

Effectiveness of Differentiated Learning Approaches Based on Learning Styles in Improving Science Learning Outcomes

A Case Study at SD Muhammadiyah Noyokerten, Sleman

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ABSTRACT

This research is motivated by the lack of fulfillment of students' learning needs in classroom activities in grade V at SD Muhammadiyah Noyokerten and the low science learning outcomes on the water cycle material. The general aim of this study is to determine whether a differentiated learning approach based on learning styles can improve science learning outcomes. The type of research used is Classroom Action Research (CAR) consisting of two cycles. Each cycle is conducted over 2 meetings, comprising planning, implementation, observation, and reflection stages. The subjects of this study are 24 students in grade V. The instruments used include observation sheets, questionnaires, documentation, and learning outcome tests. The results of the study show that the differentiated learning approach based on learning styles can improve science learning outcomes.

Keywords
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Introduction

Education plays a crucial role in the development and realization of every individual and serves as a tool to achieve happiness and well-being [1]. Quality education reflects a progressive, peaceful society and fosters constructive traits. The current era of education, the 21st century, is a modern era characterized by digitalization in almost every aspect of life. However, this technological advancement should not erode the principles of education in Indonesia, which always prioritize human values according to Ki Hajar Dewantara's concept of education, viewing students as learners and teachers as facilitators [2].

As facilitators, teachers must be able to accommodate differences to ensure that every student acquires the same knowledge and goals. Learning activities should always be oriented towards developing the potential of students, who have unique characteristics [2]. Therefore, teachers are required to understand the characteristics and uniqueness of each student and are obliged to create quality learning experiences. Additionally, teachers should create a pleasant learning atmosphere and environment for students, ensuring they feel safe, comfortable, and calm while learning, as their needs are met [3].

However, field observations reveal that in the implementation of traditional classroom learning processes, intellectual intelligence remains the primary focus of teachers [4]. As a result, the differences among students are often seen as problems. In this context, a differentiated learning approach is crucial and can be an alternative in the 21st-century learning process. This is essential because Ki Hajar Dewantara's educational philosophy aligns with the concept of differentiated learning [5]. Differentiated learning is an approach or strategy to manage learning by considering the characteristics and abilities of students. Each student is a unique individual who perceives the world in their way. Every individual has different learning styles in receiving, processing, and remembering information [6].

Learning style is a preferred way for individuals to react to and use stimuli to absorb, organize, and process information during learning [7]. These differences require teachers to treat each student differently according to their learning style. Knowledge and understanding of students' learning styles will help teachers guide students to learn in ways that suit them, making it easier for them to absorb lessons and improve their learning outcomes. Additionally, understanding students' learning styles will help teachers effectively transfer knowledge [8]. Efforts to improve learning outcomes can be made by using learning approaches that align with the characteristics and learning needs of students.

Observations conducted by the researcher show that the learning implementation in grade V for the science subject on the water cycle material is quite good. The learning process has considered students' learning needs in terms of differentiated learning environments. However, the learning implementation still falls short of meeting students' learning needs regarding their

learning profiles, content differentiation, and product differentiation. This is evident from the lack of student learning modalities (visual, auditory, and kinesthetic) and the absence of diverse learning resources. Additionally, the assignments given by the teacher are limited to one way of completion, leading to student boredom.

This significantly impacts the science learning outcomes on the water cycle material, indicating that students' learning completeness is very low. This is marked by the percentage of students' learning completeness being ≤ 40%. Only 4 students (17%) have scored above the Minimum Mastery Criterion (*Kriteria Ketuntasa Minimum* or KKM), while 20 students (83%) have not achieved mastery. Based on the above, the researcher deems it necessary to conduct a study titled "Differentiated Learning Approach Based on Learning Styles to Improve Science Learning Outcomes of Students at SD Muhammadiyah Noyokerten."

Based on this background, the problem formulation in the school internship program is how a differentiated learning approach based on learning styles can improve learning outcomes. Thus, the objective of this program is to apply a differentiated learning approach based on learning styles to improve science learning outcomes.

Literature Review

A. Differentiated Learning Approach

Differentiated learning is an approach or strategy for managing learning by considering the characteristics and abilities of students. According to Marlina (2019), differentiated learning involves adjusting to students' interests, learning preferences, and readiness to enhance learning outcomes. Differentiated learning can also be understood as an effort to tailor the learning process in the classroom to meet the individual learning needs of each student. Therefore, differentiated learning must be rooted in fulfilling students' learning needs and how teachers respond to these needs. In this regard, teachers need to identify learning needs to respond appropriately to students' needs [9].

