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Project-based learning: Does it affect geographic literacy skills and learning outcomes?

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Abstract

This study aimed to determine the effect of project-based learning on student geographic literacy skills and to determine the effect of project-based learning on student learning outcomes. The research design was quasi-experimental, with a group pretest-posttest design. The research participants were students of the Health geography course in the Geography Education study program, at a State University. The data in this study were analyzed using a normality test, homogeneity test, and paired sample t-test. The results showed that project-based learning had a significant effect on student geographic literacy skills, and project-based learning had a significant effect on student learning outcomes. Implications of the study, a project-based model is recommended for learning in Health Geography courses to improve geographic literacy skills and learning outcomes. Further research is needed to examine the effect of project-based learning with other variables or integrated with web GIS connected to mobile learning media.

Keywords: Geography; learning outcomes; literacy skills; project-based learning.

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1. INTRODUCTION

Literacy abilities are one of the qualities that students must learn in the digital era. Literacy is an individual's ability to use potential and skills to process and understand information while reading and writing (Oktariani & Ekadiansyah, 2020). Literacy is considered a solution to improve the education quality in Indonesia. Prianto (2020) showed that a high literacy culture would increase the nation's development. Therefore, literacy campaigns in schools and universities are needed. Students with high grades must have complete and integrated competencies to improve literacy skills. However, in reality, students' literacy skills are still low (Novitasari, 2018; Prianto, 2020). The poor literacy levels of university students in Indonesia are caused by a culture of plagiarism. Ideally, students read activities to acquire knowledge that can support lectures or knowledge that is useful for life. The university is a meeting ground for intelligent individuals from diverse academic cultures, including the literacy culture (Gong & Ikrham, 2012).

Sari & Pujiono (2017), reported that the phenomena occurred because students completed tasks for grades at 60% and because students loved reading at 11%. Writing activities conducted for personal enjoyment contribute between 17% and 40%, while those performed to meet course requirements contribute between 25% and 42%. Meanwhile, 53% of students combine reading and writing activities. The data showed that most literacy culture among students is due to grades while reading for personal enjoyment has a very small percentage. The observations conducted on geography students at the State University of Padang, Indonesia, showed that student's geographic literacy skills are still relatively low. Only 20% of 64 students are proficient in understanding and applying Geographic Information Systems (GIS). The students' limited geographic literacy skills affect the low learning outcomes. Therefore, a solution is required to improve student's reading skills, thus improving the learning outcomes.

One of the solutions offered is project-based learning using GIS. Early learning agreements are needed to encourage students to read carefully, one of which is developing suitable products for literacy (Tjahjadarmawan, 2017). It demonstrated that teachers also play an essential role in increasing student literacy through geographic literacy projects. The lecture concluded with various geographic literacy projects created by students during the lecture process following the course materials and lecturer's instructions.

Project-based learning (PjBL) is a learning model used to gather and integrate new information based on experience in actual activities (Sumarmi, 2015). PjBL is student-centered and suitable to be applied in universities (Lou & Kim MacGregor, 2004). The advantages of PjBL are that students become used to solving complex problems, gain independence and self-confidence, develop a positive response to their environment, develop critical thinking and collaboration, become more active, interactive, and inspirational, and improve communication skills, planning, and organizing, information management, and project development (Parrado-Martínez & Sánchez-Andújar, 2020; Li et al., 2022). Problem organization activities, problem-solving analysis, and the preparation of geographic projects in PJBL require high geographic literacy. It is expected that students can complete geography projects with adequate literacy, as PJBL learning requires comprehensive learning facilities and resources. PjBL is suitable for university students as students at the highest level are required to implement literacy in several activities, including the conditioning of literacy-friendly physical environments; prioritization of the social and affective environment as a model for literate communication and interaction (Li et al., 2023; Rusdi et al., 2019; Gandolfi et al., 2024). Geographic literacy skills include media literacy, literacy maps, and geography knowledge (Utami & Zain 2018). Understanding geographic literacy requires basic

skills in calculating data, writing or drawing, and reading or interpreting maps. Therefore, geographic literacy skills are needed in learning Health Geography.

Health geography (medical geography) is a field of geography that applies spatial approaches to the research of health and disease distribution (Zain & Kuspriyanto, 2020; Brattig et al., 2024). Health geography uses concepts and techniques from geography to explain a phenomenon in the health area. One of the studies discussed in health geography is disease distribution. The Geographic Information System (GIS) is the most frequently used technique for analyzing the disease distribution or the level of disease exposure. According to Indriasih, (2008), GIS is used in the medical field to define the state of health, conduct epidemiological analyses, and manage health care. Health geography focuses on analyzing disease distribution and death on various geographical scales to assess the experience with the social or physical environment of some diseases due to various aspects (Boulos, 2002).

