PILLAR OF PHYSICS EDUCATION
Vol. 17 (3), 2024, page.168-176
ISSN (Print) : 2337-9618
ISSN (Online) : 2684-8880

Differentiated Learning through the Discovery Model and Gallery Walk to Accommodate Students' Learning Needs: A Needs Analysis

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ABSTRACT

Meeting students' needs based on their characteristics is crucial to ensure they can learn comfortably and optimally. The objective of this research is to formulate learning plans that align with students' characteristics. This study adopts a descriptive qualitative approach, encompassing case studies and literature reviews. The research was conducted at Public Senior High School of Godean 1, with the subjects being 36 students from the 11th Science 3 class. Observation sheets and questionnaires were employed as instruments to identify students' characteristics, guided by the theory of differentiated learning. The analysis techniques involved data reduction, data presentation, and drawing conclusions/verification. Observation results indicate that the learning process has not effectively addressed students' Zone of Proximal Development (ZPD) and learning modalities. The majority of students operate at the potential level, with visual, kinesthetic, and audio modalities being the dominant ones in that order. A literature review on learning design suggests that differentiated learning, particularly through methods such as discovery learning and gallery walks, can serve as alternatives to meet these diverse learning needs.

Keywords : Differentiated learning; Discovery model; Gallery walk; Students' learning needs.

I. INTRODUCTION

Meeting the learning needs is an entitlement that all students must receive when studying physics material. This is further reinforced by the awareness that each student possesses their own uniqueness. This distinctiveness or dissimilarity has evolved into a vital aspect or inherent quality that needs to be accommodated, with its corresponding rights fulfilled through differentiated learning. The paradigm of differentiated learning regards each student as inherently diverse, recognizing that they come from diverse cultures and environments [1]. According to Santika & Khoiriyah [2], the primary proposition in learning is the acknowledgment and acceptance of students' diversity, incorporating it as a crucial consideration in the planning of the learning process. This aligns with the perspective of Fitra [3], who asserts that differentiated learning is designed to be student-centric. Consequently, it can be inferred that the physics learning process should take into account various factors inherent in students and accommodate them as a means of aligning with and fulfilling their learning needs.

There are several theories that support the necessity of differentiated learning and can be utilized to identify students' learning needs. Firstly, ecological theory, which describes the impact of the surrounding environment on student development. [4]. According to this theory, it can be comprehended that students' current conditions result from interactions between themselves and their surrounding environment. Bronfenbrenner outlined several interactions, including the relationship between students and the people around them (microsystem), the connections between microsystems (mesosystem), social issues in which students are not directly involved but

are affected by (exosystem), cultural influences (macrosystem), and past events that students have experienced (chronosystem). For instance, a student originating from a different region exhibits distinct characteristics. Therefore, the learning process should be adjusted to accommodate these conditions. Failure to do so may result in students feeling uncomfortable during the learning process, leading to suboptimal learning outcomes.

Second, the Zone of Proximal Development (ZPD) theory. Suardipa [5] stated that Vygotsky introduced the Zone of Proximal Development (ZPD) to enable educators to comprehend students' developmental levels, their learning processes, and how to enhance their abilities. The ZPD signifies the position of students' abilities within the learning process. If teachers can grasp this position, they can offer suitable support to foster students' abilities. Conversely, without this understanding, students may not progress. The ZPD represents the range between students' actual and potential developmental levels. When a student can complete a task independently, it indicates reaching the actual level of development. If assistance is still required, the student remains at the level of potential development. [5].

Thirdly, the theory of multiple intelligences, an idea developed by Howard Gardner, illustrates the diverse intelligences that students can possess. [6]. These intelligences encompass visual-spatial, linguistic-verbal, logical-mathematical, kinesthetic-physical, musical, interpersonal, intrapersonal, and naturalistic. Students are not confined to possessing only one intelligence; they can exhibit multiple intelligences. However, typically, only a few intelligences tend to stand out. Fourthly, the learning modality theory. Learning modality pertains to the most effective way for an individual to receive, process, and interpret information [7]. There are three types of learning modalities: visual, auditory, and kinesthetic. Similar to multiple intelligences, a student can possess multiple learning modalities, and in some cases, individuals may exhibit all three.