Implementing a differentiated learning approach in learning activities requires teachers to develop students' ways of acquiring, managing, using, and communicating the necessary information [10]. The differentiated learning approach is crucial to apply in the learning process to create meaningful learning and improve student outcomes, as it strongly supports students and considers their inherent nature [11]. The differentiated learning approach essentially unites aspects of differentiated learning and student diversity. In this context, there are four aspects of differentiated learning under the teacher's control: content, process, product, and learning environment or classroom climate. Teachers play a critical role in deciding how these four elements will be incorporated into classroom learning. Additionally, teachers are given the

freedom and opportunity to modify the learning environment, content, process, and product of each class based on student profiles [3].

The content aspect of the differentiated learning approach relates to the material that the teacher will teach or that students will learn in class. The process aspect refers to the activities that students engage in during class. The product aspect of the differentiated learning approach is the result of learning, demonstrating students' abilities to showcase their knowledge, skills, and understanding after completing a learning unit. Unlike the product aspect, which is the outcome of learning, the learning environment aspect emphasizes the personal, social, and physical structure of the classroom. The learning environment is closely related to students' readiness to learn, their interests, and their learning profiles to maintain high motivation to learn [3].

B. Learning Styles

Learning style is a consistent pattern or method applied by a learner to access information and stimuli, process information, remember it, and complete tasks (Nasution, 2013). Every individual has a unique way of learning and processing information. Not only do individuals learn at different speeds, but they also process information differently. Therefore, each student will use different methods to understand the same information or lesson. There are three types of learning styles: 1) visual learning style; 2) auditory learning style; and 3) kinesthetic learning style. The visual learning style emphasizes visual acuity. The auditory learning style relies on hearing to understand and remember specific information. In contrast, the kinesthetic learning style requires individuals to touch something that provides specific information for them to remember [12].

The visual learning style relies on sight or seeing evidence before believing it. Some characteristics typical of students with a visual learning style include: needing to see something (information/lesson) visually to know or understand it; having a strong sensitivity to color; having a good understanding of artistic issues; having difficulty engaging in direct dialogue; being overly reactive to sound; having difficulty following oral instructions; and often misinterpreting words or speech [6]. Students with a visual learning style tend to absorb information more quickly by watching the teacher explain the lesson in front of the class, using written aids, data, or pictures. In this context, parents can play an active role by providing stimuli in the form of pictures and visual information [12].

Unlike the visual learning style, which emphasizes visual acuity, the auditory learning style relies on hearing to understand and remember specific information. The characteristics of this learning style place hearing as the primary tool for absorbing information or knowledge. This means students must hear information first to remember and understand it. Some characteristics typical of students with an auditory learning style include: absorbing all information through hearing; having difficulty absorbing information in written form directly; and having difficulty

writing or reading [6]. Students with an auditory learning style tend to absorb and concentrate better when the teacher explains in front of the class and answers questions posed. In this context, parents can play an active role by engaging students in dialogue and giving them opportunities to express their opinions [12].

The third learning style, the kinesthetic learning style, requires individuals to touch something that provides specific information for them to remember. The distinctive characteristic of students with a kinesthetic learning style is that they use their hands as the primary tool to receive information and remember it. Simply by touching something, students with a kinesthetic learning style can absorb information without reading the explanation [6]. Additionally, students with a kinesthetic learning style pay close attention to physical conditions during learning activities. This is because they perform actions directly using their physical body in learning activities [13]. Other characteristics of students with a kinesthetic learning style include a tendency to absorb information more quickly when there are aids and props and the ability to concentrate better when moving parts of their body [12].

Methods

This study is a classroom action research using a research design developed by Kemmis and McTaggart, consisting of four stages in each cycle: planning, action, observation, and reflection. This study was conducted over two cycles, with each cycle consisting of two meetings. The research was carried out at SD Muhammadiyah Noyokerten, located in Noyokerten, Kadipolo, Sendangtirto, Berbah District, Sleman Regency, Special Region of Yogyakarta. The subjects of this study were 24 students of grade V, comprising 12 male and 12 female students. The instruments used in this study were observation sheets, questionnaires, documentation, and learning outcome tests.

Data analysis was performed by processing data from the observation sheets and student learning outcome tests. The observation sheets consisted of 10 statements, filled out by checking (√) the available answer options. The observation sheets were measured using the Guttman scale, which has two intervals: "Yes" and "No." The observation data were then analyzed qualitatively and descriptively. This analysis involved a description of the data obtained from the observations. Meanwhile, the student learning outcome data, obtained from a written multiple-choice test consisting of 15 questions, were analyzed by calculating the average student learning outcomes and determining the percentage of achievement of the KKM.