In this study, the implementation of the geographic literacy project aims at enhancing the reading, writing, and calculations of Dengue Hemorrhagic Fever (DHF) in the Health Geography course using GIS. DHF is one of the health problems caused by the dengue virus and spreads very quickly. The disease spread from the bites of the Aedes aegypti and Aedes albocpictus mosquitoes (Wahyuni, 2021). It is expected that the geographic approach using Geographic Information Systems can provide information about the spread of dengue fever through environmental parameters (Sekarrini et al., 2022b). The DFH vulnerability level was analyzed with several factors, including rainfall, temperature, altitude, slope, and land use. These factors are examples of uncertain objects. If the uncertainty is more significant, the resulting information becomes more incorrect or unrealistic, making the modeling unreliable due to the constraints of the given data.

One way to reduce uncertain projects is to substitute the fuzzy method for the scoring system previously used in GIS development. The use of fuzzy logic in GIS is based on the fact that when presented with a firm classification, various phenomena on the earth's surface are less representative (Adzan & Danoedoro, 2012) because the generalizations presented are excessive or inappropriate, so simple and more flexible generalizations are used, such as fuzzy methods. The fuzzy method enables the progress of student literacy to be tracked throughout the learning process. The advantage of using fuzzy logic is that the concept is simple to understand and very adaptable, as it is based on everyday language and set theory, which means that the mathematical concepts behind fuzzy reasoning are quite simple to understand (Kusumadewi, 2003). A fuzzy model is defined as a linguistic description (IF-THEN fuzzy rules) of processes that can be combined into a fuzzy system model. Fuzzy model applications can be found in artificial intelligence, computer science, control engineering, decision-making theory, expert systems, management science, research, robotics, and others (Setiadji & Fwa, 2009). The fuzzy model used in this study is the Mamdani fuzzy model. The Mamdani model is very precise in reflecting the situation in existing reality and is also the most commonly used model in fuzzy systems.

1.1. Purpose of study

This study aimed to determine the effect of project-based learning on students' geographic literacy skills in Health Geography, lectures and to determine the effect of project-based learning on student learning outcomes in Health geography lectures. Therefore, the research hypothesis is that project-based learning affects geographic literacy skills and learning outcomes.

2. MATERIALS AND METHODS

2.1. Participants

This study used a quasi-experimental design in a one-group pretest-posttest design. The design is described in the following table 1.

Table 1

One group pretest-posttest design

Pretest	Treatment	Posttest
O_1	X	O_2

Source: Sugiyono (2012)

Participants in this study were students of the Department of Geography Education, Padang State University. The research was carried out from January to May of the 2020/2021 academic year. The sample was determined using the purposive sampling method. The sample criteria are students taken Health geography courses, especially GIS, mapping, and introduction to geography courses. The geographic literacy-based project learning topic is Dengue Hemorrhagic Fever (DHF) spread using GIS media.

2.2. Data collection instruments

The research instrument used a geographic literacy questionnaire to obtain data on geographic literacy skills and an essay test for learning outcomes data. The geographic literacy questionnaire used a Likert scale of 1-5 based on geographic literacy skill indicators according to Utami & Zain (2018), namely (1) media literacy, (2) literacy map, and (3) geography knowledge. The assessment of geographic literacy skills is based on the distribution map of dengue fever in Padang City. Furthermore, 5 essay questions were included based on learning indicators in the health geography course. Data collection was carried out two times, before and after learning.

The literacy skill and learning outcomes instrument in this study has been tested for validity using the product-moment correlation technique (Walker, 2017). The test results showed that the instrument is valid with a validity value shown in the following tables 2 and 3.

Table 2

Validity test of geographic literacy

Indicator	R count	R table	Result
Media Literacy	0.636	0.5151	Valid
Literacy Map	0.854	0.5151	Valid
Geography Knowledge	0.811	0.5151	Valid

Table 3

Validity test of learning outcomes

Question	R count	R table	Result
1	0.585	0.5151	Valid
2	0.578	0.5151	Valid
3	0.650	0.5151	Valid
4	0.672	0.5151	Valid

5	0.645	0.5151	Valid

Furthermore, the instrument has also been tested for reliability using the Cronbach's alpha method (Adamson & Prion, 2013). The test results showed that the instrument is reliable with a significant value for geographic literacy skill 0.661 and learning outcomes 0.608.

2.3. Data collection procedure

The data collection methods used in this study were pretest and posttest before learning. Furthermore, project-based learning activities used the syntax from using GIS media as shown in Table 4.

