The STAD learning model: Cognitive learning and self-regulation effects

Ericka Darmawan, Karunia Galih Permadani, Alfi Anjani,

Biologi Education Study Program, Universitas Tidar, Indonesia

*Corresponding author: darmawan.ericka@untidar.ac.id

ABSTRACT

The learning approach at MAN Temanggung is predominantly teacher-centered, neglecting the individual learning needs of students. Consequently, the cognitive learning outcomes of students remain subpar. Furthermore, self-regulation, a crucial psychological factor that impacts student learning outcomes, is not adequately addressed. This study aims to determine the effect of the Student Teams Achievement Division (STAD) learning model on students' cognitive learning outcomes and self-regulation on excretion system material at MAN Temanggung. The STAD learning model based on differentiated learning is applied to the experimental class. The applied differentiation learning is product differentiation. Data was collected using a pretest and post-test to measure cognitive learning outcomes and a questionnaire to measure self-regulation abilities. The results showed a significance value of 0.000 <0.005, meaning that the STAD learning model based on differentiation learning affects cognitive learning outcomes and students' self-regulation. Thus, the Student Teams Achievement Division (STAD) learning model based on differentiation learning significantly affects cognitive learning outcomes and students' self-regulation.

INTRODUCTION

Education plays an essential role in developing students' potential, talents, and abilities so that students are expected to be able to apply them in everyday life. Following Law Number 20 of 2003 concerning the National Education System, it is mandated that the process of developing students' personal qualities as the nation's next generation will be realized through education. The curriculum is one of the elements that play a role in realizing the process of fostering students. The
curriculum contains objectives, content, and learning materials used to achieve national goals in a lesson (Fussalam, 2018; Siregar & Ulfia, 2022; Triwiyanto, 2022).

Following the times, the curriculum underwent changes and developments to achieve national education goals. Curriculum changes and developments are expected so that students can obtain optimal learning outcomes. However, curriculum changes will only have a tangible impact if the implementation of applied learning strategies is appropriate; teacher-centred learning and not adapted to the learning needs of students and affects low student learning outcomes.

Low academic achievement is also evidenced in the 2018 PISA (Program for International Student Assessment) results, which show Indonesia is ranked in the bottom 10 of 79 participating countries. In addition, students' science skills are still below the average for ASEAN countries (OECD, 2019). Based on the analysis of PISA results, several factors influence the decline in the competence of students, including internal factors and external factors. Internal factors include learning motivation, toughness, competitive nature, and so on. External factors include the learning environment, teaching practices carried out by the teacher, and the completeness of facilities and infrastructure. According to Asih (2018), the low cognitive learning outcomes of students can be attributed, in part, to the utilization of inappropriate learning methods or models, as well as the students' limited thinking ability and understanding of concepts.

Based on the results of observations at MAN Temanggung, it was found that the biology learning outcomes of class XI MIPA students still needed to be optimal. The average daily test score shows 68% of students have not reached the predetermined mastery value. The low learning outcomes are due to teaching methods that tend to be teacher-centered and lack variation in learning, so students are not actively involved in learning. It has an impact on learning interest and low student learning outcomes.

Learning outcomes are abilities or skills students possess after experiencing learning activities which consist of knowledge, skills, and attitudes (Djonomiarjo, 2020; Ilmiyah & Sumbawati, 2019; Nurrita, 2018). Internal factors and external factors influence learning outcomes. Internal factors include physical factors and psychological factors. Physical factors such as health and physical condition of the body. While psychological factors such as intelligence, interests, talents, motives, maturity, and readiness. At the same time, external factors include social and non-social factors. Social factors, such as teachers, staff administration, and classmates, may influence student learning outcomes. Additionally, society, neighbors, and the physical or natural environment can also have an impact on student learning. On the other hand, non-social factors, such as the school building and its location, the student's family home and its location, learning tools, weather conditions, and the amount of time spent studying by students, can also affect student learning outcomes (Suryabrata, 2005).

