Pak. j. life soc. Sci. (2025), 23(1): 2376-2394 E-ISSN: 2221-7630;P-ISSN: 1727-4915

Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

https://doi.org/10.57239/PJLSS-2025-23.1.00187

RESEARCH ARTICLE

The Influence of Learning Models Project Based Learning (PjBL) and Learning Styles on Geography Learning Outcomes in High School

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ARTICLE INFO

Received: Nov 18, 2024

Accepted: Jan 14, 2025

Keywords

Project Based Learning Model

Learning Style

Learning Outcomes

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ABSTRACT

This study aims to explain the influence of the PjBL learning model, learning styles, and the interaction of the PjBL learning model with learning styles on learning outcomes. To achieve this goal, the following hypotheses are formulated: (1) The PjBL learning model affects learning outcomes; (2) Learning styles affect learning outcomes; (3) The interaction of the PjBL learning model with learning styles affects learning outcomes. This study was conducted at SMA 1 Ngadiluwih Kediri in the 2023/2024 academic year. The subjects used were two classes with 34 students in each class. The instruments used in this study were a cognitive aspect learning outcome test and a learning style questionnaire. The test instrument was a multiple choice test comprising 20 questions with five answer choices and an essay test comprising 3 questions. An interview and observation would be conducted if the learning style questionnaire scored similarly. This study used a Quasi Experiment with a 2 x 3 factorial design. The results of the analysis using two-way ANOVA showed that (1) the PjBL learning model had an effect on learning outcomes, (2) learning styles had an effect on learning outcomes, and (3) there is no influence of the interaction between the PjBL learning model and learning styles on learning outcomes. This study found that the PjBL learning model can train students to express ideas better with factual and contextual investigations, eliminate selfishness, and be willing to accept other people's ideas or opinions. There are differences in learning outcomes for students with visual, auditory, and kinesthetic learning styles. Students with an auditory learning style get better learning outcomes than groups with visual and kinesthetic learning styles. It is recommended that teachers use a variety of evaluation methods, such as portfolio assessments, project reports, and presentations, to measure learning outcomes holistically. For further researchers, it is recommended that the PjBL model be integrated with thinking techniques such as SCAMPER and TRIZ to develop 21st-century skills, namely creative thinking, collaboration, and critical thinking.

INTRODUCTION

The need for critical, creative, and collaborative thinking skills is becoming increasingly urgent, especially in education. Conventional learning systems that are generally one-way are often

inadequate to facilitate the development of these competencies. Learning in high schools (SMA) plays an important role in forming the basis of students' knowledge and skills to face the challenges of the global world. One of the subjects that play a significant role in building students' insight into the environment, space, and human interaction with nature is Geography. Geography learning not only emphasizes theoretical knowledge but also critical, analytical thinking skills and problem-solving abilities that are very important for student's cognitive development (Tanjung, 2015).

The reality faced in Geography learning in various schools needs satisfactory results. Most students have difficulty understanding abstract concepts such as maps, natural phenomena, and social interactions taught in lecture format (Kasmiati et al., 2023). The traditional learning approach, which is still dominated by the teacher-centered learning method, results in students tending to be passive and only receiving information without sufficient opportunities to think critically or participate in meaningful learning experiences (Nyoman Sutama et al., 2014)(Schultz & Demers, 2020).

The model that is considered capable of increasing active participation and student learning outcomes is Project Based Learning (PjBL). PjBL is a student-centered learning model, where they are directly involved in completing projects that are relevant to the real world (Blumenfeld et al., 1991). Through this model, students are required to understand theory and apply it to solve concrete problems. This active involvement is expected to maximize the learning process to improve student learning outcomes (Susanti et al., 2019). PjBL is a learning model that uses projects in problem solving and student involvement independently through peer mediation to solve a problem (Siregar et al., 2024) (Larasati et al., 2022)(Purwaningsih et al., 2020).

