Improving grade xi students' learning outcomes in sensory system through discovery learning

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ABSTRACT

The sensory system is a sub-chapter of the Coordination System which is difficult to understand if you only study orally. For this reason, a learning model and teaching and learning activities are needed to support the improvement of learning outcomes. Classroom Action Research (PTK) with the spiral model from Kemmis and Mc Taggart using 2 cycles with each cycle consisting of 2 meetings is one of the solutions to overcoming class problems. The increasing result of learning outcomes was analyzed by evaluating the effectiveness of the N - Gain formula. The research subjects were students of class XI MIPA 3 at SMAN 1 Ampel, Centra Java. learning outcomes in each cycle have increased with the results in cycle 1 was 0.79 and cycle 2 was 0.75. The discovery learning model and experiments with the simple practical can improve student learning outcomes, in cycle 1 from 53 to 90, and in cycle 2 from 48 to 87. The use of the discovery learning model toward student learning outcomes runs effectively with the significance category of N – Gain values from each cycle in the high category.

INTRODUCTION

Education is one of the determining factors for the progress of a nation. A nation can be said to be advanced if one of its factors has been fulfilled, such as HR (Human Resources) which has achieved certain targets, namely intelligence or level of education. According to Muamar (2019), education is one of the benchmarks for determining whether a nation or country is said to be advanced and developing. Education is also regulated in the UUD'45 (1945 Constitution) which provides a clear mandate to make the life of the nation intelligent. This indicates that, in general, the government and all Indonesian citizens in Indonesia are responsible for education in Indonesia. The responsibilities given can be in the form of innovation in learning and all kinds of learning tools that will be applied in the classroom.
One of the materials covered in class is the coordination system. The coordination system is divided into several sub-chapters including the nervous system, hormonal system, sensory system, and the influence of psychotropic substances (Kusuma, 2020). The results of interviews with teachers at SMAN 1 Ampel revealed that most of the grade XI students often struggle to grasp the coordination system material, especially in the sensory system sub-topic because the material was hard to understand (the students were not capable of visualizing it). This leads to a lack of interest and difficulty in comprehending the concepts of the material, ultimately resulting in bad learning outcomes for the students. From last year's data in XI Science 3, there were 22 out of 37 got scores (learning outcomes) below the minimum passing grade (KKM). In the class, teachers often carry out learning activities using a lecture model on all biology material. Nisak (2021) states that inviting or involving students in learning activities such as simple experiments will help students understand the material. In general, discovery learning is divided into several research models (Hopkins, 2022). One of the research models that are currently popular is the CAR model in the form of a spiral or consisting of more than 1 cycle, or cycles. One model that can be used. The first PTK model that was introduced was the PTK model by Kurt Lewin which showed that the coordination system material. In this condition, it does not lead to the class theory itself, but the class being directed is a group of students (Arikunto et al., 2015). PTK has several research models that can be used. The first PTK model that was introduced was the PTK model by Kurt Lewin which showed that there was a stage consisting of 4 parts including: 1) Planning, which is an activity to prepare a learning plan such as the need for learning tools (RPP/Lesson Plan, learning media, etc.), the process of analyzing data from the process and results of actions; 2) Acting, is an activity that contains steps or implementation of the results of plans that have been prepared which refer to the RPP that was formed, such as the initial, core, and closing activity stages; 3) Observing, is a stage for supervising or observing students regarding learning; 4) Reflecting, is the final stage of the cycle which leads to the process of recording observation results, evaluating observation results, analyzing student learning outcomes, and all the results of the plan, of course, this reflection provides input to the teacher for future improvements (Purnama et al., 2020). The development of the first CAR model, there were many changes, especially in the number of repetitions or cycles. One model that is currently popular is the CAR model in the form of a spiral or consisting of more than 1 cycle, this model is known as the research model by Kemiis and Mc Taggart (Hopkins, 2022).

