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An Analysis of Differentiated Instruction Under the Merdeka Curriculum in Grade 11 Biology Classes at Public Senior High School 1 Tinambung

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ABSTRAK

Penelitian ini bertujuan untuk menganalisis penerapan pembelajaran berdiferensiasi dalam Kurikulum Merdeka pada mata pelajaran Biologi kelas XI SMA Negeri 1 Tinambung serta mengidentifikasi faktor-faktor yang mendukung dan menghambat pelaksanaannya. Penelitian menggunakan pendekatan kualitatif deskriptif untuk memperoleh gambaran mengenai praktik pembelajaran di kelas. Subjek penelitian terdiri atas guru Biologi dan peserta didik kelas XI. Data dikumpulkan melalui observasi, dokumentasi, dan wawancara langsung. Selanjutnya, data dianalisis secara sistematis melalui tahapan reduksi data, penyajian data, dan penarikan kesimpulan. Hasil penelitian menunjukkan bahwa guru menerapkan empat aspek pembelajaran berdiferensiasi, yaitu diferensiasi konten, proses, produk, dan lingkungan belajar. Dalam pelaksanaannya, guru menggunakan asesmen diagnostik untuk memperoleh informasi tentang kondisi peserta didik dan mengelompokkan mereka berdasarkan tingkat kemampuan, minat, atau preferensi belajar. Namun, penerapan pembelajaran berdiferensiasi masih menghadapi beberapa hambatan, terutama keterbatasan sarana dan prasarana serta waktu yang tersedia dalam proses pembelajaran. Motivasi peserta didik menjadi salah satu faktor pendukung. Ketika pembelajaran disesuaikan dengan kebutuhan dan preferensi belajar mereka, peserta didik cenderung lebih termotivasi dan aktif mengikuti kegiatan pembelajaran.

ABSTRACT:

This study aimed to analyze the implementation of differentiated instruction under the Merdeka Curriculum in Grade XI Biology classes at Public Senior High School 1 Tinambung and to identify the factors that support or hinder its implementation. A descriptive qualitative approach was used to provide an account of classroom teaching and learning practices. The participants were Biology teachers and Grade XI students. Data were collected through classroom observations, document analysis, and in-depth interviews. They were then analyzed systematically through data reduction, data presentation, and conclusion drawing. The findings show that teachers implemented four aspects of differentiated instruction: content, process, product, and learning-environment differentiation. They used diagnostic assessments to gather information about students' characteristics and grouped students according to their ability levels, interests, or learning preferences. However, implementation was constrained by inadequate facilities and infrastructure, as well as limited instructional time. Student motivation was a supporting factor: when instruction was adapted to students' needs and learning preferences, they tended to be more motivated and actively participate in learning activities.

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Introduction

Education plays a strategic role in developing an intelligent and adaptable generation equipped with 21st-century skills, including critical thinking, creativity, communication, and collaboration, to meet the challenges of globalization and rapid technological development (Ainia, 2020). Nevertheless, the quality of education in Indonesia continues to face various challenges relating to students, teachers, and educational facilities and infrastructure (Bahri, 2022). Curriculum development involves validation, implementation, and evaluation to align learning components with a school's vision and mission, as well as the needs of teachers and students. This process is intended to ensure that teaching and learning proceed effectively and achieve the expected outcomes. Curriculum adaptation is carried out systematically through a cycle of planning and continuous improvement to address contemporary challenges and develop an effective learning model (Yenti et al., 2024).

The Merdeka Curriculum is an intr curricular curriculum developed by Indonesia's Ministry of Education and Culture. It aims to enable schools to design and implement a curriculum suited to their students' needs and potential. The Merdeka Belajar Curriculum is designed to equip students with skills such as problem-solving, creativity, critical thinking, communication, collaboration, digital literacy, and social-emotional competence, all of which are essential in responding to the rapid development of information and technology (Hanipah, 2023).