These theories can serve as the initial step in initiating the planning of differentiated learning. For instance, drawing upon the learning modality theory, an educator can structure a learning process that aligns with the specific learning modality a student possesses. Therefore, the planning of differentiated learning is intricately connected to activities involving the identification of students based on the aforementioned theories. This approach ensures that teachers can formulate suitable responses tailored to the individualized learning needs of each student [8]. The identification data then becomes the basis for designing differentiated forms of learning. The form of differentiated learning is realized in four aspects, namely content, process, product and learning environment.

The identification data subsequently serves as the foundation for crafting various forms of differentiated learning. Differentiated learning takes shape in four key aspects: content, process, product, and learning environment [9]. Content refers to learning material, process refers to learning activities, product refers to the output of the learning process carried out, and learning environment refers to the conditioning of the learning place.

Based on the explanation above, differentiated learning is necessary to accommodate the learning needs of students. However, the learning process at Public Senior High School of Godean 1 has not yet facilitated the differentiation of students' learning, thus their learning needs remain unmet. These learning needs can be identified through analyses related to ecological theory, ZPD, multiple intelligences, and learning modalities inherent in the students. Therefore, a preliminary study is required to understand the differentiation of students' characteristics. Consequently, a differentiated learning approach can be designed for the topic of sound waves that aligns with their characteristics.

II. METHOD

The research type employed is qualitative descriptive with a case study and literature review approach. The study was conducted at Public Senior High School of Godean 1, with the research subjects being 11th Science 3 class, consisting of 36 students. The research instruments utilized were observation sheets and questionnaires to understand the ecological system, ZPD, multiple intelligences, and students' learning modalities. The analysis techniques employed encompassed data reduction, data presentation, and drawing conclusions/verification. [10]. The observation and questionnaire data were analyzed and condensed to identify issues and trends in characteristics based on theories that will serve as a foundation for designing differentiated learning. Subsequently, a literature review was conducted to support the planning process. Following that, a presentation of a differentiated learning plan was developed as an alternative solution based on the four aspects of

differentiated learning, and conclusions were drawn.

III. RESULTS AND DISCUSSION

The results of the observation conducted in 11th Science 3 class at Public Senior High School of Godean 1 indicate the diversity among students, as examined through various theories supporting differentiated learning. Firstly, the ecological system theory. Students of 11th Science 3 class have a microsystem manifested in positive friendship relationships. They also possess mesosystems and exosystems that support the learning process. Additionally, the students' macrosystem tends to be similar, as they come from the surrounding area of the school and share a common culture. In terms of chronosystem, the majority of students have not experienced drastic changes in their lives. For those who have undergone significant changes, the impact on their current learning process is not disruptive. Therefore, it can be concluded that the chronosystem of the students is in good condition.

However, there is an issue within the microsystem in the form of the relationship between students and educators. In the learning process, educators do not provide comprehensive attention to all students, including those with lower abilities. The attention is often limited to only a few students. Additionally, teachers do possess the capability to utilize technology but demonstrate a lack of innovation in teaching. This results in students appearing bored as most of the learning activities involve listening to presentations from other students, as depicted in Figure 1.

Fig. 1. Students Conducting a Presentation.

The issue concerning educators' attention to students is closely related to the Zone of Proximal Development (ZPD) theory. Most students are still at the potential level, as evident from their tendency to rely on teacher or peer assistance in completing tasks. Only a small portion of students work independently or are already at the actual level. However, there seems to be a lack of effort from educators to provide guidance so that students at the potential level can progress to the actual level. This is closely linked to the quality of the microsystem between educators and students mentioned above.