One of the psychological factors that affect learning outcomes is self-regulation. Self-regulation is a person's ability to regulate their cognition and use strategies to achieve their actions to achieve a target of learning outcomes (Putrie, 2021). The importance of self-regulation to one's achievement is also conveyed by Woolfolk (2004), who states that self-regulation is one of the personal factors influencing one's achievement. Self-regulation integrates several things, including knowledge, motivation, and self-discipline, which are essential factors in self-regulation (Friskilia & Winata, 2018). Based on the results of observations, students have not been able to regulate themselves, as evidenced by the inability of students to set learning goals and learning strategies so that students do not have target learning outcomes, and learning outcomes still need to be improved.

In studying biology, excretory system material is tricky because it includes bioprocesses that cannot be sensed directly. In line with what was conveyed by Hanifah (2015), excretory system material has characteristics whose processes cannot be perceived because the study includes...
physiological processes in the human body. It has caused students difficulty in understanding excretory system material. The biology teacher at MAN Temanggung also said that excretory system material covers quite a lot of material, so it needs easy-to-understand delivery.

The solution that can be done to overcome the problems described above is to use the Student Teams Achievement Division (STAD) learning model. The STAD learning model is a type of cooperative learning that emphasizes student motivation and interaction in learning to achieve optimal learning outcomes (Jalal, 2022; Takdir, 2021). In this study, the STAD learning model was combined with differentiation learning. Differentiated learning assesses that each student has different uniqueness, interests, potential, and talents, so the teacher must be able to coordinate and collaborate on differences to suit students' learning needs (Faiz et al., 2022; Fitra, 2022; Maryam, 2021). Differentiated learning applied in this research is product differentiation.

Based on the description above, this study aimed to determine the effect of the Differentiated Learning-based Student Teams Achievement Division (STAD) learning model on cognitive learning outcomes and students' self-regulation on excretion system material at MAN Temanggung. It is hoped that this research can provide a solution to the biology learning problems at MAN Temanggung.

RESEARCH METHODS

Research Design

This study uses a quasi-experimental or quasi-experiment with a quantitative research approach. This study uses the Nonequivalent Control Group Design. The research design consisted of an experimental group that received treatment or treatment of the STAD learning model based on differentiated learning and a control group using conventional learning. The research design is explained in Table 1.

<table>
<thead>
<tr>
<th>O₁</th>
<th>X</th>
<th>O₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₃</td>
<td></td>
<td>O₄</td>
</tr>
</tbody>
</table>

Source: (Sugiyono, 2015)

Information:
O₁ = Pretest for the experimental group
O₂ = Post-test for the experimental group
X = Provision of treatment with the STAD-based learning model
Differentiation:
O₃ = Pretest for control group
O₄ = Post-test for the control group.

Population and Samples

The population in this study were all students of class XI MIPA MAN Temanggung, totaling 216 students. The samples used in this study were two classes from the whole population class, namely class XI MIPA 3 and XI MIPA 5, each consisting of 30 students. The sampling technique used was the purposive sampling technique. Purposive sampling is a research sampling technique that involves specific considerations determined by the researcher (Sugiyono, 2017).

