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Implementation of Differentiated Learning in Science Learning to Improve Learning Activities and Learning Outcomes in Elementary School Students

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Abstract: This study aims to improve student activity and learning outcomes in Static Electricity material. The differentiated learning strategy used is to link the characteristics of learning styles consisting of visual, auditory and kinesthetic in group formation and assignment giving. The method used in this study is classroom action research consisting of cycle I and cycle II. This study was conducted in SDN 253 Gresik class VI with 20 students. Student activity data was measured using an observation sheet consisting of six aspects of activities whose values and learning outcomes were measured using a written test. The results of the study using differentiated learning strategies in cycle I showed an average percentage of learning activities of 78% and an average value of learning outcomes of 70.75 where there were 9 students who completed and 11 students did not complete, while learning in cycle II showed an average percentage of learning activities of 90.83% and an average value of learning outcomes of 93.75 where there were 2 students who did not complete and 18 students completed. Based on the results of the analysis data, it shows that the implementation of differentiated learning on the material Static electricity can increase the activity and learning outcomes of class VI students at SDN 253 Gresik.

Keyword: Differentiated Learning, Learning Activities, Learning Outcomes, Static Electricity

PRELIMINARY

Learning is one of the tools to prepare students to become responsible and superior young people who can face global challenges. Significant advances have occurred in the 21st century, significantly impacting scientific and technological advancements. Therefore, students are expected to be equipped to meet the various demands of modern development and master the necessary skills. Among the 21st-century skills that students must master are critical thinking and problem-solving abilities, creativity, communication skills, and the capacity to collaborate (Firda et al., 2022). Mastery of these 21st-century skills is essential in the current learning process, which refers to the Merdeka curriculum.

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Minister of Culture and Education Nadiem Makarim launched the Merdeka curriculum in 2023 as an evaluation and improvement effort of the 2013 curriculum, which requires students to be more active and develop critical thinking skills (Karomah, 2024).

The Merdeka curriculum framework centers on basic materials that encourage the development of student abilities according to their needs and characteristics (Aini Qolbiyah et al., 2022). In supporting the implementation of the Merdeka curriculum, teachers play an active role in enhancing student learning activities by: 1) stimulating learning motivation, 2) fostering interests and talents, 3) planning student-centered learning activities, and 4) using appropriate learning media in the learning process (Sutrisno, 2023). Learning with the Merdeka curriculum prioritizes student-centered learning, meaning that student learning activities must be considered to achieve the planned learning objectives. Student-centered learning emphasizes the process of how students learn and its impact on student development. For example, science learning emphasizes students' direct experiences to understand and explore the natural world around them scientifically (Suwartiningsih, 2021). Learning that connects students to phenomena occurring around them can provide meaningful learning for students.

The implementation of the Merdeka curriculum offers many new paradigms, one of which is "Merdeka Belajar," which allows students to choose learning materials tailored to their individual characteristics (Sari et al., 2022). "Merdeka Belajar" can also be defined as the freedom to learn according to their interests and abilities. For example, students can choose learning resources tailored to their learning styles or are entitled to learning materials tailored to their ability level. The abilities and interests of each student vary, so teachers are expected to accommodate this diversity by implementing differentiated learning (Insani & Munandar, 2023). Differentiated learning is one application of the new paradigm in the Merdeka curriculum, which seeks to provide learning tailored to the diverse needs and characteristics of students (Fitra, 2022). Differentiated learning consists of four aspects: content, process, product, and the classroom learning environment (Wahyuningsari et al., 2022). In implementing differentiated learning in the classroom, teachers can choose one or more aspects tailored to the characteristics and needs of students.

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In science learning at SDN 253 Gresik, particularly for sixth graders, many students still receive low grades. In the pre-cycle learning activities conducted by the researcher, only 20% of students were considered to have completed the course, while the majority of students still did not reach the minimum completion criteria, even though the teacher had implemented various engaging learning media, such as learning videos, simulator media, and slides using the Canva application displayed on an LCD. Learning outcomes, according to Pranoto (2023), are student achievements from the learning process, encompassing aspects of knowledge, skills, and attitudes. Learning outcomes applied in schools are grouped into two criteria: completed if students obtain a score above 80, according to the Minimum Competency Minimum Competency (KKM) determined by SDN 253 Gresik, and incomplete if students obtain a score below 80. Various factors can influence student learning outcomes, including the use of learning methods that significantly influence student learning outcomes and the provision of learning that is appropriate to the characteristics and needs of students.