Project Based Learning (PjBL) is a learning model that focuses learning activities on students by encouraging them to actively explore, analyze, and produce real products due to the learning process. PjBL allows students to develop practical skills that suit their real-life needs, including understanding complex Geography concepts. This is supported by research showing that project-based learning can improve geography skills and student's understanding of concepts and encourage them to learn independently and collaboratively (A. K. Putra et al., 2021)(A. Rose et al., 2023)(Larasati et al., 2022)(Z. A. Z. Putra et al., 2024).

The application of PjBL in learning activities according to (Rosenfeld, Sherman; Benhur, 2001)Consists of: (1) creating questions that will be used as projects, (2) choosing the main question or determining the project, (3) reading and searching for material relevant to the problem, (4) designing the problem, (5) designing/appropriate methods in solving the problem, (6) writing a project proposal, (7) implementing and creating task documents, (8) analyzing data and conclusions, (9) creating a final report, (10) presenting. Five shorter steps, according to (Sumarmi, 2012)These can be implemented by (1) determining the project theme, (2) determining the learning context, (3) planning activities, (4) processing activities, and (5) implementing activities to complete the project.

Buck Institute for Education (1999) states that Project Based Learning has the following characteristics: (a) students as decision-makers and create a framework, (b) there are problems whose solutions are not previously determined, (c) students as process designers to achieve results, (d) students are responsible for obtaining and managing the information collected, (e) conducting continuous evaluation, (f) students regularly review what they have done, (g) the final result is a product and its quality is evaluated, and (h) the class has an atmosphere that tolerates errors and changes (Sumarmi, 2012)

PjBL is a learning model with a research-based approach to weighty problems and questions that are real and relevant to life (Sumarmi, 2012). PjBL demands teamwork, using dynamic and complex issues, and conducting real experiences (Nation, 2008). The PjBL learning model encourages students to be more active, collaborative, independent, and creative in solving a problem (Pradana

et al., 2024)(Denuga & Nkengbeza, 2022). Students are motivated to work with teams to produce creative ideas, which are then realized in a product (Hartono & Asiyah, 2019) (Sumarmi et al., 2021).

Based on the opinion about the advantages of the PJBL learning model as described, implementing this model in learning will build social relationships between students, and students are mutually responsible for their learning outcomes individually and in groups. This makes researchers interested in testing the PJBL learning model to determine its influence on geography learning outcomes.

Many other factors influence learning outcomes. (Brandt, 1991) Stated that the learning model and student characteristics influence the learning outcomes obtained by students. Almost the same thing was conveyed by (Reigeluth, 1983)Who stated that the learning outcomes achieved by students are influenced by (1) the learning methods or strategies applied, (2) existing learning conditions, and (3) the interaction between methods and learning conditions. Student characteristics, quality, and learning processes are relevant to a person's learning outcomes. When applying an effective learning model, attention must be paid to student characteristics or conditions. One of the student characteristics that influence the application of the learning model is the student's learning style. (Azizah, 2022) Emphasized that adjusting the learning model to the student's learning style can improve achievement and behavior.

According to (Graf et al., 2007) (Slavin, 2012) (Ariastuti & Wahyudin, 2022) Educators have realized that students have different ways of acquiring knowledge. Some students can learn well only by doing it with others. Usually, they like the presentation of coherent information. They prefer to write down what they see from the activities carried out by the teacher. Visual students have different learning styles from auditory students. They rely on their ability to listen and take notes. They may talk a lot during learning and are easily distracted by sounds or noises. Students who have a kinesthetic learning style prioritize direct involvement in learning activities. They tend to be impulsive, self-willed, and impatient.

Three learning styles can be developed in students: visual, auditory, and kinesthetic. Each child has a different learning style from one another. Visual learning style is learning through seeing something. Students with a visual learning style like to see pictures or diagrams. They also like shows, demonstrations, or watching videos. The auditory learning style is learning through hearing something. Students with an auditory learning style like to listen to audio cassettes, lectures, discussions, debates, and verbal instructions (commands). Kinesthetic learning is a learning style that involves direct activity and involvement. Students with a kinesthetic learning style like to move, touch, and feel or experience themselves, easily remember what is done and not what is said and observed (C. Rose & Tracy, 1998)(Ora et al., 2018).

