

The Implementation of Project-Based Learning (PjBL) in Biology Learning on Genetic Concepts

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Abstract

This study analyzed the implementation of Project Based Learning (PjBL) learning model in biology learning on genetic concepts of grade XII at one of the public high schools in Tangerang Regency. The purpose of the study was to evaluate the effectiveness of PjBL in improving students' learning outcomes and their engagement in the learning process. The research was conducted using descriptive method which included one learning cycle with four stages: planning, implementation, observation, and reflection. The results showed that the implementation of PjBL was able to improve students' active participation, creativity, as well as learning outcomes, with most students scoring above 90. However, some students with scores below 80 showed a lack of engagement in the group. The PjBL model proved effective in creating meaningful and in-depth learning experiences for students.

Keywords: PjBL, Genetic concepts, Students' active participation

INTRODUCTION

Learning in the 21st century involves the use of information and communication technology in various aspects of life. Learning in the 21st century aims to gain knowledge about procedures that encourage intellectual, moral development, as well as various skills, such as the ability to ask questions, creativity, understanding in creating, problem solving, and mastery of standards for accessing knowledge through educational media (Syamina *et al.*, 2021). The 21st century is often referred to as a technological era that demands high abilities and skills. In this context, learning must shift from a *teacher-centered learning* to a *student-centered learning* approach, where learners are encouraged to seek concepts independently (*self-directed learning*) and understand their own abilities (metacognition). This approach is believed to train students' skills in various fields (Lestari & Ilhami, 2022). Therefore, learners need to have basic competencies, while educators must adapt to face challenges in preparing quality learners (Indarini, 2024). In this case, producing active, productive and innovative learners is the goal of curriculum 2013 (Setiawan *et al.*, 2021). Curriculum 2013 learning combines one subject with another which is called thematic (Chandra *et al.*, 2021). Some subjects are known as thematic, including science subjects such as Biology.

Biology is a compulsory subject for students majoring in Mathematics and Natural Sciences in Senior High School. This subject is closely related to everyday life, so it is often associated with solving everyday problems. However, in the Biology learning process, there

are several challenges that cause low student learning outcomes. The challenges in learning biology lessons are memorizing scientific names, difficulty working together during practicum and difficulty accepting models, methods and learning strategies carried out by teachers. (Zamzami *et al.*, 2020).. Biology lessons require students to remember, understand, and master concepts, which often affects unsatisfactory learning outcomes. In addition, teacher skills in teaching can also affect student achievement. Many educators use methods that make students feel bored, so the subject matter is easily forgotten (Azhari *et al.*, 2022).

When delivering concepts, educators should use the right learning model so that students feel more motivated. Therefore, it is important to apply a model where students play an active role (Nurhadiyati *et al.*, 2021). One approach that can realize this goal is the *Project Based Learning* (PjBL) model. This model provides ample opportunities for students to explore their creativity. Azzahra *et al.* (2023) stated that PjBL has various advantages, such as increasing motivation, problem solving ability, collaboration, critical thinking skills, and creativity. The PjBL model has great potential to make learning more interesting for students in learning Biology concepts. The projects given in the PjBL model encourage students to complete tasks actively and creatively, so that they are accustomed to solving problems independently.

The Project-Based Learning (PjBL) model is a learning model that presents relevant situations for learners, which can positively develop their creative thinking skills. This model allows students to actively explore knowledge, ask questions, identify problems, and design and implement projects. Nababan *et al.* (2023) stated that PjBL is a learning strategy that focuses on learners, starting from a problem that is then understood in depth to produce new learning. Students will be given projects that allow them to fulfill three main competencies, namely affective, cognitive, and psychomotor aspects. The outcome of the project is usually a product, such as a written or oral report, presentation, or recommendation.

Based on the description above, the purpose of this study is to analyze the implementation of the PjBL model to grade XII students in biology learning on genetic concepts.

METHOD

The research method used in this study was descriptive qualitative research. Data collection was carried out by observation during implementation to ensure all actions were monitored, with evaluation of the results of observations carried out on an ongoing basis to assess the effectiveness of the action. At the end of the cycle, a test was conducted to obtain an overview of students' conceptual understanding, and the results were analyzed

descriptively to calculate the average score and compare it with the established criteria. Reflection was conducted based on the analysis of test results to identify aspects that needed to be improved in the next cycle, so that the weaknesses detected could be minimized.