The Ministry of Education and Culture launched the Merdeka Curriculum in February 2022 to give educational institutions the flexibility to develop curricula aligned with their students' potential (Kemendikbud, 2024). Differentiated instruction emphasizes engaging students thoughtfully and respectfully, and facilitating discussions through approaches suited to individual needs. It is an important teaching approach in which strategies, content, the learning environment, and instructional processes are adapted to the needs, interests, and learning preferences of individual students (Rahayu & Purwasih, 2020). To address educational challenges, the Ministry of Education, Culture, Research, and Technology introduced the Merdeka Curriculum, which emphasizes flexibility and the development of students' potential. One of its central focuses is differentiated instruction, a strategy designed to accommodate the diverse needs, interests, and abilities of individual students in the learning process.

Differentiated instruction is important in Biology education because students vary in their readiness to learn, interests, and needs when engaging with complex concepts. Teachers can adapt content, process, products, and the learning environment by incorporating visualizations, discussions, and hands-on activities, thereby making instruction more responsive to students' needs. At Public Senior High School 1 Tinambung, this study specifically examines how Grade XI Biology teachers adapt these four dimensions of differentiation in light of diagnostic assessment results,

student characteristics, and the school's available resources. The study's novelty lies in its analysis of differentiated Biology instruction in this specific school context, particularly the relationship between diagnostic assessment, the four dimensions of differentiation, and resource constraints.

Despite its potential benefits, the implementation of differentiated instruction at Public Senior High School 1 Tinambung faces practical challenges, including limited instructional time, scarce resources, and substantial disparities in students' abilities. Previous studies, such as those by Handayani (2022) and Pratama (2023), have identified similar challenges in implementing the Merdeka Curriculum; however, most have focused on general cognitive outcomes. This study's novelty lies in its in-depth analysis of how Biology teachers make strategic adjustments to instructional materials and assessment practices to ensure fairness despite the school's limited facilities. Unlike previous studies, it explicitly examines how diagnostic assessment is aligned with all four dimensions of differentiation simultaneously when teaching complex Biology content. The findings are expected to provide more context-sensitive practical guidance for schools facing resource constraints.

Initial observations at Public Senior High School 1 Tinambung indicate that the school has sought to integrate these principles since 2023. However, classroom practice in Grade XI Biology reveals a gap between teachers' innovative planning and the resources available. In light of these issues and the identified gap in the literature, this study undertakes an in-depth analysis entitled "An Analysis of Differentiated Instruction under the Merdeka Curriculum in Grade XI Biology at Public Senior High School 1 Tinambung." The study is expected to provide empirical contributions to the development of more adaptive and practical Merdeka Curriculum implementation at the school level.

Methodology

This study employed a descriptive qualitative approach to examine differentiated instruction practices in Biology in depth. This approach was selected to provide a systematic and factual account of curriculum implementation without intervening in the phenomenon under study (Suryana, 2022). The study was conducted at Public Senior High School 1 Tinambung, and informants were selected using purposive sampling. The inclusion criteria were: (1) Biology teachers who were certified or had at least five years of teaching experience; (2) teachers who had attended Merdeka Curriculum training; and (3) Grade XI students directly involved in differentiated learning. The informants comprised four teachers—two senior and two junior teachers—to capture contrasting perspectives based on teaching experience, as well as student representatives to support data validation.

Data were collected through triangulation using participant observation, in-depth interviews, and documentation of instructional materials, including teaching modules. Structured

interviews were conducted to explore teachers' perceptions of the practical challenges they faced. Data analysis followed the Miles and Huberman model, comprising three concurrent activities: data reduction (summarizing and selecting key information), data display (organizing information in descriptive narratives), and conclusion drawing and verification. To establish the trustworthiness of the data, the researcher used source triangulation by comparing interview data across teachers with observations of students' classroom activities.

Results and Discussion

Implementation of Differentiated Instruction under the Merdeka Curriculum in Biology at Public Senior High School 1 Tinambung

Based on the findings, the implementation of differentiated instruction under the Merdeka Curriculum in Biology at Public Senior High School 1 Tinambung is described below.

Implementation of Four Aspects of Differentiated Instruction

Differentiated instruction is an approach that adapts the learning process to students' readiness, interests, and learning needs. In this study, this principle was reflected in efforts by Grade XI Biology teachers at Public Senior High School 1 Tinambung to adapt learning activities to students' circumstances and the school's available resources. Accordingly, the following discussion focuses on the forms of adaptation observed during instruction rather than restating the definition of differentiated instruction.