Learning models cannot facilitate learning for all students with different learning styles. Learning will be meaningful if it is well organized and adjusted to changes in student behavior as connoisseurs of learning conditions created by teachers. Teachers have a great responsibility to identify students' learning styles and are not the ones who bear the burden of adjusting the teacher's teaching style. Based on this, researchers use learning style variables in this trial. Researchers want to know the ability of the PjBL model to facilitate different student learning styles.

Specifically, students' visual, auditory, and kinesthetic learning styles may influence their participation in projects and understanding of the subject matter. For example, students with visual learning styles may be more helped by tasks that involve maps or diagrams. In contrast, kinesthetic students may be more comfortable with field observations or physical experiments. Therefore, this study aims to identify the relationship between learning styles and the effectiveness of PjBL in improving geography learning outcomes. This important aspect has been under-discussed in previous studies.

This study offers a new approach to measuring Geography students' learning outcomes, focusing on material mastery, critical thinking skills, problem-solving skills, and creativity. This more comprehensive assessment reflects the demands of the 21st-century education world, which emphasizes higher-order thinking skills as an indicator of learning success, not just content mastery (Munzenmaier & Rubin, 2013)(Fadhil et al., 2021).

One area that has not been widely explored in the literature is how PjBL models can be adapted to accommodate different learning styles of students flexibly. This research is expected to contribute to the development of a more inclusive PjBL, where all students, regardless of their learning style, can feel involved and get maximum benefits from the projects they work on (Van Zwanenberg et al., 2000).

This study also addresses teachers' practical challenges in implementing PjBL in Geography classrooms. Although PjBL is considered an ideal model for increasing student engagement, many teachers find it challenging to implement this method due to limited time, resources, and ability to adapt projects to suit individual student needs. Thus, this study also provides practical contributions through suggestions on how teachers can adapt projects designed for students' diverse learning styles so that they can be applied more widely in various school contexts.

This study's novelty lies in exploring the relationship between learning styles and PjBL in geography learning and developing a more comprehensive and adaptive evaluation approach to students' needs. Thus, this study offers a new perspective on implementing more personalized and effective PjBL and provides insight for teachers on the importance of paying attention to students' learning preferences in improving their learning outcomes.

METHOD

This study uses a quasi-experimental approach (an experiment that is not controlled). The design used in this study is the pretest-posttest Nonequivalent Control Group design using a 2 x 3 factorial (Sugiyono, 2011). The experimental design of the study is shown in table 1 below.

Table 1 2x3 factorial experimental design

Learning Styles (A)	PJBL Learning Model (P1)	Lecture and Discussion Learning (Conventional) (P2)
Visual (A1)	A1P1	A1P2
Auditory (A2)	A2P1	A2P2
Kinesthetic (A3)	A3P1	A3P2

Information:

A1P1 = group of visual style students are given the PJBL model

A2P1 = group of students with an auditory style are given the PJBL model

A3P1 = group of students with kinesthetic style are given PJBL model

A1P2 = group of visual style students are given conventional models

A2P2 = group of auditory style students given conventional model

A3P2 = group of students with kinesthetic style are given conventional model

Based on the research design, two groups of research subjects were determined with relatively homogeneous research subjects regarding ability, learning time, number of subjects, and the same teaching teachers. This research was conducted at SMA 1 Ngadiluwih Kediri in the 2023/2024 academic year. The research subjects were two classes based on the regular class criteria, with 34

students each. Semester 1 report card scores for the Geography subject were collected, then two classes were selected with the same or close average report card scores. From the average report card scores for the Geography subject in semester 1, classes X-2 and X-4 were determined as research subjects because they had the same average report card score, namely 78.2. Class X-4 was chosen as an experimental class with PjBL learning models, and class X-2 as a control class with lecture and discussion learning.

