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Students Science Literacy Differences Based on Gender Using Project Based Learning Model

Any Fatmawati[1*], Baiq Muli Harisanti[2], Titi Laily Hajiriah[2], I Wayan Karmana[2]

[1] Teacher's Profession Education, Postgraduate Programs and Professions, Universitas Pendidikan Mandalika, Mataram, Indonesia
[2] Biology Education, Faculty of Science, Engineering and Applied Sciences, Universitas Pendidikan Mandalika, Mataram, Indonesia

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Corresponding Author:
Any Fatmawati
anyfatmawati@undikma.ac.id

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Abstract: Science literacy has become one of the skills needed to prepare a young generation that is adaptive to the advances of science and technology in the 21st century. According to research by some experts, the literacy of science students in Indonesia is still low. The reason for the poor science literacy of students is that they are not activated continuously in the learning process. Therefore, there is a need for the application of innovative learning models, one of which is the project-based learning (PjBL) model. The PjBL model phase is useful to train students to be responsible for their own learning and develop their ability to think systematically. The gender of students, consisting of men and women, is important to note because it relates to several things, including thinking skills, decision-making, and the ability to draw conclusions. All these abilities are supportive factors of student science literacy, so it is necessary to conduct a study of differential science literacy by differentiating the gender of students. The research was conducted at SMAN 7 Mataram Nusa Tenggara West (NTB) with quasi-experiments. The subject of the study is class X students, consisting of 5 parallel classes, with a total number of 126 people (44 males and 82 females). The free variable in research is the PjBL model, and the bound variable is science literacy. Research instruments for science literacy use essay questions. The results of the study showed that the average science literacy of female students is 55.99; this figure is higher than the male literacy score of 53.03. Furthermore, the Anova test result shows that the significance value at the level of 5% is 0.62 ≥ 0.05, so it can be concluded that there is no significant difference in the literacy value of male and female science students after learning using the PjBL model.

Keywords: Gender; PjBL; Science literacy.

Introduction

Introduction Science literacy is the scientific ability to understand the characteristics of science, to understand how science and technology form the natural, intellectual, and cultural environment, to identify questions, acquire new knowledge, explain scientific phenomena, and draw factual conclusions (Illingworth et al., 2012; Mujahidin et al., 2023; Nilyani et al., 2023). Programme for International Student Assessment (PISA) assesses students' science literacy by using three indicators: (1) they can explain science phenomena; (2) they can design and evaluate scientific research; and (3) they can understand scientific evidence. Science literacy is defined as abilities and skills in four interrelated domains—the context, knowledge, competence, and attitude of science—determining science literacy (Adnan et al., 2021; Illingworth et al., 2012; Seprianto & Hasby, 2023).

PISA results show that Indonesian science students' literacy remained low until 2018. Therefore, to achieve better results, more intensive treatment and training are

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needed (Seprianto & Hasby, 2023; Tindani et al., 2021). The EFA (Education for All) goals, set by UNESCO (United Nations Educational, Scientific and Cultural Organization), emphasize the importance of science literacy. Good literacy will reduce problems and boost sustainable development, according to UNESCO (Ssempala, 2017).

Test of Science Literacy Skills (TOSLS) is a test that assesses skills in some key aspects of science literacy, such as the ability to organize, analyze, and interpret quantitative data and recognize and analyze research methods that produce scientific knowledge. Science literacy assessments include measurements of students' level of understanding of science knowledge and various aspects of its processes, as well as their ability to apply such knowledge and processes in real-world situations (Rahmawati et al., 2018) and scientific information (Zubaidah, 2016). Improvements are needed in innovative learning models such as the project-based learning model (PjBL) so that students have science literacy.