Furthermore, based on the observation results, students in 11th Science 3 class exhibit a fairly diverse range of intelligences. They possess spatial-visual, kinesthetic-physical, musical, interpersonal, intrapersonal, and naturalistic intelligences. However, spatial-visual and kinesthetic-physical intelligences dominate. Spatial-visual intelligence is evident in their ability to create visually appealing presentation media, while kinesthetic-physical intelligence is demonstrated through their agility in physical activities. This aligns with the learning modalities of students in 11th Science 3 class, as indicated in Table 1.

Table 1. Percentage of Learning Modalities among Students

Learning Modalities	Percentage of Students

Visual	50%
Auditory	11%
Kinesthetic	33%
VAK	6%

However, the teaching process provided by educators has not accommodated these aspects. Educators only ask students to create presentation materials and then present them in turn. Learning that does not meet the learning needs of students results in their inability to absorb information optimally. Based on the above observation results, the planning of differentiated learning is carried out based on ZPD and students' learning modalities. This is because if ZPD is accommodated, the microsystem between educators and students will also be accommodated. Meanwhile, if students' learning modalities are accommodated, their multiple intelligences will also be accommodated

The physics learning process that can be applied based on the characteristics of Zone of Proximal Development (ZPD) and learning modalities for students in in 11th Science 3 class at Public Senior High School of Godean 1 is differentiated learning through discovery learning with a gallery walk approach on the topic of sound waves. The discovery learning model is an instructional approach that encourages students to discover concepts from a set of information through observation [11]. In various literature, discovery learning has been shown to have a positive impact on learning outcomes. [12–15], understanding of concepts [11], [16], [17], and critical thinking skills [13], [18]. Additionally, discovery learning can enhance learning engagement [13] and learning motivation [14], [19], [20]. This can certainly overcome the boredom experienced by students

Gustika [13] stated that this instructional model can facilitate communication between educators and students. This serves as an entry point for scaffolding to guide students from potential to actual levels. The discovery learning model consists of 5 syntaxes, namely Stimulation, Problem Statement, Data Collection, Data Processing, Verification, and Generalization. Differentiated learning aspects that can be applied to this model include content, learning environment, and product. The instructional model can be combined with a gallery walk. Gallery walk is an activity that involves displaying, presenting, and assessing students' works arranged in several stands. One of the works that can be created is a mind map. According to Harahap & Harahap [21], in a mind map, there is a combination of color, images, and graphic arrangements. This is highly suitable for students with a visual learning modality. Presentation activities will be suitable for students with an auditory learning modality. On the other hand, kinesthetic learners are not confined to sitting still, as in traditional learning. They can move more freely and shift between stands to study the material. This is also aligned with the multiple intelligences observed in the students. Furthermore, the mind map assists students in understanding the topic of sound waves. This is because the mind map presents concrete concepts related to sound waves.

The gallery walk activity encourages students to engage in discussions, interact with their peers, self-regulate, and enhances their motivation to learn. [22]. This is consistent with the statement by Ronoili et al. [23], that gallery walk can enhance students' activeness and cultivate a positive attitude. Students will build new knowledge by collecting concepts acquired during the gallery walk. They also have the opportunity to help each other overcome difficulties in understanding the material. Therefore, there will be an emotional connection for students in gaining new knowledge [24,25]. Various research findings indicate that gallery walk can enhance learning outcomes [24], critical thinking [26], creativity, and communication skills [27]. The differentiated learning aspect that can be applied to this activity is the process aspect. Here is an overview of how differentiated learning through discovery learning with gallery walking is implemented.

In the introductory activity, the learning session begins with a prayer, followed by conducting a diagnostic assessment. The teacher can pose direct questions as a form of diagnostic assessment [28,29]. Diagnostic assessment is not only related to the learning material, but educators can also inquire about the students' feelings. To make it more engaging, students can express their emotions through Padlet, as illustrated in Figure 2.

