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The effect of project-based learning model assisted by interactive digital modules on scientific literacy in biotechnology topic in 9th grade of junior high school

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ABSTRACT

Low scientific literacy skills, teaching materials used in learning are not facilitated by students to understand science concepts and apply them in everyday life. The purpose of this study was to determine the effect of project-based learning (PjBL) model that help digital interactive modules on students' scientific literacy skills and students' responses to digital modules on the subject matter of biotechnology. The population in this study was 9th grade of junior high school at Bandar Lampung with sampling techniques, namely purposive sampling techniques, class IX-9 as an experimental class and class IX-8 as a control class. The results showed that there was a significant influence on the use of a PjBL model of digital interactive module assistance on scientific literacy skills between control classes and experiments on biotechnology subject matter in 9th grade Junior High School with a significance value of independent sample t test of 0,001. The results of student responses to the digital interactive module obtained an average proportion of 89% in the excellent category.



INTRODUCTION

Education in the 21st century is faced with increasingly severe challenges, one of which is that education is expected to be able to produce human resources who have intact abilities in facing various challenges in life. This is because education is the main base to contribute to all sectors by providing the necessary competencies both skills and knowledge (Aslamiah, 2021; Hujjatusnaini et al., 2022). The existence of these challenges encourages students to have the ability not only to pay attention to the field of study (core subjects), but also to emphasize life skills (life skills), learning skills (learning & thinking skills) and Information and Communication Technology (ICT) literacy (Damayanti et al., 2022; Ifthinan et al., 2019). One of the basic sciences that has a very important role in supporting science and technology is science learning (Nofiana & Julianto, 2018; Rustamova, 2020). Science is the science of natural objects and phenomena obtained from the thinking and research of scientists carried out with the skill of experimenting using scientific methods. The nature of science is the foundation for learning natural sciences (Widodo et al., 2019; Hatimah & Khery, 2023). This proves that science is one of the lessons that is related to science literacy.

The literacy needed by students in the 21st century is scientific literacy. Scientific literacy is one of the most important skills to pay attention to so that students are able to apply science appropriately (Jufrida et al., 2019; Mudawamah, 2020). Scientific literacy emphasizes how students can understand, communicate, and apply science skills. A person is called understanding science when involved in matters related to science and technology that require competence to explain phenomena scientifically, evaluate and design scientific investigations, and interpret data and evidence scientifically. In the context of science learning (IPA) students are not required to become a scientist, but students are expected to have the ability to engage with science-related issues, to identify questions, draw conclusions based on evidence in understanding and assisting decisions related to science and changes made through human activities.

In fact, the results of the Program for International Student Assessment (PISA) survey from 2001 to 2018 overall scientific literacy tends to be flat. The average PISA score in 2018 in all countries reached 500 points, while Indonesia only reached 396 which shows that Indonesia has a scientific literacy score that is far below the world average score (Syofyan & Amir, 2019).

The results of interviews with science teachers at one of junior high school in Bandar Lampung showed that scientific literacy was still relatively low. This is also evidenced in the results of pre-research at the school, students were given questionnaires containing aspects of scientific literacy and showed that 81,2% of students had low scientific literacy. The educator also added that during classroom learning students are less able to explain scientific phenomena, this is evidenced when students are unable to apply their scientific knowledge appropriately, especially in daily activities.

From these problems, science learning is needed that can improve students' science literacy. Project-based learning (PjBL) model is one of the things that affects the increase in science literacy in students (Ramdani, 2023). Students conduct an inquiry through questions or by applying the knowledge they have. PjBL can be used as an alternative learning model because in its implementation it has several advantages, including being able to increase student enthusiasm because students are always active, helping to create a conducive learning atmosphere (Avivi et al., 2023). The learning model is also inseparable from learning aids or supports to make learning activities more enjoyable, so that students become more motivated, one of which is the use of teaching materials. The need for appropriate teaching materials as an effort to improve students' science literacy through interesting teaching materials in the form of interactive digital modules. This is in accordance with the statement (Khamidah et al., 2019; Wilke et al., 2018) that the use of interactive digital teaching materials is in accordance with the 2013 Curriculum which requires teachers to use information and communication technology in learning. Modules are teaching materials that are arranged systematically and interestingly which include material content,

methods, and evaluations that can be used independently (Zulaiha, 2020). By using interactive digital modules as teaching materials, it will help students in learning, especially in training scientific literacy. This is relevant to research which states that the application of module-assisted PjBL has a greater opportunity to train scientific literacy of experimental class students compared to learning with lecture and discussion methods in control classes (Avivi et al., 2023).

One of the basic competencies in 9th grade requires students to be able to understand and apply the concept of biotechnology and its role in human life. Basic competencies in student skills are expected to make one of the conventional biotechnology products in the surrounding environment. The basic competencies used in this study are because this material is material whose objects can be studied in real and close to everyday life. Some kinds of products such as tempeh, soy sauce, yogurt, tape, and others can be made at home. However, students do not understand the concept and role of biotechnology itself.