The project-based learning model (PjBL) organizes classes within the project (Rezeki et al., 2015). PjBL is student-centered learning, teacher-facilitator, and student-working in groups (Lou et al., 2017; Mujahidin et al., 2023). According to Monika et al., (2023), PjBL aims to help students become more self-sufficient in learning so that they can complete assigned tasks. However, teachers must train students in learning independence in order for them to get used to learning with PjBL (Astriani et al., 2023; Chintya et al., 2023; Nuri et al., 2023). Teachers should help guide students so that the learning process runs according to the course of learning. According to Kuo et al., (2019), project-based learning focuses on making products or artifacts through in-depth research processes on real-world subjects. PjBL focused on solving the real world, and inquiry learning focused on problem-solving skills, whereas PjBL focused on the creation of projects or products in building concepts.

The PjBL stage was developed by two experts the George Lucas Education Foundation and Dopplet. PjBL syntax (Harto et al., 2019; Rezeki et al., 2015) consists of: Phase 1: Start with an essential question; Phase 2: Design a project; Phase 3: Create a schedule; Phase 4: Monitor the students and progress of the project; Phase 5: Assess the outcome; and Phase 6: Evaluate the experience.

After the learning process is over, teachers and students reflect on the activities carried out and the results of the project. Reflection can be done individually or in groups. At this stage, students are asked to describe what they feel and experience while working on the project. Teachers and students talk about how to improve performance during the learning process. Eventually, new questions were found to solve problems raised at the first stage of learning.

So far, no research has studied plant growth and development material in high school using a PjBL model that considers the scientific linkages reviewed by gender. Therefore, the researchers believe it is important to conduct in-depth research on such variables.

The aim of this research is to explore the effectiveness of the Project-Based Learning (PjBL) model in teaching plant growth and development material in high schools, while considering scientifically structured linkages reviewed by gender. Thus, this study aims to identify differences in science literacy between male and female students in the context of learning this material.

Method

This study is experimental or quasi-experimental, which means that free variables are treated to see how they affect bound variables, although they cannot be strictly controlled. The experimental group and the control group are the two groups involved in this study (Creswell, 2012). This study uses a quasi-pre-test-posttest experimental design with a 2x2 factorial, as shown in Figure 2. Treatment consists of two types of learning called factors; a project-based learning model is a bound variable in this research. Science literacy is also a boundless variable. Details regarding this research can be seen in Figure 1.

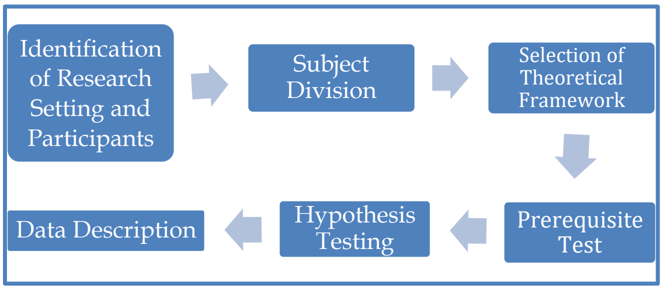

Figure 1. Image of research flow.

The research was conducted at SMAN 7 Mataram during the strange semester of the 2023–2024 academic year, which began in July 2023. Active students of IPS class X at SMAN 7 Mataram are the subject of this research. 126 students were divided into two groups: 44 males and 82 females.

For the assessment of science literacy in schools, this theoretical scale is more suitable (Mahardika et al., 2016; Zubaidah, 2016). Research can use this scale as one of the theoretical frameworks. Each scale consists of: 1) Illiteracy of science: students cannot answer basic questions about science. Students do not have the necessary concepts or contexts to identify questions as a scientific process. 2) Nominal science literacy: students are able to recognize concepts in the science of curiosity, but their understanding is limited. 3) Functional science literature: students can explain concepts well and correctly, but they are limited in their understanding. 4) Conceptual science literation: students may develop several relevant concepts, but their understanding is restricted. 5. Multidimensional science literacy: this term refers to literacy that includes an understanding of a discipline that goes beyond the concepts and procedures of scientific research. It covers the philosophical, historical, and social aspects of science and technology.

The study's prerequisite test was performed through a parametric statistical test, which included a test of normality and homogeneity of variants with a degree of significance of 0.05. The Kolmogorov-Smirnov test was used to check for normality, and the Levene test was used to check for homogeneity of the variants. These tests showed that the sample data group came from populations with similar variance (homogeneity). The data used for normality and homogeneity tests are taken from the student's initial and final test data.