Instruments

The research instrument used to measure cognitive learning outcomes is a multiple-choice test consisting of two types: pretest and post-test, each containing 30 questions. To measure self-regulation abilities, a self-regulation questionnaire with 25 statement items was used. The
instrument questions used previously had passed the validity, reliability, difficulty level, and item discrimination tests. At the same time, the questionnaire instrument results from the research adoption by Permana (2017) and Ardiana (2018). The results of construct validity, conducted by material and content expert validator Mrs. Serafica Btari Christiyani Kusumaningrum, M.Sc, obtained a score of 70.2%, indicating moderately valid validity criteria and question construction. Additionally, the question construction expert validator, Mrs. Ismeini Tri Nugraheni, S.Si, obtained a score of 97.2%, indicating highly valid validity criteria. Therefore, it can be concluded that the pretest and post-test instruments are suitable for use. After the construct validity was carried out, a content validity test was conducted using the SPSS Statistics 22 program. The validity test utilized the corrected item-total correlation SPSS Statistics 22, with a predetermined significance level of 5% (r table = 0.339). If the calculated r is greater than 0.339, the question is considered valid; otherwise, it is declared invalid. Based on the results of the content validity test on 50 questions, 30 were deemed valid while 20 were considered invalid. The questions utilized as test instruments were valid. Therefore, the number of questions used as a test instrument is 30. The results of the reliability test for 30 questions, based on the equal length reliability value, were 0.786. These results indicate that the question items have high reliability. The level of difficulty for the questions was analyzed, revealing 1 question item with difficult criteria, 21 questions with medium criteria, and 8 questions with easy criteria. The analysis of the discriminating power of the questions showed that 16 questions had fairly good discriminating power criteria, 13 questions had good discriminating power criteria, and 1 question item had very good discriminating power criteria.

Procedures

The stages in this study were (1) observing the problems that occurred at MAN Temanggung, the situation in this study was that the learning model applied had little effect on cognitive learning outcomes and students' self-regulation, and the learning needs of students had not been met. (2) Looking for references and collecting relevant research references. (3) Developing learning plans with the STAD learning model based on differentiated learning. (4) Applying the STAD learning model based on differentiated learning in the experimental and control classes. (5) Provision of post-tests and self-regulation questionnaires to obtain research data. (6) Analyze the research data that has been obtained. (7) Summarize the research results. The research process is explained in the Chart I.

![Chart 1. Research process](chart1)

Data Analysis

The data analysis technique in this study used a quantitative descriptive analysis technique with statistical calculations. The test instruments used will be tested for the appropriateness of the questions in the form of a validity test, reliability test, level of difficulty test, and test for discriminating power of questions. The validity test was carried out with a construct validity test by two expert lecturers as validators. To determine the effect of the STAD learning model based on differentiation learning on cognitive learning outcomes and students' self-regulation, a t-test was
carried out. T-test with independent sample t-test. Before conducting a hypothesis test, it is important to first conduct a prerequisite test. The prerequisite tests were performed using SPSS Statistics 22 and included the Kolmogorov-Smirnov normality test and Levene's test for homogeneity of variances. Data is considered to be normally distributed if the significance value is greater than 0.05, and it is considered to be homogeneous if the significance value is also greater than 0.05. The results of the Kolmogorov-Smirnov normality test indicated that both the pretest and post-test scores for the experimental class and the control class were normally distributed, with significance values ranging from 0.061 to 0.200. Additionally, the post-test scores for cognitive learning outcomes in both classes were found to be homogeneous, with a significance value greater than 0.05.

In regards to the prerequisite test for self-regulation, the grades were used. The initial questionnaire for the experimental class had a significance value of 0.200, and the final questionnaire value for the experimental class had a significance value of 0.200. Therefore, it can be concluded that the data is normally distributed. Similarly, the initial questionnaire value for the control class had a significance value of 0.188, and the final questionnaire value for the control class had a significance value of 0.128. Hence, it can be stated that the data is normally distributed. Consequently, the entire dataset can be considered to be normally distributed. Furthermore, the homogeneity test revealed that the final value of self-regulation in the experimental class had a significance value of 0.087, and in the control class, it had a significance value of 0.088. Since both values are greater than 0.05, the data was deemed to be homogeneous.

**RESULTS**

Measurement of cognitive learning outcomes through pretest and post-test. Descriptive statistical data on the cognitive learning outcomes of the control and experimental classes are summarized in Table 2.