METHODS

This research was carried out in one of the public junior high schools in Bandar Lampung. This research design uses a quasi-experimental design. The population used in this study was all ten classes of 9th grade. The sampling technique uses purposive sampling techniques with certain considerations (Yuliani & Banjarnahor, 2021). The sample of this study was in the form of class of IX-9 as an experimental class and class IX-8 as a control class.

The experimental class includes 6 project learning steps (Nilsook, 2021; Omar, 2018; Susanti et al., 2020), namely, 1) determination of fundamental questions; 2) designing project planning; 3) drawing up a schedule; 4) monitor learners and project progress; 5) test results; and 6) evaluate experience. Modules are used as teaching materials during learning that can be used as references as well as project guidelines. The project carried out is to make fermented yogurt. While in the control class using discussion and lecture methods using teaching materials using reading sources from school.

The data collection instrument uses a pre-test & post-test sheet consisting of 6 essay questions containing 3 aspects of competence from science literacy that have been tested for validity and reliability on the questions. Then, a student response questionnaire was used to determine student responses to the interactive digital module. The data analysis used in this study was descriptive statistical analysis, normality test, homogeneity test, hypothesis test, N-gain test, and student response questionnaire analysis using a scale of 1-5.

RESULTS AND DISCUSSION

The results of the research that have been carried out obtained results in the data normality test using Saphiro Wilk are normally distributed, namely $\text{sig} (0,269) > 0,05$ in the experimental class and in the control class $\text{sig} (0,110) > 0,05$ it can be concluded that H_0 for both classes is accepted. The homogeneity test using Levene obtained Sig data $(0,380) > 0,05$ on the pre-test value and obtained Sig data $(0,297) > 0,05$ on the post-test value, so it can be concluded that H_0 is accepted which means that the second variant of the class is homogeneous. Because the prerequisite test meets the criteria, namely normal and homogeneous data, it is continued with the hypothesis test, namely the independent sample t-test, obtained sig data (2 tailed) of $0,001 < 0,05$, meaning that H_1 is accepted so that it can be concluded that there is an influence of the PjBL model assisted by interactive digital modules on scientific literacy, this is supported by post-test average score data experimental class is 73,8 higher compared to the control class which is 49,4.

The average score of students on each scientific literacy indicator in the experimental class was higher than the control class presented in Figure 1.

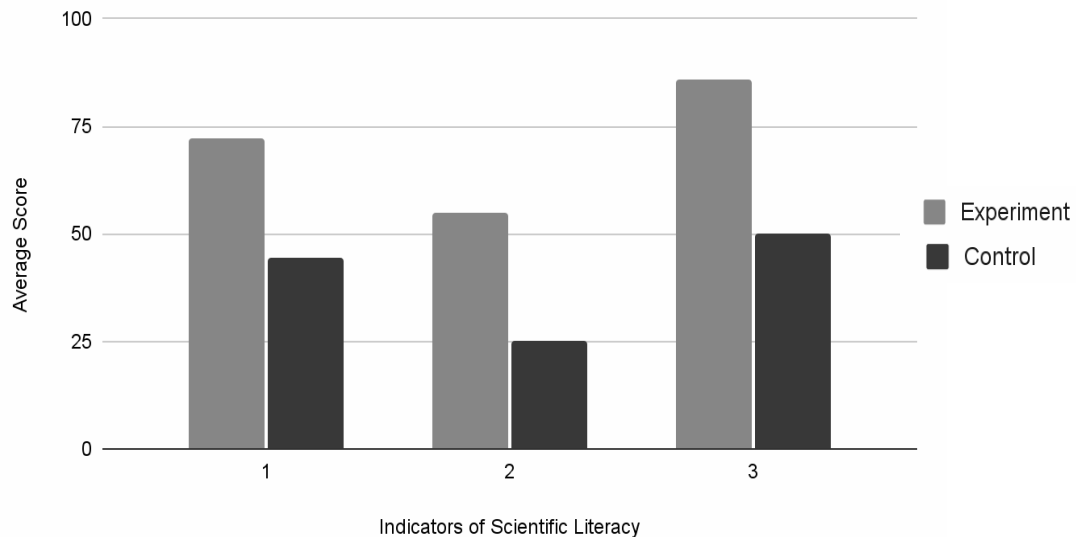


Figure 1 Average post-test result scores based on aspects of science literacy competence. Information: 1. Explain the phenomenon scientifically; 2. Evaluate and design scientific investigations; 3. Interpret scientific data and evidence

Based on Figure 1, experimental classes that use the interactive digital module-assisted PjBL model are able to have an influence on improving each indicator in scientific literacy because the interactive digital module-assisted project learning model causes students to be able to understand, apply, and combine the knowledge they already have. This is also helped when students read and understand interactive digital modules with concepts found in interactive digital modules.