Table 4

PjBL syntax in learning health geography

Syntax	Description
Project Selection	Students listen to the lecturer's explanation of the DHF distribution and then determine the observation location.
Preparation	Students write steps to determine DHF distribution.
Project Completion	Students conduct observations to determine the level of DHF distribution using GIS applications.
Report Preparation	Students calculate and interpret the resulting map of the level of DHF susceptibility to GIS applications.
Presentation	Students present reports, attend other groups' presentations, and share ideas critically about the projects that have been completed.
Evaluation	Students provide evaluations of project assignments to be used as a standard for the next project.

PjBL learning activities in the experimental class are carried out online. The learning process in the experimental class is described in Figure 1

2.4. Data analysis

The data were analyzed using normality and homogeneity tests as prerequisite examinations for statistical tests. Furthermore, the effect of PjBL learning on geographic literacy skills and learning outcomes was tested with a paired sample t-test. The statistical data analysis in this study was tested using IBM SPSS 23.0 for Windows. The hypothesis on the paired sample t-test is as follows.

H_{01}: there is no significant effect of PjBL learning on geographic literacy skills.

H_{a1}: there is a significant effect of PjBL learning on geographic literacy skills.

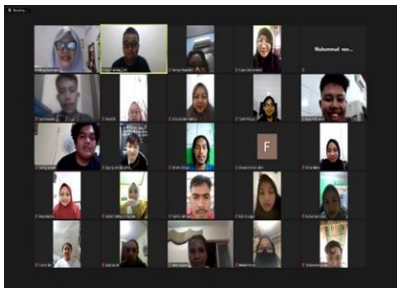
H_{02}: there is no significant effect of PjBL learning on student learning outcomes.

H_{a2}: there is a significant effect of PjBL learning on student learning outcomes.

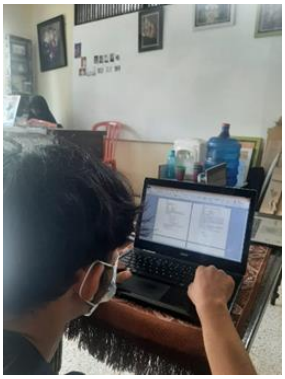
The hypothesis is carried out by comparing the probability value (*p-value*) of significance level α = 5%. If the probability value is $\geq \alpha$ then H0 is accepted, but if the probability value is $< \alpha$ then H0 is rejected (Sugiyono, 2012).

Figure 1

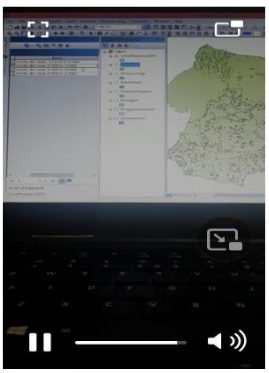
PjBL learning implementation process



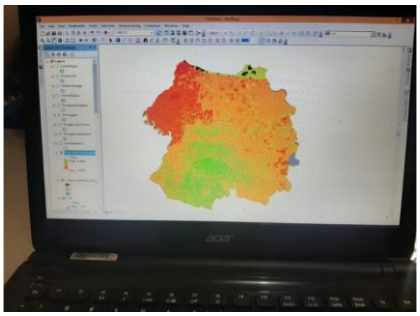
(a) Online project Selection



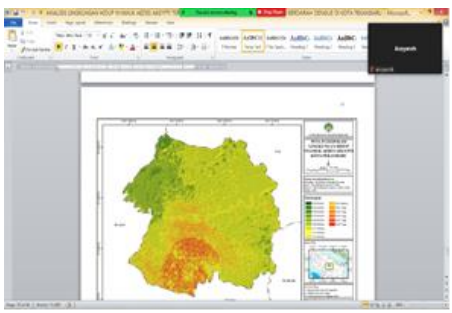
(b) Project planning



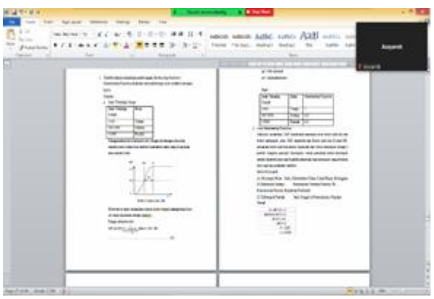
(c) Project completion



(d) Report preparation



(e) Presentation and evaluation



(f) Presentation and evaluation

3. RESULTS

3.1. The effect of PjBL on geographic literacy skills

The gain scores of students' geographic literacy ability before and after learning with PjBL are shown in Table 5, and the homogeneity results are shown in Table 6.