<table>
<thead>
<tr>
<th>Statistik</th>
<th>Cognitive Learning Outcome Statistics</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control Class</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pretest</td>
<td>Post-test</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Average</td>
<td>49.73</td>
<td>64.37</td>
<td>51.50</td>
</tr>
<tr>
<td>Median</td>
<td>51.50</td>
<td>65.00</td>
<td>53.00</td>
</tr>
<tr>
<td>mode</td>
<td>57</td>
<td>57</td>
<td>57</td>
</tr>
<tr>
<td>Variant</td>
<td>128.754</td>
<td>112.930</td>
<td>182.672</td>
</tr>
<tr>
<td>Min Value</td>
<td>27</td>
<td>47</td>
<td>27</td>
</tr>
<tr>
<td>Maximum Value</td>
<td>67</td>
<td>83</td>
<td>77</td>
</tr>
<tr>
<td>Range</td>
<td>40</td>
<td>36</td>
<td>50</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>11.347</td>
<td>10.627</td>
<td>13.516</td>
</tr>
</tbody>
</table>

Based on these data, the difference in the average value of cognitive learning outcomes between the control and experimental classes can be seen. The experimental class showed an average cognitive learning result that was higher than the control class.

While the results of student self-regulation were obtained from the average score of the questionnaire given, based on the results of descriptive statistics, the experimental class had a higher average self-regulation score than the control class. Then the results are interpreted in the criteria of self-regulation. In the control class, the average self-regulation of students was in good enough
criteria, while in the experimental class, the average self-regulation of students was in good criteria. The results of descriptive statistical statistics on students’ self-regulation scores are summarized in Table 3.

**Table 3. Descriptive Statistical Results of Self-Regulation Results**

<table>
<thead>
<tr>
<th>Statistik</th>
<th>Student Self Regulation</th>
<th>Control Class</th>
<th>Experiment Class</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Beginning</td>
<td>End</td>
</tr>
<tr>
<td>N</td>
<td></td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Average</td>
<td></td>
<td>54.43</td>
<td>58.40</td>
</tr>
<tr>
<td>Median</td>
<td></td>
<td>54.00</td>
<td>56.00</td>
</tr>
<tr>
<td>Mode</td>
<td></td>
<td>45</td>
<td>54</td>
</tr>
<tr>
<td>Variant</td>
<td></td>
<td>78.461</td>
<td>76.110</td>
</tr>
<tr>
<td>Min Value</td>
<td></td>
<td>42</td>
<td>45</td>
</tr>
<tr>
<td>Maximum Value</td>
<td></td>
<td>71</td>
<td>73</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>29</td>
<td>28</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td></td>
<td>8.858</td>
<td>8.724</td>
</tr>
</tbody>
</table>

To determine the effect of the learning model Student Teams Achievement Division (STAD) based on differentiation learning on cognitive learning outcomes and students' self-regulation by using the independent sample t-test. Before conducting the t-test, a prerequisite test was carried out, including the normality test and data homogeneity test. The results of the prerequisite tests that have been carried out are normally distributed and homogeneous data. Furthermore, an independent sample t-test was carried out on cognitive learning outcomes and the results of students' self-regulation. The test results of the independent sample t-test showed a value of $0.000 < \alpha (0.05)$, so it can be concluded that the learning model of Student Teams Achievement Division (STAD) is based on the differentiation of learning outcomes cognitive and self-regulation of students.

**DISCUSSION**

The results of the independent sample t-test show that the learning model of Student Teams Achievement Division (STAD) based on differentiation learning affects students' cognitive learning outcomes. The effect of applying this model can also be seen from the experimental class's average value, which is higher than the control class. The Student Teams Achievement Division (STAD) learning model is a variation of cooperative learning that encourages students to encourage and help one another to complete assignments given by the teacher. In this study, the use of the STAD learning model consisted of six phases of learning activities namely (1) phase 1 conveying learning objectives and motivation, (2) phase 2 presenting learning material, (3) phase 3 organizing students into study groups, (4) phase 4 guiding study groups, (5) evaluation, (6) giving awards.