The average score represents the overall learning outcomes obtained by the students, used to assess and calculate the overall learning outcomes in the class. The percentage of student learning completeness obtained was then analyzed using learning achievement criteria (Table 1).

Table 1. Percentage Criteria for Learning Mastery

Percentage of Scores	Description
80% - 100%	Very Good
66% - 79%	Good
56% - 65%	Fair
41% - 55%	Poor
≤ 40%	Very Poor

The indicators used to measure the fulfillment of students' learning needs in the learning activities are based on aspects of the differentiated learning approach, namely content differentiation, process differentiation, product differentiation, and learning environment differentiation. The indicators used to measure the improvement in science learning outcomes in this study are based on the KKM set, which is 75. The criteria used to measure the success rate of the learning improvement are individual and group learning outcome improvement, with at least 70% of the students achieving mastery in learning.

Results

A. Description of Action Implementation

The implementation of Classroom Action Research began with a pre-cycle study conducted from Monday, May 28, 2023, to Monday, April 4, 2023. This pre-cycle study involved observation, the administration of learning style questionnaires, and the provision of pre-test questions to the students. Observations were made to directly monitor the learning activities in grade V. The learning style questionnaires were used to identify the diverse learning styles of each student, while the pre-test questions aimed to assess students' learning outcomes in the science subject on the water cycle material.

Observations of the learning activities in grade V were conducted using an observation sheet. Based on the observations, it was generally found that the learning activities in grade V were quite good. This was evidenced by the fulfillment of student's needs in the aspect of the learning environment differentiation, which included an ideal room temperature, adequate classroom lighting, and varied table/chair arrangements. However, the learning implementation was still lacking in meeting students' learning needs in the aspects of learning profile, content differentiation, and product differentiation. This was indicated by the absence of learning modalities (visual, auditory, and kinesthetic) and a lack of diverse learning information sources. Additionally, the tasks assigned by the teacher were limited to a single method of completion, causing students to easily become bored. The data related to the learning style questionnaires showed that 6 students (25%) had a visual learning style, 4 students (17%) had an auditory learning style, and 14 students (58%) had a kinesthetic learning style. Meanwhile, observations of students' learning outcomes in the science subject were made by administering a pre-test. The

results showed that 4 students (17%) scored above the KKM, while 20 students (83%) did not meet the criterion. The average learning outcome of students in the initial science learning activities on the water cycle material was 62.67.

B. Findings from the Action Implementation

1. Cycle I

The action implementation in Cycle I was conducted over two sessions. The first session took place on Tuesday, April 4, 2023, and the second session on Wednesday, April 5, 2023. During the first session of Cycle I, a differentiated learning approach based on learning styles was applied, focusing on differentiated learning environment, content, and product. The learning environment differentiation was achieved through the arrangement of tables and chairs to meet the student's learning needs. Content differentiation involved providing alternative task assignments to each group according to their learning styles. Product differentiation allowed each group to create and present a product related to the water cycle scheme according to their learning style.

The learning activities continued in the second session of Cycle I. The teacher applied the differentiated learning approach by asking each group to present their work on the water cycle scheme or conclusions from their investigations (product differentiation). The second session of Cycle I concluded with a post-test to measure the science learning outcomes. Based on the learning outcomes data from Cycle I, 13 students (54.17%) met the KKM for the science subject on the water cycle material, while 11 students (45.83%) did not, out of a total of 24 students.

Overall, the observations during Cycle I indicated positive results. Nine out of ten indicators on the differentiated learning implementation observation sheet were met, covering aspects of student profiles, content differentiation, process differentiation, product differentiation, and learning environment differentiation. However, one indicator related to process differentiation (indicator number 5) was not met. Although learning activities were conducted in groups, some students remained passive and did not fully participate in the discussions.

There were also significant notes regarding product differentiation during Cycle I. While the learning activities provided a variety of product creation options, the presentation results were suboptimal. The group with a visual learning style used a relatively small medium for their mind-mapping product, hindering the presentation. The auditory group showed shyness and used a low voice volume, making it difficult for other students to hear. The

kinesthetic group used small media for their hands-on presentations, limiting audience engagement.

Reflecting on Cycle I, it was noted that arranging tables and chairs according to each group's learning style took a considerable amount of time. Group discussions were not very effective, as some students were not actively involved. Presentation activities also showed room for improvement, with issues in the size of visual aids and the confidence and volume of auditory presentations. Additionally, only 11 students (45.83%) achieved the KKM, falling short of the 70% success criteria.

2. Cycle II

Cycle II learning activities were conducted over two sessions. The first session took place on Thursday, April 6, 2023, and the second session on Monday, April 9, 2023. The first session of Cycle II applied the differentiated learning approach based on learning styles, focusing on differentiated learning environments and processes. The learning environment differentiation was achieved through the arrangement of tables and chairs according to students' learning needs. Process differentiation involved providing diverse facilities tailored to each student's learning style within their groups.

