

Exploring Students' Motivation in The Biology Class Using Differentiated Instruction Integrated with A Problem-Based Learning Model

Rizal M. Suhardi¹, Karmilawati Karmilawati², Harsi Admawati³, Nur Balqis Mutia⁴, Rangga Alif Faresta⁵

¹ National Sun Yat-sen University, Kaohsiung, Taiwan

² Sekolah Menengah Atas Negeri 2 Masbagik, East Lombok, West Nusatenggara, Indonesia

³ Tidar University, Magelang, East Java, Indonesia

⁴ Institut Agama Islam Negeri Langsa, Langsa, Aceh, Indonesia

⁵ Monash University, Australia

*Corresponding author: rizalm.suhardi@g-mail.nsysu.edu.tw

Abstract

The purpose of this study was to explore senior high school students' motivation in biology class using differentiated instruction integrated with the problem-based learning (PBL) model. The metabolism system was used as the topic in the learning process. Thirty 12th-grade senior high school students in East Lombok were employed as subjects. The data were collected in the posttest using a learning motivation questionnaire. It consists of six learning motivation indicators. Descriptive statistics analysis by determining the mean value and standard deviation using R Studio was used to analyze the data. The result showed students' motivation in the biology class using differentiated instruction integrated with a PBL model was categorized as good. The findings of this study can be used as considerations of differentiated instruction integrated with PBL model implementation to enhance students' motivation based on different characteristics of students in the class.

Keywords: *Biology; Differentiated Instruction; Motivation; PBL*

1. Introduction

Individuals require motivation to thrive in life as it serves as a driving force that propels them towards engaging in activities aimed at attaining their desired objectives. A person with motivation has the strength to succeed in life because it is one of the important factors influencing individual activities (Sinta & Medriati, 2022; Marisa, 2019; Sari et al., 2018). In education, motivation is a pivotal aspect of learning activities because a high level of motivation will encourage enthusiasm for learning and vice versa. Learning motivation plays an important role in the learning process because it provides passion, enthusiasm, and a sense of pleasure to learn, so high motivation students will get great learning achievements (Putri et al., 2021). Moreover, it can be a driving force to maximize students' abilities and potencies to realize learning goals (Nurfaliza & Hindrasti, 2021).

Conversely, low motivation is an obstacle in the learning process thereby the learner will not succeed optimally (Suharni & Purwanti, 2018). Besides, each student has a distinct learning motivation (Rohman & Karimah, 2018). To improve students'

motivation, peers can provide social support because of a safer and more comfortable feel to sharing opinions with them (Afiif & Makkulau, 2016). Therefore, motivation is an important aspect of learning activities to reach great learning goals and achievements that will contribute to success in life. Because it can be affected by an individual's social environment, cooperation between peers should be implemented in the learning activities.

In learning, success in achieving learning goals affects student motivation. It will raise satisfaction, motivating learners to keep trying to achieve similar goals (Sari et al., 2018). Nevertheless, the research results showed that the biology learning outcomes of high school students are still low and have yet to reach the learning objectives optimally (Irsyad & Fauzi, 2020; Garnasih, 2018). Abstract contents become difficult for students to understand and contribute to low motivation to study Biology (Yustini et al., 2021). Furthermore, it causes indifference, easily discouraged, and impairing learning concentration which may lead to students' learning difficulties (Rahman, 2021). Therefore, students' motivation in biology with abstract content, such as metabolic system topics, should be enhanced and investigated.

A biology teacher as a facilitator is required to generate students' learning motivation. Explaining learning objectives, giving prizes to outstanding students, providing opportunities for competition, providing educational punishments, helping students facing learning difficulties both individually and in groups, using varied learning methods, and using good media that are appropriate to learning objectives are several strategies to foster learning motivation in students (Suharni & Purwanti, 2018). Teachers must always innovate their teaching and learning activities by developing learning settings that are appropriate for the classroom environment (Fitriani, 2017). Subsequently, teachers can innovate learning activities by using various learning models, learning media, school environments, and curricula to enhance students' motivation.

On the other side, teaching and learning activities should be based on students' characteristics. Hanifah et al. (2020) explained that every implementation of learning activities should adjust to each student's characteristics, learning styles, and intelligence levels. In general, the characteristics of students that must be considered in learning planning include 1) characteristics related to initial abilities such as intellectual abilities, thinking skills, and movement abilities, 2) characteristics related to socio-cultural background and status, and 3) characteristics related to personality differences, such as traits, attitudes, feelings, and interests (Sitanggang & Saragih, 2013).