The Discovery Learning learning model is a learning model that can encourage students to identify a problem, then students begin to find ways to solve the problem and construct something from the results of their thinking (Astari et al., 2018). In general, Discovery Learning is also known as a learning process that is carried out by presenting material that does not reach the final stage, so...
this will direct students to find a handling process (Maharini et al., 2020). According to Batubara (2020), Discovery Learning is a scientific approach model that can improve student learning outcomes both cognitively, but also in other aspects of assessment. The use of learning models also needs to be balanced with experiments/activities/practicums to improve student learning outcomes.

Based on this description, this research implements CAR using a discovery learning model combined with simple practical lab activity on the topic of sensory systems for improving learning outcomes, which helps the students to understand the mechanism of the sensory system. The purpose of experiments/activities/practicums in a lesson is to help improve students' skills or increase students' understanding of the material being studied (Daniah, 2020). The effect of the discovery learning model on the improvement of student learning outcomes applied by Agusriyalni et al. (2021) indicates that there is an improvement in student learning outcomes in the cognitive domain and skills in the material of coordination systems. This research aims to determine the effect of the Discovery Learning learning model based on simple laboratory activities on improving the learning outcomes of class XI MIPA3 students at SMAN 1 Ampel.

**RESEARCH METHODS**

**Research Design**

The type of research to be applied is Classroom Action Research (CAR), which is research aimed at addressing issues that occur in the classroom through direct implementation (Salim et al., 2019). The CAR model used is a spiral model consisting of 2 cycles popularized by Kemmis and McTaggart. The variable of dependent variable is students’ learning outcomes, the control variable is all students in grade XI Science 3, and the independent variable is the senses system with discovery learning. The research started in October 2022 until April 2023 on SMAN 1 Ampel.

**Population and Samples**

The population in this research was grade XI Science on SMAN 1 Ampel. The sample of the research was grade XI Science 3 (consisting of 36 students) which used a sampling technique called purpose sampling which took the class that has the lowest learning outcomes.

**Instruments**

The research instruments used were observation papers about lesson plan implementation, pre-test and post-test papers, and interview papers. There are pre-test, and post – a test that has 12 questions which are divided into 10 multiple choice questions and 2 essay questions, those questions cover the assessment of cognitive abilities C1 – C6. For pre-test and post–test questions were validated by 2 two validators. The observation paper consists of observations about the implementation lesson plan such as implementation discovery learning. The pre-test, and post–test were given before treatment implementation (pre–test) and after treatment (post–test). Interview papers were used to help the researcher gain more information about the problem in grade XI Science. The information gained from the interview with the Biology Teacher such as the difficulty of the Biology chapter that students experience and frequently of using simple lab experiments in the class for abstract lessons.

**Procedures**

The research procedures were using CAR. The stages of implementing Classroom Action Research (PTK) are as follows: 1) Pre–action/Pre–intervention, this stage starts with identifying the problem by discussing it with the Biology teacher, observation, analyze the background of the problem, arranging the research plan, compiling the research instrument, and planning the simple
lab activities. 2) Action implementation, in this stage consists of 2 cycle that has steps such as plan, action, observation, evaluation, and reflection. This CAR procedure follows Kemmis and Mc Taggart from the book of Hopkins (2022) which can be seen in Figure 1.

![Figure 1. CAR (Class Action Research) stages by Kemmis and Mc Taggart.](image)

**Data Analysis**

The learning outcome data obtained will be analyzed through N-Gain testing and the calculation of the percentage of lesson plan implementation will be used in assessing the implementation of the lesson plans. N-Gain testing is used to assess the effectiveness of a given intervention. This is also supported by statements from Patmawati et al. (2018) which explain that the N-Gain formula is used to evaluate the effectiveness of an intervention based on the improvement between pre-test and post-test results. The N-Gain formula is shown in the following figure 2 (Wahab et al., 2021).

\[
Normal \ Gain = \frac{Post \ Test \ Score - Pre \ Test \ Score}{Ideal \ Score - Pre \ Test \ Score}
\]

**Figure 2.** N – Gain formula

After calculating the learning outcome data through N-Gain testing, the obtained assessment categories are reanalyzed and placed into the following Table 1 (Rahmah et al., 2019).