In this study, the author identified several problems derived from the results of a preliminary study conducted at the research school, which aimed to determine the initial conditions of classroom learning. The researcher obtained this data through direct observation of the classroom learning process using observation sheets for teacher and student activities. The teacher observation sheet included indicators of the use of various learning methods, attention to student learning styles, and student engagement in learning. While the student observation sheet included indicators of active questioning, answering questions, discussions, and involvement in learning tasks. Based on this data, issues that need to be reviewed include:

a. Teachers have not implemented learning methods that are appropriate to students' interests and learning styles.
b. Learning activities in the classroom are still relatively low.

Based on the problems mentioned above, it can be concluded that sixth grade students still have difficulty learning the science subject matter, which is indicated by the results of achievement of grades and learning activities that are relatively low. Therefore, researchers are trying to find the best solution by implementing a differentiated learning strategy that is expected to address the diverse learning needs of students and fulfill students' rights to freedom in learning. Based on the background of the problem that has

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been explained, researchers want to conduct a study with the title "Implementation of Differentiated Learning on Static Electricity Material to Improve Learning Activities and Learning Outcomes of Sixth Grade Students at SDN 253 Gresik".

METHOD

A. Research Design

This research is a Classroom Action Research (CAR) which consists of four stages including planning, action, observation and reflection based on the theory of Kemmis & Taggart (1998) which is listed in Figure 1.

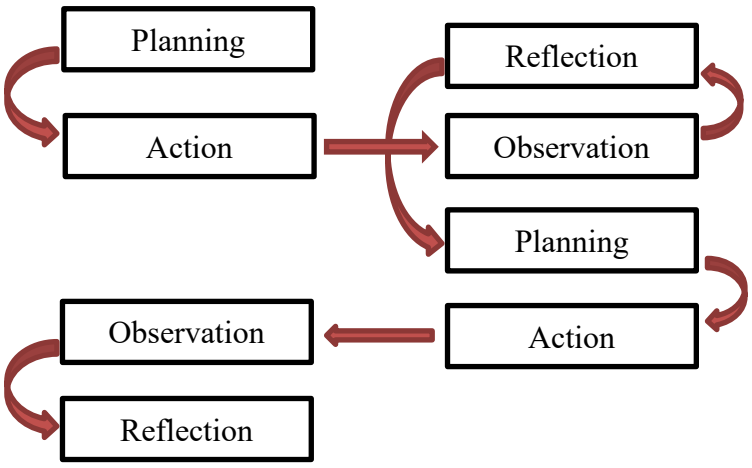

Figure 1. Stages of Classroom Action Research (CAR)

The classroom action research design shown in Figure 1 consists of four stages, including:

1) Planning

   The planning stage consists of three basic activities: the researcher begins by identifying problems that occur in learning, followed by formulating the problem, and finally, the researcher provides a solution. In this problem-solving activity, the researcher attempts to provide a solution by designing learning tools (RPP, LKPD, and assessment instruments) equipped with learning methods or strategies that can address the formulated problems.

2) Implementation

   In the implementation process, researchers began to apply the tools that had been designed in the learning process as classroom action activities.

ISSN 2579-6461 (Online) ISSN 2460-6324 (Print)
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3) Observation

In the observation stage, researchers begin observing and recording data on the extent of student achievement after the classroom action. At this stage, researchers must outline what data to collect, the instruments used, and how to collect it.

4) Reflection

Reflection is the activity of restating what was done during the classroom action, including both its strengths and weaknesses. This activity is crucial for researchers after the classroom action is completed, with the hope that researchers can design better learning in the next cycle by addressing the weaknesses identified in the previous cycle.

This research focuses on the implementation of differentiated learning to improve student activity and learning outcomes in static electricity. This research was conducted at SDN 253 Gresik in the odd semester of the 2024/2025 academic year. The subjects were sixth-grade students with varying learning styles and ability levels, in accordance with the initial objectives of the implementation of differentiated learning in this study.

B. Method of collecting data

The data collection techniques used were: 1) a written test consisting of 10 multiple-choice questions and 5 descriptive questions, administered after each learning cycle to determine improvements in learning outcomes in static electricity and simple electrical circuits. The data obtained will be analyzed using descriptive quantitative analysis, referring to the Minimum Competency (KKM) per individual of 80. 2) an observation sheet for student learning activities obtained through observations by reviewers. This observation sheet aims to measure the level of student engagement and activeness in each learning stage. Observations are conducted by assigning a score to each predetermined activity indicator, which is then converted into a percentage. The results of these observations are then analyzed descriptively and qualitatively.