There are four aspects of science literacy, namely context, content, process, and attitude. However, in this study, only focus on three indicators in the aspect of competence to measure scientific literacy, namely requiring learners to explain phenomena scientifically, evaluate and design scientific investigations, and interpret scientific data and evidence. These three indicators are important for students to practice science and key cognitive abilities such as inductive and deductive reasoning, system-based thinking, critical decision making, information transformation (for example making tables or graphs from raw data), and thinking in terms of models and the use of science (Widiana, 2020). This is also supported by research (Latip et al., 2022; Supriyadi et al., 2023) that in various studies on mapping aspects of science competence, various results were obtained which generally show that this science competence still needs improvement.

Figure 1 shows that students who obtain PjBL assisted by interactive digital modules in interpreting data and scientific evidence are higher than the other 2 indicators of science literacy competence. Students are quite capable in transforming data from one form of representation to another. In addition, learners are also able to interpret data and draw conclusions appropriately. This is proven by students who can apply their knowledge and experience by producing a yogurt product and presenting it in front of the class. The same thing is also done by students in making project reports in the form of videos, where students are able to present them very well and conclude the results of the projects that have been made. Learners engage in real-life problem-solving activities and engage students in inquiry. The involvement of students in this activity allows students to apply science concepts in real life so as to encourage students' scientific literacy to develop better than those who do not get project learning (Artaga, 2021; Melindayani, 2022).

The results of the percentage of student response questionnaires obtained are presented in Table 1.

Table 1. Results of student response questionnaire

No	Questionnaire indicator	Questionnaire items	Average	Category
1	Student responses related to learning activities	1, 3, 6, 9, 11, 15	88,8%	Excellent
2	Student responses regarding interest in using interactive digital modules	2, 4, 5, 7, 8, 10, 12, 13, 14	89,2%	Excellent
Average percentage			89%	Excellent

Based on this research, students' scientific literacy can be improved through PjBL assisted by interactive modules on biotechnology topics. Biotechnology is the science of using microorganisms or biological agents to produce technology or products that have benefits for human life. It is believed that the use of biotechnology can overcome the current food and energy crisis (Anggarkasih & Fatimah, 2022; Zimmerman et al., 2020). The biotechnology product created by students through this research is yogurt. Yoghurt is a product of fermented milk by *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. The combination of these two bacteria functions to convert lactose into lactic acid which can lower the pH to a lower level. In addition, this fermentation process causes the formation of lumps caused by the coagulation of milk proteins by acid, resulting in a distinctive taste. This is because yoghurt products contain flavor components such as diacetyl, acetaldehyde and carbon dioxide (Derler, 2019; Zimmerman et al., 2020).

Through PjBL, students can be contextually involved in the impact of science in everyday life. Scientific literacy in science learning is expected to be able to solve problems in real life in the future (Holle & Miller, 2021). Through scientific literacy, students have an important role in understanding scientific facts and the relationship between science, technology and society. Scientific literacy concerns all aspects of science such as knowledge, attitudes and competencies, as well as their context with life and advances in science and technology, so that the development of science learning which leads to mastery of scientific literacy will better equip students to have the ability to understand and skill science in the context of personal, local life, and global.

The PjBL provides opportunities for students to use their knowledge in creating products that are then presented (Almulla, 2020; Kang & Zhang, 2023). This is the first step in collecting and integrating new knowledge based on students' experiences in real activities (Avivi et al., 2023). Improvements in students' scientific literacy are also supported by interactive digital modules that contain guidelines during learning and scientific theories that are packaged attractively with audio-visual media that make it easier for students to work on their projects so that students are more independent and able to make the right conclusions. This is supported by the results of the questionnaire, student responses (Table 1) obtained a score of 89% with a very good category which shows that students are interested in interactive digital modules so that scientific literacy can increase. This can be proven in research that suggests that learning using digital modules can increase students' scientific literacy because students can be more independent and more active in participating in learning (Aulia et al., 2021; Dalaila et al., 2022; Suryanda et al., 2020).

The aspect of explaining the phenomenon scientifically in Figure 1 shows the lowest average score among 2 other aspects of literacy competence. Students who obtain PjBL learning assisted by interactive digital modules are quite capable of explaining phenomena scientifically. According to competence includes describing or interpreting phenomena, predicting change, and recognizing or identifying appropriate descriptions. Students are able to make predictions but have not been able to give the reason correctly. For example, in post-test questions that require students to make predictions and the right reasons for the results of yogurt making practicum

with different treatments, participants answer predictions correctly but have not been able to give the right reasons. This is due to the lack of interest of students to explore knowledge by finding new information and relating it to information that is already known from previous experiences, besides that it can also be caused by students not relating facts in the environment contextually to support problem solving in the learning process (Widiana, 2020).

CONCLUSION

Based on the results of research and discussion, it can be concluded that the PjBL model assisted by interactive digital modules has a significant effect on students' scientific literacy on biotechnology topic in 9th grade of junior high school.

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