Once the data is stated to be homogeneous and normal, the hypothesis test is carried out. Student science literacy data is described with descriptive and parametric statistical techniques. Averages and percentages of changes from the initial and final tests are included in descriptive statistical values. In addition, tied variable scores are displayed in tables and graphs. Anova's two-way test, with a 5% degree of significance, is used to analyze parametric statistics.

Result and Discussion

Research Result

Based on the data collected, the student's science literacy score is presented in Table 1. The total number of male students is 44, while the female student is 82. The average LS of the male student is 53.03, lower than the LS score of the women's group, which is 55.99.

Table 1. Data Description Science Literacy of High School Students 7 Mataram Based on Gender

Statistic	Male	Female
N	44	82
Mean	53.03	55.99
Median	58.33	58.33
Mode	58.33	50.00
Std. Deviation	1.46E1	13.69
Variance	213.47	187.38
Range	75.00	75.00
Minimum	10.00	16.67
Maximum	75.00	91.67

Furthermore, for the results of the normality test data, which can be seen in Figure 1, i.e., normality using Q-Q Plot, it is seen that the data is distributed normally. Similarly, the results of the homogeneity test can be found in Table 2. The homogenity test uses the Levene test. Based on the significance value at the level of 5%, which is 0.87 ≥ 0.05, it can be concluded that the data is homogenous.

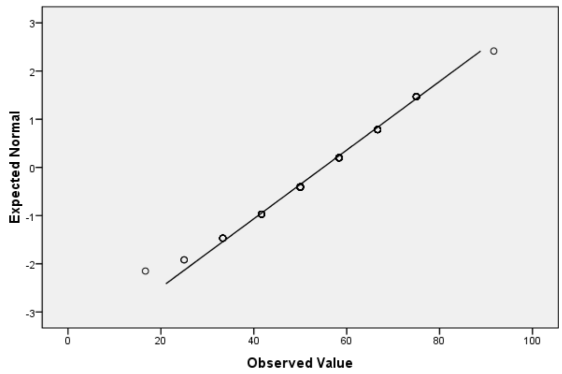

Figure 2. Q-Q Plot Data Literacy Science

Table 2. Students' Science Literacy Data Homogeneity Test

Levene Statistic	df1	df2	Sig.
0.03	1	124	0.87

The Anova one-way test results are presented in Table 1. The Anova test results can be seen from the significance value of 0.26≥0.05, so it can be concluded that there is no difference between the literacy scores of male and female science students.

Table 3. Anova One-way Test

Science Literation	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	251.98	1	251.98	1.28	0.26
Within Groups	24357.15	124	196.43		
Total	24609.14	125			

Discussion

Based on the data analysis results, there was no difference between male and female students literacy. This suggests that with the PjBL model, all students experienced the same improvement. Therefore, the pjBL is suitable for use in classes consisting of male and female students.

The PjBL model consists of the learning stages that lead students to their learning goals. Thus, students systematically absorb every piece of material taught by teachers, especially in terms of science literacy (Mujahidin et al., 2023). Nowadays, with very rapid technological advances, science literacy is vital to society. This is because the literacy of science relates to everyday life and work, including technology, equipment, and products that are used to facilitate human lives and work (Aini et al., 2023; Dahlia Yuliskurniawati et al., 2019). According to Zubaidah (2018), science helps humans become creative, rational, analytical, critical, and analytical. It also helps them acquire the ability to solve problems systematically and make decisions using a variety of reliable evidence-based information, all of which are required by both male and female students.

The project-based learning model (PjBL) organizes the classroom in the context of the project (Rezeki et al., 2015). The goal of PjBL is for students to become independent in their learning in order to complete the tasks they face (Maulidah et al., 2023); however, teachers must train students to get used to the learning model. Students at all levels of education should be assisted in completing the project. Teachers should help guide students so that the learning process runs in accordance with the learning course (Bacong & S, 2015). Project-based learning (PjBL) focuses on solving real-world problems and increasing students' attention and effort. According to Kuo et al., (2019), PjBL focused on creating products or artifacts using problem-based and question-based learning based on the depth of the driving question. PjBL and inquiry based learning (IBL) are related. Student-centric learning, teacher-facilitator, and group work are the main characteristics of PjBL (Lou et al., 2017).