C. Data Analysis Method

The data analysis methods used in this study are both quantitative and qualitative. Quantitative data are generated from learning outcome tests calculated using simple statistical formulas, while qualitative data are generated from observations of student learning activities. Once the data is collected, data analysis will be conducted and conclusions drawn.

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a. Quantitative Analysis

Quantitative data are obtained from simple statistical calculations of student learning outcomes. The following formula can be used to calculate the average student score:

$$X = \frac{\Sigma x}{n}$$

Information:

X = Average value

Σx = sum of all values

n = Amount of data

b. Qualitative analysis

Qualitative data was obtained from observations of learning activities recorded on an observation sheet by the reviewer. The collected data will be analyzed qualitatively using an inductive approach, where the learning activities are represented using the following formula:

$$P = \frac{F}{N} \text{ x } 100\%$$

Information:

P = Percentage figures

F = The frequency whose percentage is being sought

N = Number of frequencies or number of individuals

RESULTS

Before entering the first cycle of learning, the researcher conducted a pre-cycle activity (pretest) on the Static Electricity topic without using differentiated learning. This pre-cycle activity aimed to determine the initial conditions of students before the classroom actions in cycle I were implemented. The learning outcome data obtained regarding the initial conditions of sixth-grade students at SDN 253 Gresik before the first cycle of classroom actions were as follows:

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Table 1. Pre-Cycle Student Learning Outcomes Data

No	Aspects	Deskription
1	Number of students who took the test	20 People
2	Number of students who completed the test	4 People
3	Number of students who did not complete the test	16 People
4	Total scores	925
5	Highest score	80
6	Lowest score	30
7	Average	46,25

Based on the results of pre-cycle learning data in Table 1, it shows that 16 students achieved results that were still far from expectations because the scores obtained were still below the Minimum Completion Criteria (KKM). The completion that students must achieve is 80. Table 1 also shows that the highest score obtained by students is 80 and the lowest score obtained by students is 30. The average score achieved by class VI is 46.25. The data on the completion of student learning outcomes before the cycle is depicted in the following graph:

Figure 2. Diagram of Student Learning Outcomes Completion Pre-Cycle

Based on the diagram in Figure 2, it shows that there are 4 students who have completed the task with a percentage of 20% and 16 students who have not completed it with a percentage of 80%. Students who fall into the incomplete category are students who pay less attention and are not actively involved in the learning process, so there needs to be improvement in learning by implementing differentiated learning for the Static Electricity material. This improvement in learning is implemented through classroom action research

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in cycles I and II. Data from observations of student learning activities in the pre-cycle attended by 20 students are presented in Table 2.

Table 2. Pre-Cycle Observation Results Data

No	Aspect	Presentage
1	Student readiness to receive the lesson material	65%
2	Student enthusiasm in discussions and questions and answers during apperception activities	75%
3	Student enthusiasm in problem identification activities	70%
4	Student enthusiasm in participating in group data collection activities	75%
5	Student enthusiasm in presenting experimental results	60%
6	Closing activities	85%
Average		**71,6%**

Based on the observation data from pre-cycle student learning activities in Table 2, the highest percentage of student activity, at 85%, was in the closing activity. Meanwhile, the lowest percentage of student activity, at 60%, was in the activity of presenting experimental results. The average percentage of learning activity achieved by sixth graders was 71.6%.

1. Learning Outcomes of Cycle 1

Based on pre-cycle learning outcomes data, researchers made improvements to learning in Cycle I by implementing differentiated learning to help students improve their learning outcomes on Static Electricity. Learning outcome data from Cycle I can be seen in Table 3 below:

Table 3. Student Learning Outcomes Data for Cycle I

No	Aspect	Deskription
1	Number of students who took the test	20 people
2	Number of students who completed the test	9 people
3	Number of students who did not complete the test	11 people
4	Total scores	1415
5	Highest score	100
6	Lowest score	40
7	Average	70,75