The students' characters must be known to maximize their potencies and help the teacher's ability in learning management. Understanding the characteristics of learners is an obligation for a teacher (Sahri & Zulkarnaen, 2022). Teachers who understand the characteristics of their students will be able to optimize the achievement of learning objectives, help the process of students' growth and development, maximize students' potencies easily, diagnose students' problems, and help students to socialize and interact with their environment (Janawi, 2019). Mutammam (2013) explained that students who

enter the formal operation stage are generally in secondary schools-junior high school to high school in Indonesia. The characteristics of students at the age of adolescence that are categorized by sexuality can be detailed as follows: 1) boys love to give protection, imitate their idol actively, and try to show their capability and prestige; 2) girls love protection, admire their idol, and often please others (Sitanggang & Saragih, 2013). Hence, learning should pay attention to individual differences or characters to maximize students' achievements and facilitate teachers to formulate learning objectives and activities.

One method of learning that facilitates individual differences is differentiated instruction. Differentiated instruction is an effective learning method that recognizes the differences of each student to maximize their potencies based on abilities, interests, and learning profiles (Tomlinson and Imbeau, 2010). Learning environment preferences, group orientation, learning styles, and intelligence preferences are key aspects of differentiated instruction based on student learning profiles (Santangelo & Tomlinson, 2009). In addition, the objectives in learning are differentiated to maximize the cognitive growth of each student by recognizing that students' distinctions are not only in cognitive interests but also in learning profiles and metacognitive skills (Lauria, 2010). Thus, differentiated instruction can enhance students' affective, psychomotor, and cognitive domains.

Based on the character of differentiated instruction, problem-based learning can be integrated. Problem-based learning (PBL) is defined as a student-centered approach that is implemented in the field of education (Suwono et al., 2023). Putra and Iswantir (2021) explained that this learning model focuses on students. Problem-based learning is a learning model that has a huge positive impact on teaching and learning. Implementing PBL improves students' learning activities and outcomes (Saragih & Sitompul, 2021). PBL stimulates teaching and learning and enhances students' critical thinking skills (Hussin et al., 2018). Moreover, the PBL model influences students' lateral thinking ability (Mustofa & Hidayah, 2020). Besides, it motivates students to learn and facilitates promoting students' problem-solving skills, communication skills, collaborative skills, and lifelong learning attitudes (Zakaria et al., 2019; Ghani et al., 2021). Hence, differentiated instruction integrated with problem-based learning can be implemented in the biology classroom in the metabolism system topic.

Consequently, students' motivation as one of the crucial factors in Biology class using differentiated instruction integrated with problem-based learning should be investigated. Therefore, this study describes students' learning motivation in biology class using differentiation instruction integrated with a problem-based learning model in senior high school. The question of this study is "How are the students' learning motivation in the biology class using differentiation instruction integrated with the problem-based learning model?"

Motivation is one aspect that plays an important role in one's learning success. Motivation influences the feeling of pleasure and joy for learning and activities. An individual with strong motivation within himself will positively correlate with the

achievement of his learning outcomes (Sinaga et al., 2017). Therefore, every teacher plays an important role in developing the motivation that exists in students by carrying out various methods and techniques that can be used.

One method that can be used to develop student motivation is by applying differential learning during learning activities. Differential learning is based on meeting the learning needs of students and how the teacher responds to these learning needs (Suwartiningsih, 2021). Based on this, before learning activities are carried out, the teacher should identify and analyze the learning needs of students so that they can respond comprehensively to the steps that can be taken to meet the needs of these students.

Differentiated Instruction is an inclusive instructional practice that enables teachers to meet the needs of all learners in heterogeneous classrooms (Pozas et al., 2020). Divergent diversified instruction approaches enhance the learning environment for individual students or homogeneous groups, necessitating teachers to establish objectives and design learning pathways according to their talents and educational requirements. Implementing a personalized learning route for each student can lead to an increase in student differentiation (de Graaf et al., 2019).

Teachers plan and design learning situations to accommodate students' educational needs, so it is important to consider students' perspectives when investigating teaching and learning processes and their efficacy. These measures are designed to meet students' diverse educational needs (Montuoro & Lewis, 2015). Implementing Differentiated Instruction by teachers is intended to maximize students' learning outcomes. Teachers must consider five fundamental dimensions to differentiate Instruction: 1) coping with student diversity; 2) adopting a specific teaching strategy; 3) introducing variety in learning activity; 4) monitoring individual student needs; and 5) pursuing optimal learning outcomes (Suprayogi & Valcke, 2016).