(1) Content Differentiation

Content differentiation relates to students' readiness to learn, interests, and learning profiles. Several perspectives can be used as indicators when mapping students' readiness. The findings show that teachers used videos and textbooks to deliver Biology content. For example, one teacher described using videos to help students understand the form and structure of bones. Another teacher mentioned using videos and textbooks to adapt the materials presented. These findings indicate some variation in how content was delivered. However, the available data are insufficient to conclude that content was systematically differentiated according to each student's readiness or interests.

(2) Process Differentiation

In process differentiation, teachers are responsible for considering whether learning activities should be completed individually or in groups. Process differentiation may include: (1) tiered activities, which help students develop a shared understanding of the material while accommodating their differences; (2) guiding questions that prompt students to explore the material; (3) individual student agendas, such as task lists tailored to students' needs; (4) flexible time allowances, including additional time for students who need it to complete tasks; (5) activities that support visual, kinesthetic, and auditory learning preferences; and (6) grouping students according to their abilities and interests.

Teachers adapted the learning process by selecting methods according to the subject matter and students' circumstances. Interview data indicated the use of group discussions, projects, demonstrations, experiments, assignments, and videos. One teacher stated that method selection took students' readiness into account. These findings indicate flexibility in organizing learning activities, but they do not establish that every method was used for every topic or with all student groups.

(3) Product Differentiation

Product differentiation involves students demonstrating their understanding of the learning material to the teacher. Learning products enable teachers to assess students' abilities and inform subsequent instruction. Products may take various forms, including written observation reports, presentations, videos, songs, and other outputs. They are intended to provide a broad view of students' understanding, whether they work individually or in groups. Challenge and creativity are two central considerations in product differentiation.

The findings indicate that Biology teachers at Public Senior High School 1 Tinambung applied four aspects of differentiation under the Merdeka Curriculum. This was reflected in interviews with the teachers, one of whom stated:

"There are four aspects of differentiated instruction: content, process, product, and the learning environment or classroom climate. We implement all four at Public Senior High School 1 Tinambung; all four are included in our classroom practices."

Process differentiation was also reflected in teachers' efforts to select methods suited to students' needs. This involved varying teaching strategies and the ways teachers interacted with students. Product differentiation was reflected in the different forms and levels of difficulty of students' work. Students were given opportunities to demonstrate their understanding in different ways, such as through presentations, projects, or written assignments.

(4) Learning-Environment Differentiation

The learning environment, or classroom climate, is another important aspect of instruction. Effective classroom management contributes to a productive learning process. At Public Senior High School 1 Tinambung, classroom routines included ensuring that students were in the classroom before the teacher arrived. This practice was intended to support a conducive and orderly learning atmosphere and encourage respect for instructional time.

The application of several aspects of differentiation can be compared with the study by Niswah and Zulfahmi (2024), which examined differentiated instruction in supporting the social-emotional development of children aged 5–6 years. The studies share an interest in differentiated instruction but differ in educational level, subject matter, and research focus. Given these differences in context, the study can serve as a general point of comparison, but it cannot directly demonstrate that the practices at Public Senior High School 1 Tinambung produce the same outcomes. The learning environment includes arrangements intended to create an enjoyable, safe, and comfortable atmosphere in which children can learn calmly (Suhartiini et al., 2025).

Teachers used videos, textbooks, and other learning resources to present the material. One teacher explained that the limited availability of teaching aids made videos an important option, although students did not always remain focused while watching them. This finding suggests that media selection was influenced by available facilities and student responses. Videos therefore provided an alternative way to present content, but the findings do not establish that their use consistently improved students' understanding.

Based on the informants' accounts, the four aspects of differentiated instruction—content, process, product, and learning environment—were implemented in the teaching and learning process at Public Senior High School 1 Tinambung. Content differentiation was reflected in the use of various instructional media, including videos intended to support students' understanding of the material.

Varied Teaching Methods

Differences in students' characteristics and ability levels pose challenges for teachers in carrying out their roles in the learning process. Teachers therefore need to manage their classes flexibly and apply appropriate instructional strategies. The roles and challenges associated with this issue have become a key focus of policies concerning the implementation of new curricula (Putri & Siswanto, 2024).