ISSN 2579-6461 (Online) ISSN 2460-6324 (Print)
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Based on the results of the learning data for cycle I in Table 3, it shows that the highest score obtained by students was 100 and the lowest score obtained by students was 40. The average score achieved by class VI was 70.75. The data on the completeness of student learning outcomes for cycle I is depicted in the following graph:

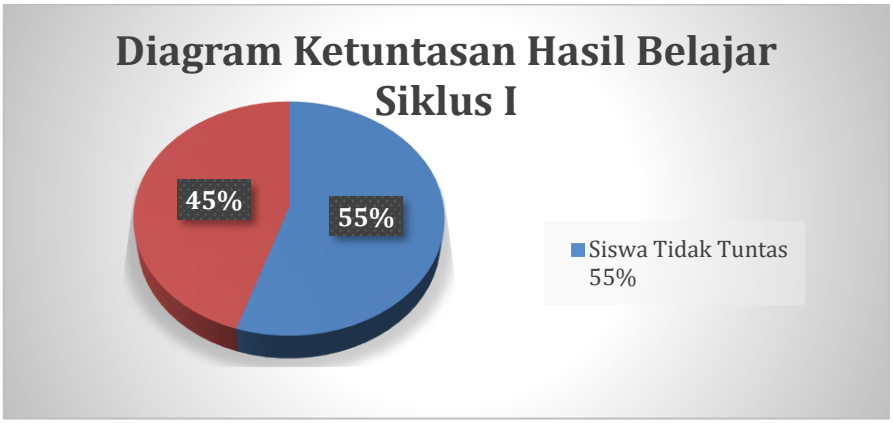

Figure 3. Diagram of Student Learning Outcomes Completion in Cycle I

Based on the diagram in Figure 3, there are 9 students who have completed the course (45%), and 11 students who have not completed it (55%). The number of students who are included in the incomplete category has decreased significantly compared to the learning outcome data in the pre-cycle. In Cycle I, there was an increase in learning outcomes, but it was not optimal because many students still had difficulty understanding the static electricity material. This could be due to the lack of variety in the material presented and the need for improved time management, which resulted in students not being fully actively involved in the learning process. Therefore, improvements are needed in Cycle II so that learning can be packaged more interestingly, interactively, and improve student learning completion. In Cycle II, the researcher made improvements by adding explanatory guides using PPT, Phet simulations, and icebreakers using the help of bamboozles games containing simple electrical circuit material.

2. Cycle II Learning Outcomes

Based on the learning outcomes data from Cycle I, the researchers improved learning in Cycle II by implementing differentiated learning, adding explanatory guidance using PPT, Phet simulations, and icebreakers using bamboozles games to help students improve their learning outcomes on simple electrical circuits. Learning outcome data from Cycle II can be seen in Table 4 below:

ISSN 2579-6461 (Online) ISSN 2460-6324 (Print)
DOI: https://doi.org/10.29407/jpdn.v11i2.27576

Table 4. Student Learning Outcomes Data for Cycle II

No	Aspect	Deskription
1	Number of students who took the test	20 people
2	Number of students who completed their studies	18 people
3	Number of students who did not complete their studies	2 people
4	Number of values	1875
5	The highest score	100
6	Lowest Value	60
Average		93,75

Based on the results of the learning data for cycle II in Table 4, the highest score obtained by students was 100 and the lowest score obtained by students was 60. The average score achieved by class VI was 93.75. The data on the completion of student learning outcomes in cycle II is depicted in the following graph:

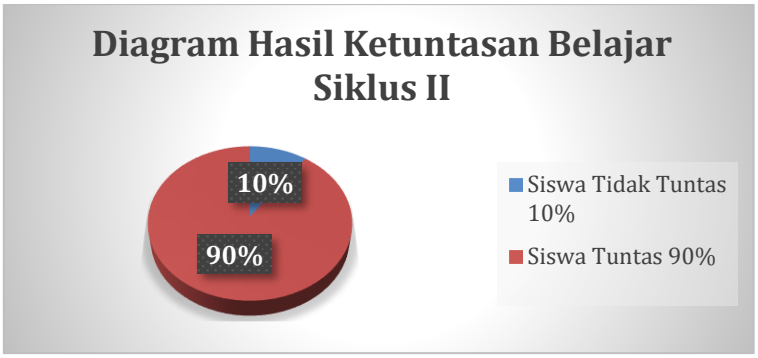

Figure 4. Diagram of Student Learning Outcomes Completion in Cycle II

The diagram in Figure 4 shows that two students failed to complete the task (10%), while 18 students completed the task (90%). The results of cycle II data indicate that the implementation of the learning improvements was successful and effective. The improvement in student learning completion in cycle II indicates that the use of explanatory guidance through PPT, the PhET simulator, and the Bamboozzles icebreaker game improved student understanding and engagement in learning simple electrical circuits. In cycle II, students were more enthusiastic, actively asked questions, and successfully completed assignments. Therefore, the actions in cycle II were deemed successful, and the research did not need to be continued to next cycle.