Fig. 2. Example Display of Padlet

Next, the teacher provides an introduction with triggering questions such as, "Do you like listening to music? Have you ever played a musical instrument?" This introduction serves as an entry point for students to delve into the topic of sound waves. The teacher then communicates the learning objectives and the activities that will be carried out.

First, syntax of stimulation. In the core activity, the stimulation syntax is filled by inviting students to analyze their experiences with sound waves in daily life. Stimulation can take the form of direct questions or written questions through a questionnaire. Questions given may include, "What causes the sound of a guitar string to vary?", and others.

Second, syntax of problem statement. Educators provide an opportunity for students to identify as many questions as possible related to the material, such as sound classification, speed of sound, strings, organ pipes, and others. These questions will be stored first and will be answered in the verification syntax.

Third, syntax of data collection students are then divided into several groups, taking into account their learning modalities. One group consists of one auditory learner, two kinesthetic learners, and three visual learners. This grouping is a form of differentiated learning environment. The good relationships among students (microsystem) also serve as valuable assets in forming groups. Yuliawan & Taryatman Yuliawan & Taryatman (2020) state that these relationships can boost students' confidence.

Group learning will also provide positive value throughout the learning process. Hardi & Mudjiran [31] state that the values obtained include mutual respect, sharing, and equality. Additionally, the formation of groups allows for diversity in students' cognitive abilities within a group. Students with higher abilities will typically play the role of peer tutors for other students with lower abilities independently [32]. This will undoubtedly have a positive impact on the collective progress of the group, particularly for students with lower abilities.

Yuliawan & Taryatman [30] state that peers can influence students' behavior and development because there is interaction and emotional support, allowing mutual acceptance and reinforcement. The quality of relationships with peers within that microsystem framework becomes one of the assets in the development of differentiated learning. Hardi & Mudjiran [31] also express that the concept of differentiated learning correlates with efforts to self-awareness, self-appreciation, and the formation of a positive culture. Such a positive classroom environment will further nurture close relationships [33]. Therefore, arranging the learning environment by having students sit in groups as part of the differentiated learning process will provide positive affirmation for each student.

Each group is provided with a student worksheet containing several tasks. The first task assigned to each group is to create a mind map of the material. The task distribution for each group is as follows: Group 1 focuses on the Understanding of Sound Waves, Types of Sound, and the Speed of Sound; Group 2 covers Fundamental and nth Strings; Group 3 addresses Open Organ Pipe Fundamental Note; Group 4 works on Open Organ Pipe nth Note; Group 5 deals with Closed Organ Pipe Fundamental Note; and Group 6 focuses on Closed Organ Pipe nth Note. Students are given the freedom to gather information from various sources and formats. This represents a form of content differentiation.

Fourth, syntax of data processing. Students then discuss to process the information gathered and create a mind map using Canva. Canva is chosen as the medium because it is easy to use, has many features, and is supported by devices compatible with students. During the creation of the mind map, students are allowed to choose a workspace that they find comfortable. This is a form of differentiated learning environment. Additionally, the teacher builds interaction with students through discussions (question-answer) as a form of scaffolding or providing assistance to students.

Ismajli & Imami-Morina [34] state that each student has a different learning pace; therefore, the learning process must adapt to their abilities, not vice versa. Scaffolding will greatly assist them as it provides attention according to their level. The interaction and assistance provided by the teacher to students can also enhance the quality of the microsystem in the class. More intensive interaction through discussions between teachers and students in each group will accommodate students with lower abilities. Discussion activities can also increase the participation of all group members [35]. Therefore, students can build their knowledge and progress together with their group in learning the material. The teacher will gradually remove this assistance when students are deemed capable of learning independently [36]. This means that scaffolding is useful for bringing students from the potential level to the actual level. This is also in line with the statement of Faiz et al. [1] that the teacher's activity plays a crucial role in the differentiated learning process, especially in analyzing the class conditions and the learning needs of students. The groups that have completed the mind map then upload it to the Google Drive folder. This is done so that all students can access the mind maps created by each group.