RESULTS AND DISCUSSION

Implementation of the Project Based Learning (PjBL) Model to the Student Learning Process

The implementation of the PjBL model in the learning process includes apperception, core activities, and closing stages. Meanwhile, PjBL consists of six steps, namely: (1) ask; (2) plan; (3) schedule; (4) monitor; (5) test, and (6) assess and evaluate. The six steps are distributed into three stages of the learning process. The following is an explanation of each step:

Apperception

Apperception is done by the teacher to help students understand the concepts to be taught. PjBL steps in the apperception stage include:

1) Basic Questions

In the first step, researchers who act as teachers ask essential or basic questions to students to encourage them to think and solve the problems given. After that, the teacher explains the learning indicators and provides basic concepts, instructions, or references needed in the learning process. Next, the teacher conducts brainstorming where students are introduced to images, videos, or animations about chromosomes, DNA, and genes. From these observations, students find various problems and ask questions, such as: a) what is a chromosome?; b) what is DNA?; c) what is a gene?; d) where are the chromosomes located in our body?; e) what is the function of DNA?. The implementation of PjBL provides a meaningful learning experience for students because it allows them to understand concepts, solve problems through projects, and encourage creative ideas in completing tasks (Candra *et al.*, 2019).

2) Planning the Project

The teacher divides students into 6 groups of 6-7 students heterogeneously. Then divide the concepts for each project, the concepts is chromosomes, genes, DNA, RNA, transcription and translation to students. Then direct students to design projects that will be made according to the creativity and agreement of their group members. After completing the project, students are asked to upload the results of their group work on an Instagram account managed by a group representative. This is a creative way to integrate academic learning with technology and social media. According to Herowati (2023), in the stages of the PjBL process there is a

project planning stage which includes organizing cooperation, selecting topics, gathering information related to the project, making predictions, and designing investigations.

3) Making a Schedule

Each student and teacher agree on a schedule in the form of a learning contract which includes an agreement on the project title and completion time. In the third stage, the researcher and students discussed the schedule for collecting the projects undertaken by each group. Furthermore, the researcher gave 7 days to complete the project, while reminding that the task was aimed at the students. According to Restu *et al.* (2020), the Project-Based Learning Model (PjBL) is a learning method that takes a long time, focusing on students' active involvement in understanding concepts or principles through in-depth investigation of a problem and finding the right solution, then applying it in a project. Thus, students experience a meaningful learning process and build their knowledge independently.

Core Activities

1) Monitoring Project Creation

The teacher should facilitate and monitor the students' work (see Figure 1 dan Figure 2). The teacher acts as a facilitator who provides direction, facilitation, and encouragement for students. In addition, the teacher must encourage students to work effectively and efficiently in groups, help each other and have responsibilities according to the roles assigned by the group. In the fourth stage, the teacher asks students to work on project-related activities about genetic concepts in groups at home. Furthermore, the teacher asks students to ask questions if they experience problems or something that students do not understand. According to (Ratih, 2021) the teacher was originally a learning resource but in PjBL the teacher becomes a facilitator of learning activities that guide students to solve problems. In the implementation of the PjBL learning model, each student's work must be monitored and facilitated in the process, at least at two stages carried out by students (checkpoints). Facilitation that also needs to be done, for example project assessment is the process of evaluating tasks that must be completed within a certain period of time (Panjaitan *et al.*, 2020).



Figure 1. Learner demonstration activities in groups on chromosomes and DNA

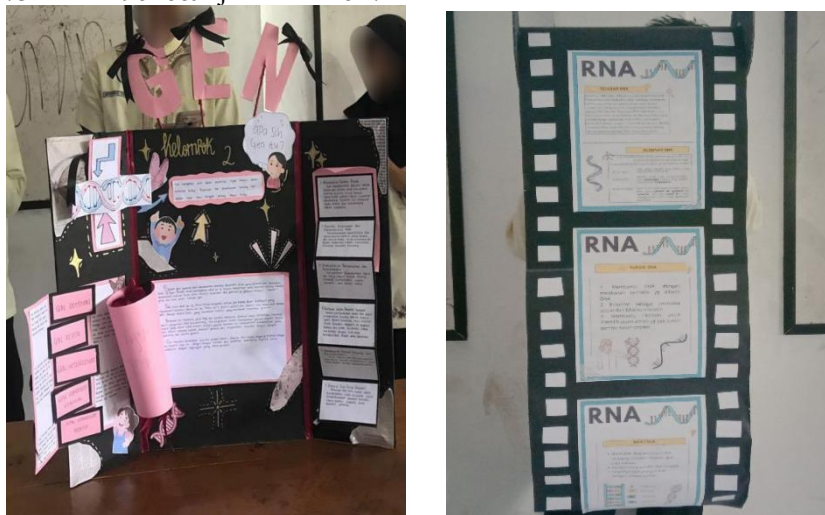


Figure 2. Learner demonstration activity in groups of Genes and RNA concepts

Cover

1) Assess and evaluate

Assessment is carried out on student competencies covering aspects of knowledge, attitudes, and skills in accordance with predetermined learning concepts. This project model is applied until the evaluation stage, where the results of the project assessment are presented in front of the class. Students of grade 12 MIPA must be presented in front of the class. Each group will showcase their project results in front of classmates and teachers. Students will explain and display their work to other groups and the teacher. In this assessment, the teacher evaluates each group by asking questions to those who are presenting. Students also give good responses to questions from the teacher and classmates. Learning using the discussion method is also fun for them. Even with time constraints, students can still connect with each other, so they need to organize the distribution of discussion concepts, wording, and time management well (Prasetyo & Lenggono, 2024).