3. Results of Observations of Learning Activities in Cycle I

Data from observations of student learning activities in cycle I, attended by 20 students and attended one meeting (2 JP), are presented in Table 5.

ISSN 2579-6461 (Online) ISSN 2460-6324 (Print)
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Table 5. Observation Results Data from Cycle I

No	Aspect	Presentage
1	Student readiness to receive the lesson material	86%
2	Student enthusiasm in discussions and questions and answers during apperception activities	80%
3	Student enthusiasm in problem identification activities	70%
4	Student enthusiasm in participating in group data collection activities	86%
5	Student enthusiasm in presenting experimental results	60%
6	Closing activities	86%
Average		**78%**

Based on the observation data from student learning activities in Cycle I, Table 5 shows that the highest percentage of student activity, at 86%, was in the activities related to student readiness to receive material, student enthusiasm in participating in group data collection activities, and closing activities. Meanwhile, the lowest percentage of student activity, at 60%, was in the activity of students presenting experimental results. The average percentage of learning activity achieved by grade VI was 78%.

4. Observation Results for Learning Activities in Cycle II

Data from observations of student learning activities in Cycle II, attended by 20 students and consisting of 2 meetings (4 JP), is presented in Table 6.

Table 6. Observation Results Data from Cycle II

No	Aspect	Presentage
1	Student readiness to receive the lesson material	86%
2	Student enthusiasm in discussions and questions and answers during apperception activities	90%
3	Student enthusiasm in problem identification activities	90%
4	Student enthusiasm in participating in group data collection activities	100%
5	Student enthusiasm in presenting experimental results	86%
6	Closing activities	93%
Average		**90,83%**

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Based on the results of observation data on student learning activities in Cycle II, Table 6 shows that the highest percentage of student activity, 100%, was in student activities involving group data collection. Meanwhile, the lowest percentage of student activity, 86%, was in activities related to student readiness in receiving lesson material and student enthusiasm in presenting experimental results. The average percentage of learning activity achieved by class VI was 90.83%.

DISCUSSION

The classroom action plan implemented in Cycle I showed an increase in student activity and learning outcomes compared to the pre-cycle learning outcomes. However, the improved learning outcomes in Cycle I were not as expected. This was evident from the average percentage of learning activities in Cycle I, which was 78%, categorizing students as quite active. The average student learning outcome in Cycle I was 70.75, with the Minimum Completion Level (KKM) for Social Studies (IPAS) being 80. The completeness of learning outcomes in Cycle I also needed further improvement, given that the average score was still below the established Minimum Completion Level (KKM). In Cycle I, 9 students completed the learning process and 11 students failed.

In Cycle I, the percentage of learning activities involving presenting experimental results was the lowest compared to other learning activities, at 60%. Cycle I discussed the phenomena of static electricity in everyday life. Students were directed to conduct simple experiments using tools available to investigate the phenomenon of static electricity. The tools used were rulers, balloons, straws, and wool. With this simple experimental activity, students were very enthusiastic and eager to learn, but it turned out that most students liked to play with these tools outside the direction of the Student Worksheet (LKPD). This made students lose concentration and the teacher needed more time to direct students to focus so that the teacher needed 1 more meeting to continue learning in cycle I. The distraction of these simple experimental tools also made students lack cooperation between groups in carrying out simple experiments according to procedures and discussing tasks in the LKPD. The process of social interaction between teachers and students, students with students and students with other humans is the heart of the learning process (Widyadari, 2019).