In its application, the STAD learning model is combined with differentiation learning. Differentiated learning is an attempt to adjust the learning process in the classroom to meet and facilitate the learning needs of students (Tomlinson, 2001). Learners are individuals who have unique abilities, interests, and diverse backgrounds. Therefore, teachers must organize them in differentiated learning. Differentiated learning consists of three aspects: content, process, and product differentiation. In this study, the applied differentiated learning is product differentiation. Product differentiation learning provides opportunities for students to produce products that are presented according to the interests of students. The implementation of product differentiation
learning begins with mapping the learning needs of students through non-cognitive diagnostic questionnaires to determine the learning needs of students. The mapping results are used as a consideration for the teacher to determine product assignments students must make. Students will choose the product to be made according to their interests.

In this study, the activity begins with phase 1, namely the delivery of goals and motivation. The teacher conveys the goals to be achieved during learning, provides motivation, and checks the readiness of students to take part in learning. The motivation given to students will affect the achievement of learning objectives. If students are motivated to participate in learning, the learning objectives can be achieved as expected. Motivation also plays an important role in students' cognitive learning outcomes because motivation determines the intensity of effort made by students. The stronger students' learning motivation, the stronger their efforts to learn.

Phase 2 is the presentation of the material, and the teacher presents the material in a variety of ways. The media used by the teacher in conveying the material in this study is PowerPoint. The selection of PowerPoint media is considered appropriate because excretory system material contains organs and physiological processes that need to be visualized in the form of pictures or videos. This is also in accordance with what Abbas (2020) conveyed that PowerPoint media can combine text, images, sound, and video. Thus, the presentation of the material will be more interesting and easier to understand. This phase is an important stage because the teacher transfers the concept of material to students, therefore students must focus their minds on the delivery of learning material.

Phase 3 is organizing students in small groups. Students will be given assignments in the form of LKPD to be discussed with group mates. The use of LKPD aims to facilitate teachers in the teaching and learning process and change learning conditions from teacher-centered to student-centered. In line with what was conveyed by Kristyowati (2018), LKPD can assist teachers in directing students to be able to find their own activity concepts in work groups. In this group activity, students also discuss products that will be made according to their interests and presented at the end of the meeting. After mapping learning needs, there are four groups with visual learning styles, 1 with auditory learning styles, and 1 with kinaesthetic learning styles. Groups with a visual learning style can make products in the form of posters or infographics, groups with an auditory learning style can make products in the form of podcasts or recorded interviews, and groups with a kinaesthetic learning style can make products in the form of learning videos or material presentations. However, after group discussions, groups with auditory and kinesthetic learning styles chose to create products that differed from the previous learning needs mapping results. This is not a problem because the mapping results are not absolute, and students are free to choose products that suit their interests. Differentiated learning is a simple lesson where the teacher has to make a plan all at once (Herwina, 2021).

Phase 4, namely, the teacher guides students in study groups. In this phase, students can ask the teacher directly when there are obstacles or unanswered questions in the group. So, in this learning, there is not only interaction between students and other students but also between students and teachers. This interaction can help students understand the subject matter to optimize their learning outcomes. Phase 5, namely evaluation, evaluation activities in the Student Teams Achievement Division (STAD) learning model based on differentiation learning are carried out with LKPD presentations, quizzes, and product presentations. The LKPD presentation is carried out in front of the class by presenting the results of the group's work. Groups that need to be presenting can provide questions or opinions. The teacher, in this case, acts as a facilitator and reinforces the presentation results. In addition, evaluation activities are carried out with quizzes at each meeting. Quizzes are done individually, and the scores obtained will be group scores. The goal is that each student is individually responsible for understanding the material (Ariani & Agustini, 2018). At each meeting, the teacher will see the progress of the quiz score results. Based on the
results of observations and field notes, the score for each meeting has increased. This indicates that students have a good understanding of the material being taught. The last evaluation activity was a product presentation which was presented at the fourth meeting. Each group presented their products in front of the class. Groups that do not present can provide feedback, suggestions, and questions regarding the products' results.

Phase 6 is awarding. Giving awards aims to appreciate and appreciate the learning outcomes of students. Prizes are given to the group that gets the highest quiz score. The award is a stamp affixed to the winner’s quiz answer sheet. Giving awards in learning can increase students' learning motivation. If students' learning motivation is strong, their learning outcomes are also optimal. Suparsawan (2021) states that giving awards can increase students' motivation to do even better in the following learning activity.