The learning activities continued in the second session of Cycle II. The teacher implemented the differentiated learning approach by allowing each group to present their work on the water cycle scheme according to their learning style (process differentiation). The second session of Cycle II concluded with a post-test to measure the science learning outcomes. Based on the learning outcomes data from Cycle II, it was concluded that the learning outcomes were in the very good category. Twenty-one students (88%) scored above the KKM in the science subject on the water cycle material, while three students (12%) did not.

The reflection on Cycle II showed that students were more enthusiastic and engaged in the learning process. The arrangement of tables and chairs for group formation according to learning styles was done more efficiently, with each student taking responsibility. Group discussions were more effective and showed greater student participation. Presentation activities also improved, with visual learning style groups using larger visual aids, auditory groups presenting confidently with clearer voices, and kinesthetic groups using more engaging and creative media for their hands-on presentations. Additionally, the study results in Cycle II met the success criteria, with 88% of students achieving scores above the KKM.

Discussion

Based on the research conducted, the differentiated learning approach based on learning styles can improve the science learning outcomes. The use of a differentiated learning approach in teaching and learning activities can be an alternative to meet the diverse learning needs of students. Each student is a unique individual who perceives the world in their way. Therefore, each individual has a different method or style of learning in receiving, processing, and remembering information, necessitating that learning activities accommodate these differences. When this diversity is well-facilitated, each student can learn in a safe, comfortable, and happy environment.

Standardizing things that cannot be standardized should be avoided. The behaviors, characteristics, and learning styles of each individual are aspects that cannot be standardized or forced into uniformity by a teacher. If these different learning styles are forced into a single method, it is feared that other students may become bored with the learning activities, potentially leading to feelings of disappointment and diminishing their enthusiasm for learning. In this regard, the use of a differentiated learning approach can provide learning activities that align with the student's needs (readiness, interests, and learning styles), ensuring that their learning needs are met.

Based on the pre-cycle research results, the students' learning outcomes in the science subject were relatively low. Only 4 students (17%) met the KKM of 75, while 20 students (83%) did not, out of a total of 24 students. In Cycle I, the mastery of students' learning outcomes in the science subject of the water cycle improved. Thirteen students (54%) scored above the KKM, while 11 students (46%) did not. The research continued into Cycle II, achieving the overall success indicator set at 70%. In Cycle II, 21 students (88%) scored above the KKM in the science subject on the water cycle, while 3 students (12%) did not.

The differentiated learning approach adjusts to students' interests, learning profiles, and readiness to achieve improved learning outcomes [14]. This approach recognizes that each student is unique and therefore requires tailored instructional strategies to address their individual needs [15]-[17]. Based on the research findings, the differentiated learning approach based on learning styles has proven to enhance learning outcomes significantly. This is evident from the increasing students' learning outcomes and positive observations throughout the study. The implementation of differentiated instruction allowed students to engage with the material in ways that suited their preferred learning modalities, whether visual, auditory, or kinesthetic [18]. As a result, students were more motivated, engaged, and able to retain information more effectively. The consistent improvement in students' learning outcomes throughout the research demonstrates the success of this method. The differentiated learning approach based on learning

styles not only boosted academic performance but also contributed to a more inclusive and supportive learning environment [19]-[21]. This approach ensures that all students, regardless of their learning preferences, have the opportunity to succeed and reach their full potential.

Conclusion

Based on the research findings, it can be concluded that the use of differentiated learning approaches based on learning styles can improve science learning outcomes. This conclusion is supported by the data on the achievement of learning outcomes in the science cycle water cycle material obtained through evaluation test instruments during the initial study phase (pre-cycle), Cycle I, and Cycle II. Initially, only 17% of students met the proficiency criteria in the pre-cycle phase. This increased to 54% in Cycle I and further improved to 88% in Cycle II, reaching the criteria of "very good." In addition to improving science learning outcomes, the use of differentiated learning approaches also effectively meets the diverse learning needs of students. This is evidenced by the observation data collected during the implementation of the learning activities. The observation checklist, comprising 10 indicators covering student learning profiles, differentiated content, processes, products, and learning environment, indicated satisfactory fulfillment of these aspects. While only 3 out of 10 indicators were initially met during the pre-cycle study, Cycle I showed improvement with 9 indicators fulfilled, albeit with some notes for enhancement. By Cycle II, all aspects of differentiated learning were successfully implemented, as all indicators were satisfactorily met.

Conflict of Interest

The authors declare that there is no conflict of interest.

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