At each stage of PjBL learning, the mind is set to always be active in following the instructions of teachers. Thus, students are accustomed to carrying out a project with the results desired by the teacher. As for the stage, the PjBL was developed by two experts: The George Lucas Education Foundation and Dopplet. PjBL syntax (Harto et al., 2019; Rezeki et al., 2015).

Phase 1: Start with essential questions. Learning begins with essential questions, which are questions that can give the student a task to perform an activity. These questions are structured around topics that are relevant to the real world and begin with in-depth research. Those questions must be difficult to answer and can encourage the student to create a project. Questions of this type are usually open, provocative, challenging, and require high-level thinking skills. They're also related to student life. Teachers strive to ensure that the materials taught are interesting to the students (Yanti et al., 2023).

Phase 2: Design project. According to Monika et al., (2023), learning begins with the essential question, that is, the question that assigns the student to perform an activity. These questions are structured around topics that match the real world and start with in-depth research, and they should be difficult to answer and encourage students to create projects. Questions of this type are usually open (divergence), provocative, challenging, and require extraordinary thinking skills, so the study of material has a connection to the student's real life (Fatmawati et al., 2023).

Phase 3: Create schedule. To complete the project, teachers and students work together. At this stage, the following tasks should be performed by the student: (1) make a schedule for the completion of a project; (2) specify a project end date; (3) encourage the student to make a new plan, (4) provide guidance when they make a plan that is not related to the project; and (5) ask the students to provide an explanation (reason) of how the time has been chosen. In order for teachers to track learning progress and complete projects outside the classroom, agreed-upon schedules must be agreed upon together. In this activity, everyone can plan for themselves and do all the schedules that are arranged (Nuri et al., 2023).

Phase 4: Monitoring the students and progress of the project. Through the project, teachers are responsible for monitoring students' activities. Monitoring is done by allowing students to participate in each process; in other words, teachers act as mentors for student activities. A section that can record all important activities was created to facilitate monitoring.

Phase 5: Assess the outcome. Assessment is used to help teachers measure the availability of standards of competence, evaluate the progress of each student, provide feedback on the level of understanding that students have already achieved, and help them create a better learning plan for their students.

Phase 6: Experience Evaluation. At the end of the learning process, teachers and students reflect on the activities and results of the projects that have been carried out. This reflection is done both individually and in groups. At this point, students were asked to describe what they felt and experienced when completing the project. To improve student performance during the learning process, teachers and students talk to each other. In the end, they discover new questions, or new discoveries, to solve problems that arise at the first stage of learning.

Both male and female students in some previous studies showed no differences, including critical thinking skills (Gladys Uzezi & Zainab, 2017; Rodzalan & Saat, 2015), creativity (Abraham et al., 2014; Baer & Kaufman, 2008), learning outcomes (Andayani et al., 2020; Hermawan et al., 2018), and representation skills (Dewi et al., 2017; Fatmawati et al., 2019; Fatmawati et al., 2022). It's also included in this study of science literacy. Thus, teachers should give equal attention to male and female students in every learning model so that the abilities of male and female students are equal.

Conclusion

The Anova test results showed that there was no significant difference between male and female science literacy scores, with a significance of 0.26≥0.05. However, the average science literature literacy of female students was 55.99, while the average male student literacy was 53.03.

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Author Contributions
Preparation of proposals, plans for using costs, A. F., B. M. H., and T. L. H.; Data collection and classroom teaching, H. H.; Data analysis, conceptual, preparation of research articles and reports, A. F., B. M. H., and T. L. H.; correction of data results and financial reports, B. M. H., and T. L. H.

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Conflicts of Interest
The authors declare that there is no conflict of interest regarding the publication of this paper.

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