One of the psychological factors that influence student learning achievement is self-regulation. Self-regulation is a person's ability to organize and manage cognition and learning strategies to achieve goals or targets. Based on the results of the independent sample t-test on the effects of self-regulation, it shows a significance value of \(0.000 < \alpha (0.05)\) so it can be concluded that the learning model of Student Teams Achievement Division (STAD) based on differentiation learning affects students' self-regulation. Learning steps in the learning model affect indicators of self-regulation consisting of (1) setting learning goals, (2) learning planning, (3) self-motivation, (4) self-control, (5) determining learning strategies, (6) self-monitoring, (7) search for learning assistance, (8) self-evaluation.

The effect of this learning model on indicator (1), namely setting learning goals, is seen when students are given assignments in the form of worksheets and product-making. Students with good self-regulation will try to do the jobs correctly and on time. Learners will have a solid initiative to develop a study plan to achieve their learning goals, namely, to get optimal learning results. Indicator (2) study planning is a refinement of activities related to set learning objectives. In this lesson, learning planning can be seen when students discuss the assignments, both worksheets and product creation. Students with self-regulation abilities will arrange the division of tasks and the steps to complete the job. Indicator (3) Self-motivation is encouragement from within and outside the individual to perform a task. The students' learning motivation in this study can be seen based on field notes, and there is an increased enthusiasm and learning effort at each meeting. This increase was evidenced by the quiz scores, which grew at each session. This is because there is an award for the group with the highest quiz score to motivate students to do a better job at the next meeting.

Indicator (4) Self-control is the individual's ability to compose, regulate and direct his behavior positively. In line with what Intani (2018) said, self-control is controlling one's behavior and thoughts that tend to be positive. In this study, self-control is proven in discussion activities in learning. Students can place themselves well when in discussion forums. Indicator (5) determination of learning strategy is an activity that students use when learning to help acquire and organize their learning. Students are given the freedom to develop their learning strategies. In this lesson, giving assignments like LKPD and making differentiated products allows students to determine their learning strategies. They start with compiling the division of tasks, looking for learning resources, etcetera.

Indicator (6) self-monitoring is an effort that helps students to know their cognition abilities, motivation, use of time, and learning effort. In this learning, students maximize their study time when learning takes place. Students actively seek additional learning resources to increase their understanding and ask questions if things need to be understood so that students can monitor and observe their knowledge. Indicator (7) seeking learning assistance is an attempt by students to involve other people in learning to get learning assistance when experiencing difficulties. In this
lesson, group discussion activities allow students to help each other. Based on the field notes, students actively ask group mates, or the teacher finds it difficult. Indicator (8) Self-evaluation is a way of looking into oneself regarding strengths and weaknesses for further improvement. Self-evaluation is essential because it makes students more responsible for the process and achievement of their learning goals. In this study, presentation activities are one of the efforts to support the self-evaluation process. The presentations consisted of the results of LKPD work and differentiated products. Class presentations help students evaluate their work. Other groups that do not present can provide opinions or suggestions to the presenter group so that students assess each other to achieve a proper understanding.

CONCLUSION

Based on the research results described previously, the learning model of the Student Teams Achievement Division (STAD) based on differentiation learning affects student’s cognitive learning outcomes and self-regulation. This effect is proven by the average post-test score in the experimental class, which is higher than the control class, and the average self-regulation score of the experimental class students, which shows good criteria. In contrast, the control class shows quite good criteria. This learning model can be an alternative for teachers in implementing learning in class, especially in biology learning. The implication of this research is that if the STAD learning model, which is based on differentiated learning, is consistently applied to all students, their cognitive learning outcomes and self-regulation will be optimized. To achieve this, there is a need for innovation in learning activities by selecting models, approaches, media, and learning methods that are suitable and customized to meet the specific learning needs of students.

REFERENCES