Table 5

Normality test results of geographic literacy skills

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Treatment	Statistic	df	Sig.	Statistic	df	Sig.
Geographic Literacy Skill	Pretest	.174	22	.083	.926	22	.101
	Posttest	.120	22	.200*	.953	22	.365

Table 5 shows that the normality test of geographic literacy ability using Shapiro-Wilk in the pretest has sig. 0.101, and the posttest has sig. 0.365. The pretest and posttest showed both values > 0.05, so it can be concluded that the pretest and posttest of literacy ability were normally distributed.

Table 6

Homogeneity test results of geographic literacy skills

Test of Homogeneity of Variances			
Geographic_Literacy_Skill			
Levene Statistic	df1	df2	Sig.
.682	1	42	.413

Table 6 shows that the sig. = 0.413 > 0.05, so the geographic literacy values were homogeneous.

Furthermore, a paired sample t-test analysis of geographic literacy skills data was carried out to determine the effect of PJBL learning on geographic literacy skills. The results can be seen in the following table 7.

Table 7

Paired sample t-test of geography literacy skills

Paired Samples Test									
		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig. (2-tailed)
Pair 1	Pretest - Posttest	-2.136	1.246	.266	-2.689	-1.584	-8.044	21	.000

The paired sample t-tests in Table 7 showed that the sig. = 0.000 < 0.05. This means that hypothesis H01 is rejected and Ha1 is accepted, so it can be concluded that there are differences in geographic literacy skills before and after PJBL learning. PJBL learning has a significant effect on increasing the student's geography literacy skills.

3.2. The Effect of PjBL on Learning Outcomes

The gain scores of student learning outcomes before and after learning with PjBL are shown in Table 8, and the homogeneity results are shown in Table 9.

Table 8

Normality test results of learning outcomes

Tests of Normality							
		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Treatment	Statistic	df	Sig.	Statistic	df	Sig.
Learning_Outcome	Pretest	.160	22	.150	.957	22	.425
	Posttest	.175	22	.080	.946	22	.260

Table 8 shows that the normality results of learning outcomes using Shapiro-Wilk in the pretest have sig. 0.425 and posttest have a sig. 0.260. The pretest and posttest showed both values > 0.05, so it can be concluded that the pretest and posttest learning outcomes were normally distributed.

Table 9

Homogeneity results of learning outcomes

Test of Homogeneity of Variances			
Learning_Outcome			
Levene Statistic	df1	df2	Sig.
.321	1	42	.574

Table 9 shows that the sig. = 0.574 > 0.05, so the learning outcomes values were homogeneous.

Furthermore, paired sample t-test analysis of learning outcomes data was carried out to determine the effect of PJBL learning on student learning outcomes. The paired sample t-test analysis can be seen in the following Table 7.

Table 10

Paired sample t-test learning outcomes

Paired Samples Test									
		Paired Differences					t	df	Sig. (2-tailed)
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper			
Pair 1	Pretest - Posttest	-16.136	6.349	1.354	-18.951	-13.321	-11.920	21	.000

The paired sample t-tests in Table 10 showed that the sig. = 0.000 < = 0.05. This means that hypothesis H02 is rejected and Ha2 is accepted, so it can be concluded that there are differences in learning outcomes before and after PjBL learning. PjBL learning has a significant effect on increasing student learning outcomes.

4. DISCUSSIONS

The results showed that learning health geography with PjBL helped to increase students' geographic literacy skills. Students can develop geographic literacy skills to build knowledge and understanding of geography and explore, discuss, analyze, and communicate geographic information, concepts, and ideas to make a map of dengue disease distribution (Sekarrini et al., 2022a). Geographic literacy not only understands the concept of geographic knowledge but is a systematic approach to a phenomenon that requires understanding, analytical skills, and synthesis in solving disease problems in their environment.

The learning steps in PjBL can encourage students' critical thinking skills in solving the spread of DHF. This critical thinking process improves students' geographic literacy skills (Aliman & Mutia 2021). It is supported by Utami & Zain (2018) who asserted that geographic literacy is a competency that enables the transformation of geographic knowledge into skills, as literacy processes include problem-solving, reasoning, and critical, and creative thinking. Geographic literacy is more than memorizing the names of places, rivers, mountains, and seas, but also the capacity of an individual to evaluate the surrounding environmental conditions. Geographic literacy also involves understanding the interaction between humans and the environment at various scales and its consequences (Agustina, 2019).