The findings show that Public Senior High School 1 Tinambung uses a range of teaching methods. This is reflected in interviews with Biology teachers at the school. One teacher explained:

"When matching the material with a teaching method, I usually consider the students' readiness or, more specifically, their level of understanding and then choose a suitable method. For example, if the material is extensive, such as the reproductive system, differentiated instruction works well because students can be divided into groups. This allows them to work together, rather than having the students focus on just one person."

The use of varied teaching methods at Public Senior High School 1 Tinambung suggests that instruction is not solely teacher-centered; it also considers how students can understand the material more easily. Flexibility in method selection may support more effective instruction and create a more dynamic, collaborative learning environment. In turn, students may feel more comfortable and motivated to learn, which could contribute to improved learning outcomes.

One teacher stated that groups were formed with students' preferences in mind to encourage their enthusiasm for learning. Another explained that group discussions were used to help students collaborate and support one another. These accounts suggest that grouping was intended to encourage interaction and collaboration. However, the available evidence does not establish that this strategy prevented some students from dominating group work or consistently improved students' understanding.

Based on the informants' accounts, Public Senior High School 1 Tinambung used a range of teaching methods to accommodate students' levels of understanding and readiness to engage with the material. Method selection took into consideration the complexity of the content and the characteristics of the students in each class. Teachers were not restricted to a single method but adapted their choices to students' needs in an effort to make instruction more effective and engaging. This suggests that teaching practices at the school were flexible and responsive to students' circumstances.

Varied Assessment: The Use of Diagnostic Assessment

From an analytical perspective, diagnostic testing shifts assessment from a means of simply making a final judgment to a tool for guiding instruction. By identifying students' starting points, teachers can address substantial gaps in understanding early in the learning process. This is consistent with the vision of adapting instruction to students' needs (Kemendikbud, 2020). Teachers use diagnostic assessment at the beginning of instruction to assess students' competencies and monitor their progress in both cognitive and non-cognitive areas (Dianti et al., 2025).

Several teachers used diagnostic tests or preliminary questions to assess students' understanding before teaching new material. One teacher stated that these assessments helped identify students' prior knowledge and inform instructional decisions. This finding indicates that diagnostic assessment was used as an initial source of information for planning instruction. However, the study does not explain in detail how the results of each assessment informed changes

to content, methods, or assignments. Therefore, claims about subsequent instructional adjustments should be made cautiously.

The findings indicate that Biology teachers at Public Senior High School 1 Tinambung used varied assessment methods, including diagnostic assessment. One teacher explained:

"I often give diagnostic tests to find out how well students understand the concepts related to the topic that will be taught. By using diagnostic tests, I can identify their prior knowledge and adapt my teaching."

The use of different assessment methods, including diagnostic tests, may help make instruction at Public Senior High School 1 Tinambung more focused. Teachers do not rely solely on the curriculum when planning instruction; they also consider how well students understand the concepts being taught. This reflects an approach that considers not only learning outcomes but also the learning process and students' readiness to understand the material in depth.

Teachers reported that using different methods to meet students' needs required additional time. This finding suggests that teachers need to plan activities and allocate time realistically to implement a range of methods. The study does not show that differentiated instruction saved time; a more appropriate implication is that teachers need support with instructional planning and time management.

Based on the informants' accounts, Public Senior High School 1 Tinambung used diagnostic assessment to gauge students' understanding, including through diagnostic tests administered before a new topic was introduced. These tests were used to determine students' understanding of concepts related to the upcoming topic. Diagnostic assessment can help teachers identify gaps in students' understanding and determine which concepts may need reinforcement before they proceed to the next topic. This suggests that instruction at the school considered students' readiness to learn alongside the delivery of curricular content.

Grouping Students According to Their Ability Levels, Interests, or Learning Preferences

Student engagement in learning refers to students' efforts to develop their potential through learning activities aimed at achieving learning objectives. It may be demonstrated through active participation in discussions, asking questions, summarizing lessons, and similar activities (Annadzili et al., 2024).

Students' needs and priorities for personal development vary. Some seek academic and non-academic achievement, while others may place less emphasis on academic success. Peer relationships also shape students' experiences. Some students are highly motivated to succeed in the activities they undertake (Luthfia & Triono Ali Mustofa, 2024).