Research instruments are tools used to measure research variables. This study used two types of instruments: cognitive aspect learning outcome tests and learning style questionnaires.

Test instruments

The test instrument is a multiple-choice test consisting of 20 questions with five answer choices and an essay test with three questions. Multiple-choice questions are scored by giving a weight of 1 to each correct answer and 0 to each wrong answer. Thus, each subject will get a maximum score of 20 and a minimum of 0. Each question has the same score in essay questions because it has the same difficulty level. Essay questions are scored a maximum of 4 according to the established criteria (according to the answer key) and are given a score of 0 if not filled in. Thus, each subject will get a maximum score of 12 and a minimum of 0. The validity test results by comparing the Pearson product-moment correlation index with a value of 0.3 at a real level of 5% indicate that 20 multiple-choice questions and three essay questions are considered Valid.

Test reliability shows consistency in measuring a person's ability. A test is considered reliable (has a high level of confidence) if it can provide consistent results or if there is an inconspicuous change (Purwanto, 2009).

The test criteria, according to (Arikunto, 2021)Are:

0.80-1.00 = very high

0.60-0.79 = high

0.40-0.59 = sufficient

0.20-0.399 = low

0.00-0.199 = very low

Testing the reliability of the test instrument using the reliability coefficient with the Alpha Cronbach formula. The calculation uses SPSS 16 for Windows. The results of the reliability test with Alpha Cronbach show that 20 multiple-choice questions and three essay questions are said to be reliable.

Difficulty Level

The difficulty level describes whether a question is too difficult or too easy. Questions that are too difficult are questions that almost all students cannot do, and questions that are too easy are questions that all students can do. According to (Arikunto, 2021)"a good question is neither too easy nor too difficult." Meanwhile (Purwanto, 2009)says, "A good test has a difficulty level of between 40% and 60% for standard tests and between 25% and 70% for teacher-made tests." For this reason, the test questions that will be used are first analyzed for their difficulty level. The results of calculating the difficulty level of test items show that 20 multiple-choice and 3 essay questions have a moderate or reasonable difficulty level.

Learning Style Questionnaire

The questionnaire is used to determine the learning style possessed by participants in carrying out learning activities. The learning style questionnaire consists of three parts. Part 1 contains questions related to visuals; part 2 consists of questions related to auditory, and part 3 includes questions

pertaining to kinesthetics. Each part has 12 questions with measurements: if answered, often score two, sometimes score one, and rarely score zero. Each part's total score is added to the maximum score of 24. The highest score from each part (1,2 and 3) indicates the student's dominant learning style. Interviews and observations will be carried out if the same score is found.

Data analysis

The collected data were analyzed using two-way ANOVA analysis. Statistical analysis was assisted by SPSS 16 for Windows software, performed at a significance level of 0.05 ($p<0.05$).

RESULTS

The results of the analysis show (1) the use of the PJBL model (X1) has an effect on learning outcomes (Y), (2) learning styles (X2) have an effect on learning outcomes (Y), and (3) there is no interaction between the independent variables and the moderator variables on the dependent variable. The results of the analysis can be seen in the following table.

Table 2 Results of gain score analysis

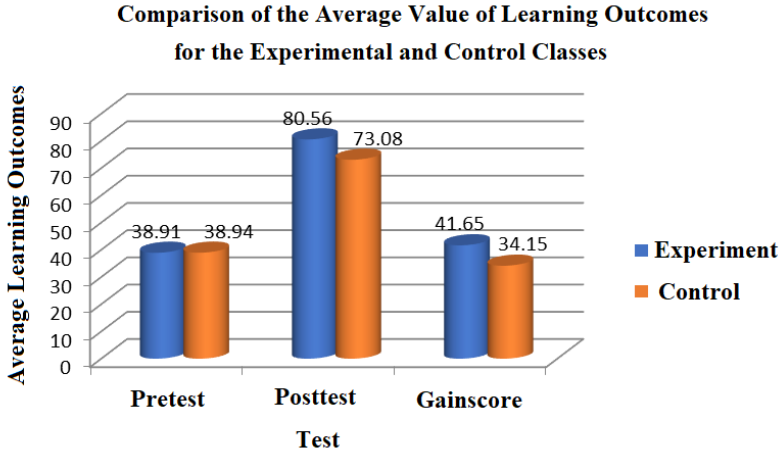
Variant Source	Sum of Square	df	Mean Square	F	Sig.
X1	884,177	1	884,177	31,446	,000
X2	386,343	2	193,171	6,870	,002
X1.X2 Interaction	76,476	2	38,238	1,360	,264