The Problem-based learning model is one of the models that can be integrated into differential learning. This is because the PBL model has the characteristics of giving a given problem which is a problem that produces not a single answer or a single solution. So that by giving these problems, participants can optimize their potential and explore to solve existing problems in various ways (Manulu et al., 2023). Sarie (2022) also affirmed that the PBL learning paradigm is highly efficient for incorporating varied learning activities. Developing a problem-oriented mindset in kids helps enhance their critical thinking skills. In addition, this learning paradigm offers students meaningful, challenging, and relevant learning experiences.

2. Material and Method

This research employed a descriptive qualitative approach conducted at SMAN 2 Masbagik in East Lombok during the second semester of the 2020–2021 academic year. The study focused on thirty students from the 12th grade Science 1 class as the primary

sample. These students were subjected to differentiated instruction utilizing the problem-based learning (PBL) model, specifically applied to metabolic system topics.

Data collection for this research utilized a questionnaire as the primary instrument, administered post-instruction. The questionnaire comprised 12 statements categorized into six indicators to assess the student's learning motivation. The Likert scale, ranging from 1 to 4, was employed to score responses on these indicators. The collected data underwent descriptive statistics analysis, where mean values and standard deviations were computed. The R program facilitated this analytical process. To interpret the mean values, criteria established by Pimentel (2010) were applied: scores falling within the range of 1.00–1.75 were considered very bad, 1.76–2.51 as bad, 2.52–3.27 as good, and 3.28–4.00 as very good. This structured analysis provided insights into the students' learning motivation following the differentiated instruction employing the PBL model.

3. Results and Discussion

The result of differentiation instruction integrated with the problem-based learning model on learners' motivation for each indicator could be seen from the result of a descriptive statistics analysis based on the data of the posttest. The mean and standard deviation results for each learning motivation indicator can be seen in Table 1.

Table 1. Learning Motivation Indicators

Indicator	Mean	SD
The existence of desire to succeed in in the differentiated instruction classroom integrated with PBL	3.20	0.05
Learning profile affects intrinsic motivation to find information and data.	3.00	0.05
The learning situation in the differentiated instruction classroom integrated with PBL was conducive	2.80	0.09
There were appreciations in the differentiated instruction classroom integrated with PBL	2.88	0.02
Student-specific performance task was exciting.	2.80	0.04
Having future hopes and goals	2.78	0.02

Self-learners who wanted to prepare schedules, instruments, and task divisions had a mean value of 3.20. This indicator reveals how motivated students are to organize and arrange learning activities based on their learning style. The learning profile suggests an intrinsic desire for information and data sources had a mean value of 3.00. Based on their learning profile, this indicator demonstrates how motivated students are to seek knowledge and suitable data sources for learning. Analytical and competent in creating information media for each group's learning style had a mean of 2.80. This indicator demonstrates how well students can analyze data and develop information mediums for each learning style. Responsible problem-solving had a mean value of 2.88. This indicator demonstrates how well students can handle problems responsibly and according to

learning principles. Student-tailored performance exercises had a mean value of 2.80. This indicator reveals if students can participate in performative activities adapted to their learning needs. Enjoys problem-solving indicator had a mean value of 2.78. This indication reveals how much students enjoy problem-solving, an essential learning skill.

Learning process using differentiated instruction

In the second semester of the 2020–2021 academic year, research subjects participated biology class on the Metabolic System topic. They learned the topic using differentiated instruction integrated with a problem-based learning model.

Data interpretation

Based on the mean value in Table 1, the indicator “self-learners who want to prepare schedules, instruments, and task divisions” had a good category. The result indicated that students in the to organize and arrange learning activities based on their learning style.

The learning profile suggests an intrinsic desire for information and data sources had a mean value of 3.00. Based on their learning profile, this indicator demonstrates how motivated students are to seek knowledge and suitable data sources for learning.

Analytical and competent in creating information media for each group's learning style had a mean of 2.80. This indicator demonstrates how well students can analyze data and develop information mediums for each learning style.

Responsible problem-solving had a mean value of 2.88. This indicator demonstrates how well students can handle problems responsibly and according to learning principles.

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Enjoys problem-solving indicator had a mean value of 2.78. This indication reveals how much students enjoy problem-solving, an essential learning skill.