Differentiated instruction seeks to address the diversity of students' needs and learning preferences through an approach informed by their cognitive abilities. Its central principle is not to

assign a different task to every student, but to manage the classroom flexibly so that grouping reflects individual potential. This allows all students, regardless of their ability levels, to receive relevant and appropriately challenging educational support (Atikah et al., 2023).

The findings indicate that teachers at Public Senior High School 1 Tinambung grouped students with consideration of their ability levels, interests, or learning preferences. This is reflected in an interview with a Biology teacher, who stated:

"Teachers need to understand students' characteristics before deciding how to support them. They also need to consider students' learning preferences. Some students are more capable, while others have greater difficulty. Some learn by listening to explanations, while others learn by looking at images. In other words, some learn through audio, audiovisual materials, or kinesthetic activities. The main point is that students' learning preferences differ."

The data show that teachers used diagnostic tests to assess students' prior understanding. Teachers also grouped students with consideration of their abilities or preferences. However, the evidence is insufficient to establish that diagnostic test results were directly used to form the groups. These practices should therefore be described as separate strategies observed in the study unless their connection is documented in the data.

Afelia and Utomo (2023) examined the learning preferences of Grade X students in the context of differentiated instruction. Their study provides a relevant point of comparison for teachers' efforts to identify differences in how students learn. The present study adds an account of Grade XI Biology teachers' practices at Public Senior High School 1 Tinambung, including their use of learning resources, group discussions, diagnostic assessment, and their experience of limitations in facilities and instructional time.

Based on the informant's account, teachers at Public Senior High School 1 Tinambung grouped students with consideration of their ability levels, interests, or learning preferences. Teachers recognized that students differ in how they engage with learning material and that teaching strategies may need to reflect those differences. They first sought to identify students' characteristics before selecting an appropriate instructional approach. These findings suggest that teachers aimed to make instruction responsive to students' individual potential.

Factors Experienced by Teachers in Implementing Differentiated Instruction under the Merdeka Curriculum in Biology

Hindering Factors

(1) Inadequate Facilities and Infrastructure

Limitations in a school's educational facilities and infrastructure can affect students' learning outcomes. The implementation of education and the challenges encountered in teaching and

learning depend not only on teachers but also on the availability and adequacy of school facilities. Facilities administration involves the procurement, use, and management of educational resources to achieve established objectives effectively and efficiently (Atikah et al., 2023).

The findings identify inadequate facilities and infrastructure as one of the barriers to implementing differentiated instruction at Public Senior High School 1 Tinambung. A Biology teacher stated:

"Time is a factor. There is limited time, and facilities such as teaching aids are often lacking."

Teachers identified the limited availability of teaching aids as a challenge. One explained that when such aids were unavailable, videos were sometimes used, although students did not always remain focused while watching them. This finding suggests that limited facilities affected teachers' choice of instructional media and the delivery of lessons. In practical terms, the school could consider providing teaching aids relevant to Biology topics, while teachers could select alternative media according to the lesson objectives and classroom conditions.

The interview findings indicate that differentiated instruction at Public Senior High School 1 Tinambung was constrained by inadequate facilities and infrastructure. One key challenge was the limited availability of teaching aids and instructional media that could support varied learning activities responsive to students' needs. Such resources can help address students' visual, auditory, and kinesthetic learning preferences. However, teachers reported that the resources were often unavailable or insufficient, making it difficult to provide engaging instruction suited to students' characteristics.

(2) Limited Instructional Time

Time-management skills are important for teachers. Without effective time management, students may postpone tasks or use their time inefficiently, which can lead to delays or failure to complete assignments.

The findings also identify limited instructional time as a challenge for teachers at Public Senior High School 1 Tinambung. One Biology teacher explained:

"One of the challenges is limited time. Using different methods to meet each student's needs takes more time, so it can be difficult to accomplish within the time available."

Teachers reported that adapting instructional methods to students' needs required additional time. This suggests that lesson planning for differentiated instruction needs to account for the duration available. As time constraints are also discussed in connection with facilities, the findings should be presented together where appropriate to avoid repetition.

