motivates students in participating in learning activities and is able to work on problem solving skills, so students can accept and develop ecosystem topics. This is in accordance with the results of research conducted Putri et al., (2019), states that learning is not only remembering, but more broadly that, namely the learning experience with the SAVI model conducted by students will be more remembered as an experience, so that it can improve learning outcomes.

The use of N-Gain test analysis in research is useful to determine the difference in the improvement of students’ problem solving skills between the experimental class and the control class. The results of the N-Gain score of problem solving skills in the experimental class and control class are presented in Table 4.

**Table 4. The Results of The N-Gain Score of Problem Solving Skills In The Experimental Class and Control Class**

<table>
<thead>
<tr>
<th>Description</th>
<th>Experimental Class</th>
<th>Control Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount Sample</td>
<td>34</td>
<td>34</td>
</tr>
<tr>
<td>N-Gain Average</td>
<td>0.73</td>
<td>0.59</td>
</tr>
<tr>
<td>Category</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

Based on Table 4, the N-Gain value obtained by the experimental class is 0.73 (high), while the control class is only obtained by 0.59 (medium). The average value of N-gain was higher in the experimental class compared to the control class, it can be concluded that the use of SAVI model provides an increase in problem solving skills that are better than classes that the use 5M model. This is following research Syazali et al., (2021), the savi model has an important role in improving students’ problem solving skills. The SAVI model helps students concentrate their minds through conceptual reasoning, investigation, problem identification, finding, creating, constructing, solving problems, and linking material to real life so that learning outcomes and learning experiences can be applied to everyday life. This is because the savi model is contextual learning. Learning will be easier for students if the material being taught is related to environmental situations or real world situations that exist in everyday life so that it is easy to understand and does not feel abstract to students. This statement is supported by Victorina & Ramadhan (2019), the contextual approach is a learning concept in which the teacher presents real-world situations to students. Contextual learning models help students understand the subject matter they are studying by connecting the subject matter and its application in everyday life (Ismawanti et al., 2022).

In addition, the SAVI model provides opportunities for students to do practicum work independently at home, thus training students’ problem solving skills independently. According to Umayah et al., (2020), the SAVI model consists of somatic, auditory, visual and intellectual elements that can be collaborated with practicum activities so that it can improve cognitive learning outcomes. Somatic which is a body movement that requires learning by experiencing and doing. Auditory emphasizes the learning process through listening, listening, speaking, presentation, arguing, and responding. Visual means are
learning by using the meta senses through observing, drawing, demonstrating, reading, using media, and teaching aids. Intellectual meaningful learning by emphasizing the ability to think (Ahmad, 2021).

An independent sample t-test was conducted because the normality test and homogeneity test results have met the parametric test requirements. This test was carried out to see the independent variable (SAVI model) on the dependent variable (problem solving skills). The results of the independent sample t-test in this study can be seen in Table 5.

Table 5. The Results of The Independent Sample T-Test

<table>
<thead>
<tr>
<th>Equal Variance Assumed</th>
<th>t</th>
<th>Df</th>
<th>Significance Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem Solving Skills</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>3.338</td>
<td>66</td>
<td>0.001 ≤ α (0.05)</td>
<td>Hₐ accepted</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>3.338</td>
<td>64.502</td>
<td>0.001 ≤ α (0.05)</td>
<td>Hₐ accepted</td>
</tr>
</tbody>
</table>

Based on Table 5, the significance value (2-tailed) is 0.001 < 0.05. There is a significant difference between the scores of students' problem solving skills in the experimental and control classes. Thus, it can be concluded that the SAVI model was effectively used in biology learning to improve problem solving skills. This is following research Sarmilah et al., (2021), learning with the SAVI model allows students to be able to solve every problem and find a solution well so that the learning outcomes obtained are also very good. The SAVI model activities, make students able to encourage more creative expression, express opinions, respond, and use thinking skills such as problem solving skills through physical activity and students' sensory tools in learning (Wijayanti & Sungkono, 2015).

The SAVI model has 4 activities, namely the preparation stage, the delivery stage, the training stage, and the performance stage. In the preparation stage, students are organized to participate in learning activities. The first thing to do is to give positive suggestions (Rusman, 2014). The second stage, namely the activity of delivering material. At this stage, the teacher conveys the material by encouraging students to use sensory devices such as analyzing problems from the learning videos given by the teacher. The third stage, namely training activities. At this stage students are encouraged to work on practicum in groups, and work on problem solving skills questions on student worksheets. The fourth stage, namely the stage of presenting the results of activities. At this stage the teacher helps students to acquire and acquire knowledge they do not know. The SAVI model consists of somatic, auditory, visual, and intellectual (Hartati & Sismulyasih, 2017). Auditory and visual elements can be seen in the second activity, where students observe, listen and analyze problems in the learning video. These activities involve the whole brain and make students active to learning independently. Intellectual ability can be seen in students' ability to answer questions about problem solving skills. Somatic activity can be seen in practicum activities (Umayah et al., 2020).

Basically the SAVI model optimally stimulates the five senses of students to be able to capture information. Somatic is a learning process that triggers body movements to move and act to solve problems. Auditory ability triggers students to learn through listening. In the learning process, hearing is very important to capture information and then stored in the brain and then applied in real life (Dapa et al., 2021). Visual triggers students to capture things or concepts from what students see directly in the learning process. Intellectual is the ability to interpret, reflect, create, solve problems, build the meaning of any information, and exchange ideas to solve a problem through discussion activities ideas to solve a problem (Syazali et al., 2021). Therefore, the SAVI model is
effective to improve students’ problem solving skills on the concept of the ecosystem. SAVI model can be used as a facility to express opinions related to problem solving on ecosystem topics, and make students active in biology learning activities, so that learning materials are more meaningful by implementing and improving aspects of students’ problem solving skills.

Conclusion

The data analysis and discussion results conclude that the implementation of the SAVI model can train student's problem solving skills, consisting of formulating identifying problems, formulating problems, organizing information, finding solutions, and choosing solution. It can be seen from the score of students’ problem solving skills that they have increased, as shown in the N-Gain score with a high category.

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