The increase in students' geographic literacy skills is also due to the ability to choose data, data processing, and data display for DHF distribution. It is based on the geographic literacy project-based learning processes required to complete the project and create the project outcomes. Laugksch, (2000) and Shannon et al., (2021) suggested that literacy development is critical because it improves social and economic life and decision-making abilities at the community and individual levels. It is supported by Fakhriyah et al. (2017) who asserted that literacy skills are needed for an individual to solve scientific problems and technological products to make decisions based on values and local environmental conditions.

Using geographic information system (GIS) media in PJBL learning could help in increasing students' geographic literacy skills. Students' understanding of media technology and ICT in GIS media is critical for analyzing the spread of DHF. PjBL learning supports students' geographic literacy skills. It is supported by Utami & Zain (2018) who asserted that the media helps students analyze geographic knowledge related to various issues in Indonesia, such as dengue fever diseases.

Using map media as final projects can help students to improve geographic literacy skills. Through map making, students can recognize the environment and explore map reading abilities. Students can explain in more detail using a map (Maxim, 2010). Therefore, the map product in the PjBL learning project can increase spatial literacy and foster students' geographic literacy skills (Maharani & Maryani 2015).

Improving geographic literacy skills aims to prepare students to become professional teacher candidates and better citizens in the global era (Bascom, 2011). It also contributes to the environment by understanding and protecting the environment from the spread of dengue fever diseases. Students are potential teachers to teach geographical concepts at school, thus geographic literature is vital for their career development (Dikmenli, 2014).

The results showed that PjBL learning affected increasing geography learning outcomes. It is supported by Sumirat et al., (2018) who asserted that students who receive learning using a geographic literacy-based learning model achieve higher learning outcomes than students with the conventional

learning model. Furthermore, the research results by Izati et al., (2018) concluded that the application of literacy-based project learning could improve learning activities and outcomes.

The application of project-based learning enables students to easily comprehend learning media and solve complex problems. The advantages of project-based learning are that students can create high-quality projects, develop critical thinking skills, solve complex problems independently, improve literacy skills, and increase participation, and project-based learning is practical, effective, efficient, and enjoyable. Students must develop, solve problems, make judgments, conduct investigative activities, and work independently with groups in project-based learning. Students who demonstrate a high level of enthusiasm will complete the stages of project-based learning, leading to optimal geography learning outcomes (Amanda et al., 2014). Students apply basic thinking skills and concepts to solve problems during the problem-solving process. This process can improve students' understanding of learning topics to achieve optimal learning outcomes.

This study found that project-based learning can increase motivation by involving students in the learning process and helping to strengthen current skills, mainly by making a map of dengue disease. Project-based learning is a systematic learning model involving students in learning complex knowledge and skills, authentic questions, and product and task design. Ngalimun et al., (2015) and Wijnia et al., (2024) also stated that project learning could increase motivation, problem-solving ability, collaboration, and resource management skills. In addition, suggested that project learning can stimulate motivation, process, and improve student learning achievement using problems related to certain materials in real situations. PjBL learning makes learning more meaningful since students construct knowledge through interactions with surroundings and information-seeking activities (Sumarmi et al., 2021). Through the correct steps, students' experiences will be more fully appreciated. Learning becomes more meaningful when the content taught is connected to the student's everyday lives (Sumarmi et al., 2020).

Students can improve cooperation skills through project learning because groups are created during the learning process to assist students in completing project tasks assigned by lecturers (Mayuni et al., 2019). Students can improve their attitudes toward problem-solving by participating in research activities in groups. While working on a project, each student can express ideas, seek information about the project, discuss with others, and compete to produce products different from other groups (Amanda & Tika, 2014). Project learning can encourage students to solve problems by offering a product using acquired ideas (Pasaribu & Simatupang, 2019). Students have a deeper understanding of the theory studied through the application process. It is supported by (Insyasiska et al., 2017) that the cognitive value of using project-based learning could increase since the students can apply the theory presented in the class.

5. CONCLUSION

The study results concluded that: 1) PjBL learning had a significant effect on geographic literacy skills, and 2) PjBL learning had a significant effect on student learning outcomes. The results showed a significant increase in geographic literacy skills and student learning outcomes at the significance level = 5%.

The research found that the PjBL model is recommended for learning in Health Geography lectures because it is proven to improve geographic literacy skills and learning outcomes. Recommendations for further research include conducting experimental research or classroom action research to determine

the effect or improvement of PjBL learning with other variables such as interest and motivation to learn on different materials. In addition, PjBL learning needs to be integrated with a web GIS connected to mobile learning media and carried out in a blended/Hybrid learning method.

Conflict of Interest: The authors declare no conflict of interest.

Ethical Approval: The study adheres to the ethical guidelines for conducting research.

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