Teachers are expected to ensure that students understand the material before moving on to the next stage. However, within the allotted instructional time, they cannot always provide

individual support to students who experience difficulties. Limited time may therefore constrain the extent to which differentiated instruction can address students' diverse needs.

The findings also point to a tension between the flexibility promoted by the Merdeka Curriculum and the practical constraints teachers face. Teachers are expected to differentiate instruction and support students' learning progress, yet limited time and the breadth of Grade XI Biology content may make this difficult. In such circumstances, teachers may rely on whole-class methods to cover the material efficiently. The available data, however, do not establish that differentiation was merely superficial, limited mainly to learning products, or affected by a lack of managerial support for flexible scheduling. Such conclusions would require further evidence.

Supporting Factor: Student Motivation

Motivation is a potential supporting factor in differentiated instruction. Instruction that takes students' learning preferences into account may support learning and encourage active participation. Student-centered approaches, such as those promoted by the Merdeka Curriculum, may also support students' independence in learning.

The findings indicate that student motivation supported differentiated instruction at Public Senior High School 1 Tinambung. One Biology teacher stated:

"Relevant learning allows students to study material that matches their interests and needs."

Teachers also described collaboration as a way to encourage student participation. Through group work, students could exchange ideas, discuss the material, and help one another understand it. This could make classroom learning more interactive and encourage students to share their ideas with greater confidence.

These findings are consistent with Afelia and Utomo (2023), who describe collaboration skills as the ability to work with others, tolerate differing views, exchange ideas, and make responsible decisions in pursuit of a shared goal. In Biology learning, group collaboration can help students combine their respective strengths to accomplish a common task.

The findings suggest that student motivation may support the implementation of differentiated instruction. When learning activities are perceived as relevant to students' interests and needs, students may be more willing to participate. Collaboration may also encourage interaction and confidence in sharing ideas. However, the present data do not establish that contextualizing Biology content increased intrinsic motivation, reduced cognitive barriers, or compensated for limited laboratory facilities. Such effects would require specific evidence from observations or student accounts.

Based on the interviews, student motivation was one factor that supported differentiated instruction at Public Senior High School 1 Tinambung. Teachers reported that students were more enthusiastic when instruction addressed their interests and needs. This suggests that students'

perceptions of the relevance of learning activities may encourage their participation and engagement in classroom learning.

Research Phenomenon

A research phenomenon is an actual condition or event observed in the field that gives rise to a research problem and warrants scientific investigation. In this study, the phenomenon concerns the conditions observed during the implementation of differentiated instruction under the Merdeka Curriculum in Grade XI Biology classes at Public Senior High School 1 Tinambung.

The phenomenon examined in this study is the suboptimal implementation of differentiated instructional strategies by Grade XI Biology teachers at Public Senior High School 1 Tinambung, despite the formal adoption of the Merdeka Curriculum. This is reflected in differences in teachers' understanding of differentiation, limitations in conducting diagnostic assessments, difficulties in adapting instructional methods to students' learning preferences and needs, and challenges in managing diverse classrooms. At the same time, there are indications that differentiated instruction may enhance students' motivation and engagement when implemented using appropriate strategies.

Conclusion

Differentiated instruction in Biology at Public Senior High School 1 Tinambung encompassed four aspects: content, process, product, and the learning environment. Teachers also used varied assessment methods, including diagnostic assessment, and grouped students according to their ability levels, interests, or learning preferences.

Biology teachers faced both barriers and support factors in implementing differentiated instruction under the Merdeka Curriculum. The main barriers were inadequate facilities and infrastructure and limited instructional time. Student motivation was a supporting factor. Students whose learning experiences were aligned with their needs and learning preferences tended to be more motivated and actively engaged in the learning process.

This study offers practical insights into implementing differentiated instruction by examining the four aspects of content, process, product, and learning environment in Biology. It also describes teachers' use of diagnostic assessment and student grouping, alongside the constraints of limited facilities and instructional time. Although students' motivation and engagement were identified as supporting factors, the findings do not establish a significant increase caused by differentiated instruction. Overall, the study highlights the relevance of adapting Biology instruction to students' diverse learning profiles in the Senior High School context.

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