<table>
<thead>
<tr>
<th>N – Gain Score</th>
<th>Classification</th>
</tr>
</thead>
<tbody>
<tr>
<td>N – Gain &gt; 0.7</td>
<td>High</td>
</tr>
<tr>
<td>0.3 ≤ N – Gain ≤ 0.7</td>
<td>Middle</td>
</tr>
<tr>
<td>N – Gain &lt; 0.3</td>
<td>Low</td>
</tr>
</tbody>
</table>
In assessing the implementation of the lesson plans, the RPP implementation observation sheet uses the Guttman scale. The Guttman scale is an assessment that provides only two options, for example: yes - no, ever - never, good - poor, etc (Pranawijaya et al., 2019). The formula for calculating the implementation of lesson plans is illustrated by Nufus (2021) in the following picture:

\[ \% = \frac{A}{B} \times 100\% \]

**Information:**

A = Implemented learning/activity steps.
B = All planned learning activity steps.

**Figure 3.** The Formula for Calculating the Implementation of Lesson Plans.

After calculating the data on the implementation of lesson plans obtained from the observation sheet/paper, it will be converted into the percentage conversion table of lesson plan implementation as shown by Nufus (2021) in the following Table 2.

**Table 2.** The Conversion of Lesson Plan Implementation Percentage in Teaching and Learning Activities

<table>
<thead>
<tr>
<th>Percentage (%)</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>81 – 100</td>
<td>Fine</td>
</tr>
<tr>
<td>61 – 80</td>
<td>Better</td>
</tr>
<tr>
<td>41 – 60</td>
<td>Good</td>
</tr>
<tr>
<td>21 – 40</td>
<td>Bad</td>
</tr>
<tr>
<td>0 – 20</td>
<td>Worse</td>
</tr>
</tbody>
</table>

**RESULTS**

The data presented is in the form of student learning outcomes and assessment sheets on RPP implementation. In student learning outcomes, there is an increase in learning outcomes in each cycle, as shown in the following Table 3.

**Table 3.** Summary of student learning results in the pre-test and post-test in each cycle

<table>
<thead>
<tr>
<th>Component</th>
<th>Grade XI MIPA 3</th>
<th>CAR Implementation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cycle 1</td>
<td>Cycle 2</td>
</tr>
<tr>
<td>Total Students</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>Highest score</td>
<td>75</td>
<td>100</td>
</tr>
<tr>
<td>Lowest score</td>
<td>15</td>
<td>75</td>
</tr>
<tr>
<td>Total the students that pass</td>
<td>2</td>
<td>36</td>
</tr>
<tr>
<td>Average</td>
<td>53</td>
<td>90</td>
</tr>
</tbody>
</table>

Based on table 3 shows that for pre–test on cycles 1 and 2, the majority of the students didn’t pass and also for the total score (average score) that they got was under 70, and for the post–test result (each cycle) majority of the students passed their minimum passing score (70).
The improvement in student learning outcomes obtained was analyzed through an effectiveness assessment using the N – Gain formula and the data obtained is in the following Figure 2.

![Figure 2. Diagram of students' learning outcomes.](image)

The following data obtained are the results of the RPP implementation sheet which was assessed by 2 observers. The results of the implementation of the RPP are shown in the following Figure 3.