Student Learning Outcomes in Experimental and Control Classes

Student learning outcome data includes the average pre-test, post-test, and gain score. The average initial ability score of students in the experimental class was 38.91, and the control class was 38.94. The data shows that the average pre-test scores for the control and experimental classes are relatively similar. The average post-test score in the experimental class was 80.55, and the control class was 73.08. The data shows that the average post-test score for the control class was lower than that of the experimental class.

The average gain score on the measurement with the experimental class test was 41.64, and the control class score was 34.14. The data shows that the average score of the Geography learning outcomes of the experimental class is higher than that of the control class.

Graph 1 below visualizes the comparison of the average values of initial ability (pre-test), final ability (post-test), and learning outcomes (gain score) using tests between the control class and the experimental class.



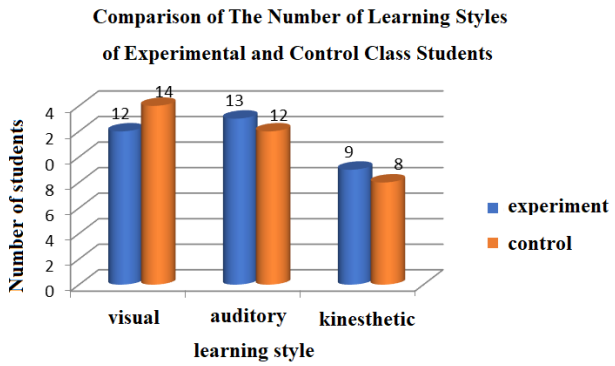
Graph 1. Comparison of average learning outcomes of the experimental class and control

Student Learning Styles

The learning style questionnaire is used to determine the learning style possessed by students. The learning style questionnaire consists of three parts. Part 1 contains questions related to visuals; part 2 consists of questions related to auditory, and part 3 includes kinesthetics. Each part has 12 questions with measurements: if answered, often score two, sometimes score one, and rarely score zero. Each part's total score is added to the maximum score of 24. The highest score from each part (1,2 and 3) indicates the student's dominant learning style.

In this study, 12 students in the experimental class had a visual learning style, 13 had an auditory learning style, and 9 had a kinesthetic learning style. Meanwhile, 14 students in the control class had a visual learning style, 12 had an auditory learning style, and 8 had a kinesthetic learning style.

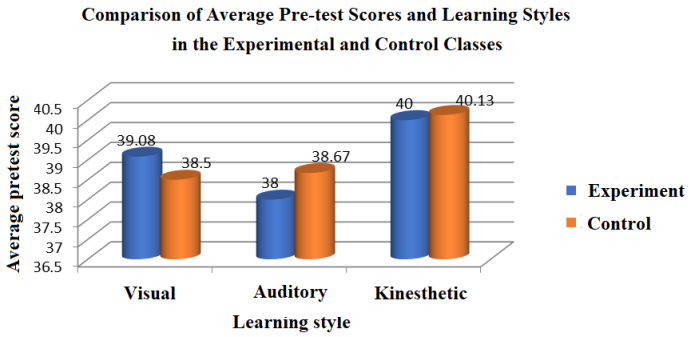
The following graph 2 visualizes the comparison of learning styles possessed by students in the experimental and control classes using a learning style questionnaire.



Graph 2. Comparison of the number of learning styles of experimental and control class students

Based on graph 2, the experimental class has the largest number of students with an auditory learning style and the fewest with a kinesthetic learning style. Meanwhile, the control class has the most significant number of students with a visual learning style and the fewest with a kinesthetic learning style.