Correlation between results with related research

Based on the results of research on the metabolic system topic, students were exposed to real-world metabolism-related problems. Those contained facts that motivated students to be active. Students felt the benefits of understanding and connecting the topic with everyday life while studying with the PBL learning model. Munawaroh and Setyani (2022) suggested that Problem-Based Learning (PBL) motivates students based on the result of their research that showed the PBL model influenced students' learning motivation, learning achievement, and critical thinking skills.

Providing authentic problems, the opportunity to work in small collaborative teams, and the tutor's support significantly impact student motivation. PBL can positively impact student motivation, though its efficacy is limited, according to research. In PBL,

problems are the primary motivator (Rotgans & Schmidt, 2019). Motivation is necessary for the successful application of problem-based learning (PBL). It can be strengthened by the facilitator's methodical motivation, which encourages students to achieve deep learning. The course's impact on the learning process is demonstrated by students' responses to motivation gained by the course (Harun et al., 2012).

The interaction between the application of PBL and differentiated learning on learning motivation can imply that the methods used in learning can influence student learning motivation. In PBL learning, it provides new knowledge to students through problems so that students are challenged to learn it. In addition, students work in groups, interact with each other, and teach each other (peer teaching). Therefore, groups of students with low learning motivation and low initial ability can study with students with high motivation if given PBL treatment. This aligns with theoretical studies about the benefits of PBL in learning; Afiif and Makkulau (2016) explained that peers could provide social support to improve students' motivation. Research by Fukuzawa et al. (2017) also stated that student motivation in response to problem-based learning demonstrated that students with more subject matter experience at the outset of the course were more motivated. Most students (76.7%) increased their motivation toward problem-based learning by the conclusion of the course. We were surprised that 78% of a subset of students had low motivation after the course, given their subject matter knowledge.

Problem-based learning (PBL) assumes students are more motivated when given authentic challenges, work in small teams, and have a tutor rather than a teacher (Rotgans & Schmidt, 2019). Suwono et al. (2023) concluded that PBL can help students acquire biological knowledge. This model encourages improving biological understanding through problem-solving and critical reasoning skills.

Students can demonstrate an attitude of cooperation, independence, creativity, and critical reasoning by solving problems independently due to differentiated biology instruction. Differentiated learning allows students to enhance their potential according to their learning readiness, interests, and learning profiles. This learning focuses on processes, content/learning materials, and learning products. Since this learning is tailored to students' preparation and learning profiles, a teacher must be able to assess whether it is learning readiness, interests, or student learning profiles. According to Pradina et al. (2021), effective teaching requires a high level of pedagogical expertise because qualified educators are the key to achieving positive educational outcomes. In differentiated learning, students are expected to be able to interpret their growth and development through a learning process that classifies the characteristics of student learning styles in the classroom so that they can freely express, argue, and carry out the learning process happily, which can support the achievement of learning objectives following the course, what they are learning in class.

In comparison, the teacher in this learning process is tasked with facilitating students to develop their best potential. The first step is to gather information about the characteristics of student learning styles that will be taught through non-cognitive

assessments through questionnaires distributed through Google Forms. In addition, the teacher also takes a direct approach to students by asking which learning activities they (students) like. The stage is to first find out the types of students in the class by carrying out non-cognitive assessments, which are shared through filling out the Google form and through direct approaches, for example, inviting students to talk casually about the expected learning process. The result is that students have an auditory learning style; that is, many like to hear while looking at pictures or videos, as well as kinesthetic, where many of these children cannot stay still in their seats or tend to be active.

In this lesson, students are happy, active, critical, and innovative by maximizing their thinking independently and combining them into one group, which will later be presented and shared. Differentiated learning is like this: a variety of unique models according to students' character so that students can receive material in the way they want and their respective learning profiles after being declared ready to learn. This is in line with research conducted by Handiyani and Muhtar (2022), which states that a differentiated learning strategy can increase students' enthusiasm for learning because students are offered learning activities that are not monotonous and can adapt to their needs so that it has a better impact on their skills and will use for them in the future. In addition, it is supported by research conducted by Puspitasari et al. (2020), which proves that the results of students' responses to this differentiation model learning obtained positive results with a percentage of the rating results of 82%.

Conclusion

Based on the research result, it can be concluded that students' learning motivation was categorized as good in the biology class on the metabolism system using differentiation instruction integrated with a PBL model. The provided information in this study indicated that implementing instruction integrated with a PBL model has a high potential to develop students' motivation. Besides, the result of this study can motivate teachers, school administrators, and policymakers to implement differentiated instruction integrated with PBL in abstract content such as the topic of the metabolism system.

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