The assessment of students' project results was conducted by observing the learning process and students' activities during the project activities. This is supported by the researcher's observation which shows that students actively ask questions and are able to answer questions from friends and teachers. Based on teachers can provide appropriate assessments. In addition to grades, assessment is also given in the form of prizes, points for each group, and snacks, which makes students more active and spurs creativity in project activities. Furthermore, the final result assessment is tested in a daily test with genetic concepts to see students' abilities on this concepts can be seen in Figure 3.

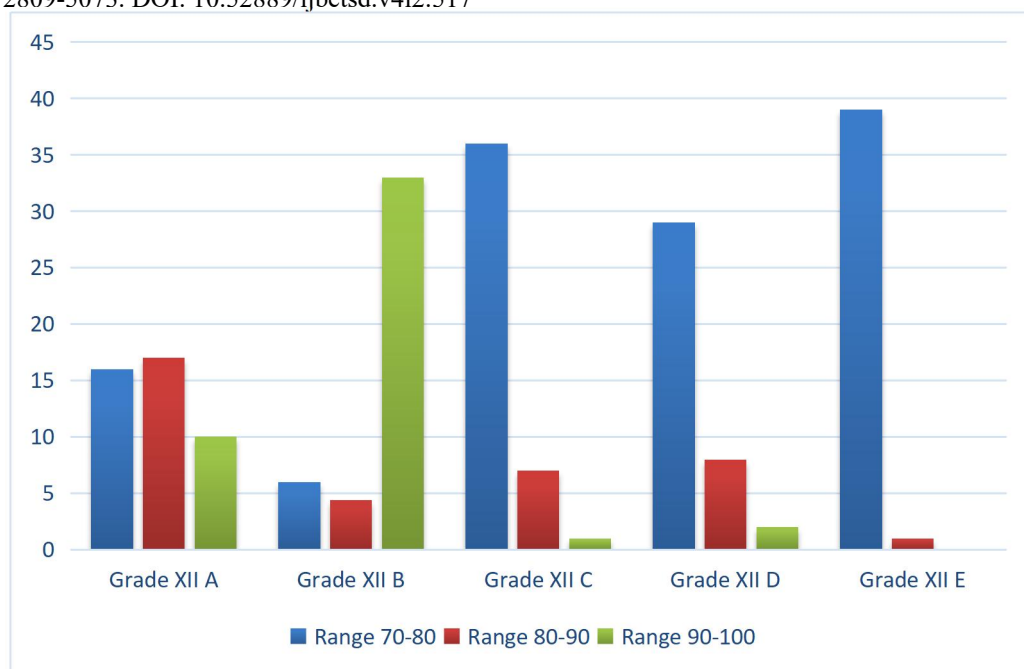


Figure 3. Average Daily Test Assessment

Based on Figure 3 presented, the highest average score was obtained by grade XII B, while the lowest average score was obtained by grade XII E. The improvement in student learning outcomes is reflected in the increasing number of students who achieved scores above 90, which can be attributed to the increased effectiveness of the learning methods applied. Projects carried out by students, such as making posters or learning media, provide meaningful learning experiences, because students are directly involved in the process, making it easier for them to remember and store the knowledge gained. However, learners who scored below 80 showed a lack of interaction with group mates during the learning process. During the evaluation test, they also tended to rush in solving the questions, which resulted in a lack of attention to the accuracy and correctness of the answers given.

According to Afsani *et al.* (2023), students need to be given the opportunity to learn independently and variedly, which allows interaction between individuals and can improve the learning process and results. Hopefully, learners are able to develop a deep mindset to produce a product. One of the learning models that can be applied to achieve this goal is Project Based Learning (PjBL). This is supported by the opinion of Aini *et al.* (2018) which states that the results of the implementation of project-based learning models affect student learning outcomes. The *Project Based Learning* (PjBL) learning model can make students more interested and confident in displaying or presenting products resulting from projects that have been assigned. The project-based learning model used increases students' interest in learning which can be seen from the students' attention that is centered on the ongoing learning process, resulting in an increase in learning outcomes. In addition, by using this

model the learning process will feel more meaningful, not only about memorizing information, but also can give a deep impression to students because learning feels more fun.

CONCLUSION

The project-based learning method has improved student learning outcomes, especially in class grade XII B, with more students scoring above 90. This improvement is attributed to students' active involvement in projects such as poster making, which provides meaningful learning experiences and helps them remember knowledge better. However, students with scores below 80 tended to interact less with the group and were less thorough during evaluation. Project-based learning also increased students' interest and confidence in presenting project results, making the learning process more enjoyable.

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