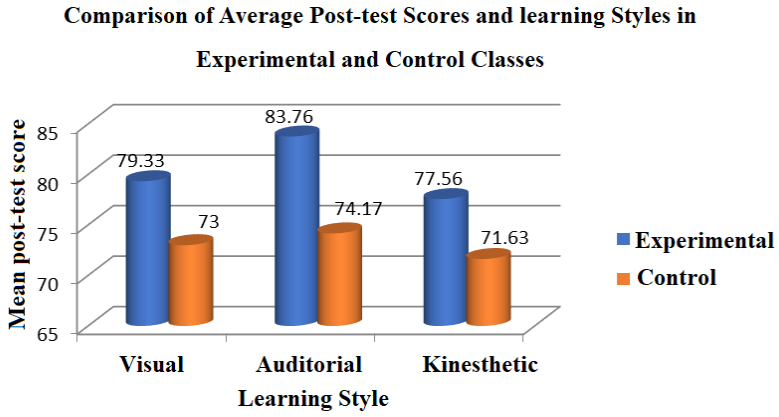
The average pre-test score in the experimental class of students with visual learning styles was 39.08, auditory was 38, and kinesthetic was 40. In the control class, the average pre-test score of students with visual learning styles was 38.5, auditory was 38.67, and kinesthetic was 40.13. The comparison of the average pre-test score and learning styles of students between the experimental class and control classes can be visualized in the following Graph 3.



Graph 3 Comparison of average pre-test scores and learning styles in the experimental and control classes

Based on Graph 3, the experimental class had the highest average pre-test score in the kinesthetic learning style and the lowest in the auditory learning style. In contrast, in the control class, the highest average pre-test score was in the kinesthetic learning style and the lowest in the visual learning style.

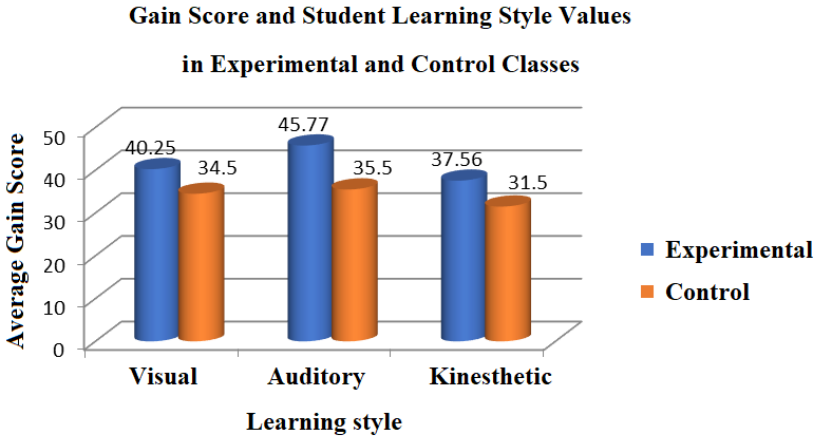
The average post-test score in the experimental class of students with visual learning styles was 79.33, auditory was 83.77, and kinesthetic was 77.55. In the control class, the average post-test score of students with visual learning styles was 73, auditory was 74.17, and kinesthetic was 71.63. The following graph 4 visualizes the comparison of the average post-test score and learning styles of students between the experimental class and control classes.



Graph 4 Comparison of average post-test scores and learning styles in the experimental and control classes.

Graph 4 shows that in the experimental class, the highest average post-test score was in the auditory learning style and the lowest in the kinesthetic learning style. While in the control class, the average post-test score was almost the same for each student's learning style.

The average gain score in the experimental class of students with visual learning styles was 40.25, auditory was 45.77, and kinesthetic was 37.56. In the control class, the average gain score of students with visual learning styles was 34.5, auditory was 35.5, and kinesthetic was 31.5. The comparison of students' average gain scores and learning styles between the experimental and control classes can be visualized in Graph 5.