ISSN 2579-6461 (Online) ISSN 2460-6324 (Print)
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Therefore, in the learning process, good social interaction is very necessary to create comfortable and conducive learning. Poor social interaction in this learning made students less enthusiastic in responding and asking questions to groups that came forward to present the results of simple experiments. In cycle I, this also showed values that were less in line with expectations where the average score of class VI in cycle I was 70.75, which was below the Minimum Completion (KKM) for the Social Sciences subject. Lack of student engagement in learning, in accordance with the instructions of the learning plan and the teacher, can also impact student learning outcomes. Many factors influence learning outcomes, including both internal and external factors within students. External factors that influence learning outcomes include the pedagogical and professional competence of subject teachers, easy-to-understand lesson content, a systematic learning process, a safe and comfortable classroom environment, and the support of a collaborative learning community. Internal factors include student persistence, cooperation, and creativity (Iskandar, 2021).

Based on observations of student learning activities in Cycle I, the learning atmosphere in Grade VI was indeed pleasant and quite conducive, resulting in significant improvements in learning outcomes compared to pre-cycle learning outcomes. This can be concluded that the implementation of differentiated learning can improve the learning outcomes of Grade VI students, but several improvements are needed in the implementation of Cycle II learning. The implementation of differentiated learning in the classroom can be defined as learning that involves student learning readiness, student interests and talents, background knowledge, teacher knowledge, planning and implementation of learning designs that can provide a range of experiences regarding content, activities, and learning scales that are appropriate to students' needs (Suwartiningsih, 2021). Improvements made in Cycle II learning include preparing students for effective learning, where teachers begin by forming groups at the beginning of the lesson to facilitate students' conditioning when conducting simple experiments. In the implementation of differentiated learning in Cycles I and II, researchers divided students based on learning styles: one auditory learning style group, two visual learning styles, and one kinesthetic learning style group.

This greatly facilitates teachers once the groups have been formed because the Student Worksheets and knowledge assessment instruments are also differentiated

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according to these learning styles. Furthermore, teachers upload worksheets (LKPD) and learning resources to the school's e-learning platform three days before the start of classes. This allows students to learn the science subject matter beforehand, making it easier for teachers to conduct group discussions. Good student readiness for learning will contribute to optimal learning outcomes (Widyadari, 2019).

According to Sarie (2022), differentiated learning can be implemented using three strategies: content, process, and product differentiation. Content differentiation encompasses teacher responses to students' readiness, interests, and learning profiles, or a combination of the three. In this study, the researchers employed content differentiation by preparing various learning resources tailored to students' learning styles, including ebooks uploaded to the e-learning platform, Canva PPTs as a guide for delivering material to students, learning videos, tools and materials for conducting simple investigations, and Phet simulators. Process differentiation refers to how students understand and interpret what they learn during the lesson. The process differentiation carried out in this study was to prepare demonstration activities during the apperception process, which aimed to attract students' interest and heighten their curiosity about the material to be studied. The researchers also prepared student worksheets (LKPD) containing simple and enjoyable investigation activities using tools and materials found around the students.

These LKPDs were equipped with interactive images, investigation tables, and questions related to the investigation process, tailored to the students' characteristics and learning styles. According to Herwina (2021), product differentiation is the result of work or performance that students must show to the teacher, which can be in the form of videos, mind maps, diagrams, or something tangible. The product differentiation carried out by the researchers in this study was to differentiate each group to present their simple investigation results according to their characteristics and interests. The group with a visual learning style presented their data results using PPT Canva or videos or other forms of visual data presentation. The group with an auditory learning style could present data through a recorded podcast or a podcast in front of the class. The group with a kinesthetic learning style could present their data results in front of the class.

The implementation of the learning design in cycle II is the result of improvements from learning in cycle I which provides more optimal results. The average percentage of student learning activities in cycle II is 90.83%, an increase of 12.83% compared to the

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average percentage of student learning activities in cycle I of 78%. The average value of student learning outcomes in cycle II learning also increased by 93.75 where there were two students who did not complete and 18 students completed. It can be concluded that learning completeness in cycle II has met the criteria set by the curriculum. Therefore, it can be concluded that the implementation of differentiated learning in the material Static Electricity can improve student activity and learning outcomes.

CONCLUSION

Based on the results of data analysis and discussion of research results, it can be concluded that:

1. The implementation of differentiated learning in the topic of Static Electricity can improve student learning activities. The average percentage of student learning activity in Cycle II was 90.83%, an increase of 12.83% compared to the average percentage of student learning activity in Cycle I, which was 78%.
2. The implementation of differentiated learning in the topic of Static Electricity can improve student learning outcomes. The average student learning outcome score in Cycle II was 93.75, an increase of 23% compared to the average percentage of student learning activity in Cycle I, which was 70.75.

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