![Figure 3. Percentage of Implementation Lesson Plan.](image)

**DISCUSSION**

Table 3 shows that there is an increase in learning outcomes in each cycle and improvements occur in each cycle. The increase shown in Table 3 in Cycle 1 meeting 2 is 90 and Cycle 2 meeting 2 is 87. The increase in student learning outcomes can be influenced by several things, one of which, if adapted to this research, is an intervention with the Discovery Learning learning model, and simple experiments/practicums prove that it can improve student learning outcomes. This is supported by a statement from (Masril et al., 2018) which explains that the implementation of KBM using the Discovery learning learning model can improve student learning outcomes, and by providing laboratory or practicum activities, both virtual and experimental, it can improve abilities.
or science skills in students. Based on the quotations taken, the results obtained show suitability because of the increased learning outcomes of students shown in the learning outcomes (post-test) who have received treatment in the form of applying the Discovery Learning learning model and practicums/experiments/simple laboratory activities.

If we observe from Figure 4, in cycle 1 the N – Gain value obtained was 0.79 which is classified as a high increase in learning outcomes (see table 1. N – Gain Value Indicator), as well as in cycle 2 the N – Gain value obtained is 0.75 which indicates that there is a high increase (see table 1. N Value Indicator – Gain) in student learning outcomes. However, from the two N – Gain results in cycle 1 and cycle 2 there is a difference of 0.04. This difference is still considered safe because there is no significant difference. This is also supported by the statement taken from Popham (2011) which explains that, if the N - Gain of the two cycles carried out has a small difference, then it can be interpreted that the two cycles have relatively the same skills in the concept measured by the N - method. Gain, but the differences that emerge from each cycle can be shown as the effectiveness of the activities carried out. The difference is not too big (0.04) so the treatment carried out using simple learning models and practical work on the sensory system still has a good influence on student learning outcomes.

The results of the RPP implementation assessment from 2 observers showed that in cycle 1, meeting 1, the percentage of implementation of the RPP was 100% and in cycle 1, meeting 2, it was 100%, while in cycle 2, meeting 1, the percentage of implementation of the RPP was 100%, with cycle 2, meeting 2, being 94.2%. In cycle 2, meeting 2, there was a decrease to 94.2%, this was because there was 1 indicator in the assessment of the implementation of the RPP that was not implemented, namely the final part of the Discovery Learning syntax in the form of students conveying learning conclusions.

The average percentage of RPP implementation in each cycle, such as cycle 1, was 100% and cycle 2 was 97.2%. The results of the analysis of the implementation of the lesson plan (Figure 5) using the Discovery Learning learning model and providing simple practical experiment treatment on the sensory system, observed by 2 people, namely observer 1 and observer 2, show that cycle 1 had a very good implementation of the lesson plan due to all the existing indicators of the achievement of the lesson plan, on the observer sheet, it was carried out well. However, in cycle 2 in this study, the average implementation was 97.2% because, in cycle 2 of meeting 2, there was a part of the RPP implementation assessment indicator that was not implemented, namely the Discovery Learning syntax, namely generalization, which should be a generalization activity carried out by students. This syntax was not implemented due to insufficient use of time. This condition is supported by the statement of Edi and Rosnawati (2021) who explain that, in implementing the RPP, you must pay attention to the KBM time in preparing the RPP so that all activities in the RPP can be carried out. However, overall the implementation of the RPP is classified as good because the percentage of implementation scores is not below 90% (high category) so it can be said that good implementation of the RPP can improve student learning outcomes. This is supported by the statement from Khaerani et al. (2020) who stated that good implementation of lesson plans can improve student learning outcomes in class.

CONCLUSION

Implementation of Classroom Action Research using a simple practicum on the sensory system which was carried out at SMAN 1 Ampel using 2 cycles. It can be concluded that the Discovery Learning learning model and simple practicum went well and there was an increase in student learning outcomes, namely cycle 1 meeting 1 (pre-test) a score of 53 and at meeting 2 (post–test) it was 90 and in cycle 2 meeting 1 (pre–test) a score of 48 and cycle 2 meeting 2
(post-test) was 87, as well as the application of the Discovery Learning learning model to student learning outcomes effective with a significance category of N-Gain value for each cycle is high.

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**REFERENCES**