Fifth, syntax of verification. The students are then asked to carry out the second task on the student worksheet, which is the gallery walk. In this activity, students will showcase and present their mind maps to other groups. The students, along with their respective groups, position themselves in designated areas, as illustrated in Figure 3.

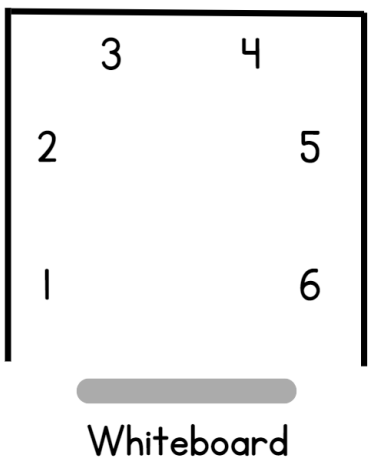

Fig. 3. Gallery Walk Plan

Students with an auditory learning modality in each group are assigned the task of managing the stand and providing explanations of the mind map to other visiting groups. This is because students with an auditory learning modality excel in explaining and grasping things verbally. Other students with visual and kinesthetic learning modalities visit stands of other groups following the teacher's instructions. Visual learners listen to explanations while observing the mind map, and kinesthetic learners can move freely to visit each stand. This is a form of differentiated process. This aligns with the statement by Yulianci & Nurjumiati [37], that visual learners observe things, while kinesthetic learners learn by doing.

The visiting groups provide critiques and suggestions for the mind map and the presentation of the material by the stand's presenter. During the gallery walk activity, the teacher accompanies the students to assess the depth of each group's understanding. The teacher gives instructions to move to a different stand every few minutes until each group returns to its original position. During the gallery walk, there are students who may not fully engage in learning the material as they prefer a quieter learning process. After the gallery walk activity, it is

followed by confirmation and verification of the learned material. This is done to align perceptions and collectively address questions arising from the Problem Statement syntax.

Sixth, syntax of generalization. The students are given the opportunity to present conclusions and reflect on their learning. Reflection is a crucial part of evaluating the students' thought processes during the learning activity so that they understand their own development [38]. In this context, students can compare their initial knowledge with the newly acquired knowledge. If students are aware of this, they will also feel the progress happening within themselves. On the other hand, the teacher can assess the students' learning progress, especially those with lower initial abilities. In addition to the content, the reflection activity can also involve self-assessment. The teacher provides reflective questions that encourage students to review the challenges encountered during the learning process, what they can do to overcome these challenges, which aspects can be improved, and so on. This activity will contribute to improving the learning process in subsequent sessions.

Next, the teacher assigns a task to investigate the variables that affect the frequency of guitar strings. The findings from the investigation are then presented in the form of an infographic, recording, or video demonstrating the variables that affect the guitar by playing it. Students are given the freedom to choose one of the products to develop, as a form of product differentiation. According to Tanesib et al. [39], this is an embodiment of independent learning that has a positive impact on students' learning motivation because they are given the freedom to determine the product they want to develop. Additionally, it is because there is synchronization between the product to be developed and the learning modalities they possess. Furthermore, in the closing activity, the teacher communicates the learning activities that will take place in the next meeting and concludes the lesson with a closing remark and farewell.

IV. CONCLUSION

Based on the review of the theories underlying differentiated learning, it is found that the majority of students in 11th Science 3 class at Public Senior High School of Godean 1 are still in the potential stage. Furthermore, the majority of students have visual and kinesthetic learning modalities. The literature review in the design of learning indicates that differentiated learning through discovery learning and gallery walk can be an alternative to meet these learning needs. Recommendations for implementing this learning design include allocating sufficient time for the learning process. Additionally, a stable internet connection is necessary to operate Canva smoothly.

ACKNOWLEDGMENT

The first author would like to thank the 2022 batch 2 pre-service physics teacher professional program students who have helped with research and provided encouragement.

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