Graph 5 Comparison of average gain score and learning style values in experimental and control classes

Based on Graph 5, the average gain score in the experimental class is highest in the auditory learning style and lowest in the kinesthetic learning style. In the control class, the average gain score is almost the same in the visual and auditory learning styles and the lowest in the kinesthetic learning style.

DISCUSSION

The Influence of the PJBL Learning Model on Geography Learning Outcomes

The two-way ANOVA data analysis showed that the PJBL learning model significantly affected Geography learning outcomes. The analysis results for the test showed that the F value = 31.446 and sig.0.000, so $p < 0.05$. There was a difference in the mean of Geography learning outcomes between the experimental and control classes. It can be decided in this experiment that Ho is rejected and Hi is accepted as the result of the study. This means that the PJBL learning model affects students' Geography learning outcomes.

Based on the results of the analysis, it can be seen that there are differences in the learning outcomes of students who learn using the PJBL model and using discussions and lectures. The learning outcomes of students using the PJBL model are higher than those with discussion and lecture learning. This can happen because students are more enthusiastic about the PJBL learning model. This model can train students to express ideas better, eliminate selfishness, dominate groups, and encourage students to accept other people's ideas or opinions and use them that are considered better. In addition, the PJBL learning model can foster an attitude of competing between groups to encourage students to master the material in depth.

The PJBL model creates learning that invites students to interact with each other and actively exchange knowledge in groups. Students learn together, contribute ideas, and are responsible for achieving learning outcomes both individually and in groups. Each group member is responsible for learning what the teacher assigns and must help their group mates learn. This can create a conducive atmosphere for students so that there is a significant difference between the pre-test and post-test scores.

The learning outcomes of students treated with the PJBL model are higher and proven to be better than those of students who use the lecture-discussion model. This is because the student group in the PJBL model has members with different abilities who collaborate. Students with low abilities will benefit from interacting with their friends with higher abilities. Meanwhile, students with higher abilities will master their information or knowledge by explaining information to students with low abilities. "The interaction between learners with low and high academics in the context of peer teaching, it is believed that learning outcomes in the classroom, in general, will increase." (Ramdani et al., 2022).

To facilitate this activity, the teacher begins by briefly explaining the phenomenon of environmental damage relevant to the project through pictures and YouTube videos that trigger students' curiosity. The information provided is in the form of phenomena relevant to everyday life so that students can relate to personal experiences. The teacher divides students into small groups to explain their observation findings. In groups, students can exchange ideas about issues they know about and potential essential questions they can ask(Buroidah et al., 2023).

The second stage is designing a project plan. After asking essential questions in the previous stage, students are directed to identify the main problems they will solve through the project. This involves group discussions to agree on the main focus of the project. Students begin to design a research framework based on the theories that have been studied. This includes preparing research objectives, problem formulation, and research steps that will be carried out. Students are encouraged to think creatively, design innovative solutions, and solve complex problems. (Blumenfeld et al., 1991) (Bell,

2010). Project planning activities train students to generate a large number of ideas, as well as develop the ability to solve problems with a variety of different solutions (Listiqowati et al., 2022).

Students evaluate various research methods that they can use to collect data; these methods can be surveys, experiments, interviews, and observations appropriate to the project context. By completing this stage, students have a structured and in-depth plan for their project and have developed critical thinking skills, creativity, and research abilities that will be useful in subsequent stages (Krajcik et al., 2005). The problems chosen by each group are different, so students can learn from the experiences of other groups and gain broader knowledge (Halek et al., 2021).

The third stage is compiling a project work schedule. This stage encourages students to think metacognitively by planning, organizing, and monitoring their project tasks to achieve the expected goals. The description of the activities at this stage begins with students breaking down their projects into smaller and more specific steps or tasks. Each step needs to be identified to ensure that all aspects of the project are handled thoroughly. After identifying the project steps, students create a realistic schedule for each step. They set deadlines for each task and ensure that the sequence of activities is logical and well-managed (Efendi et al., 2020)(Ariani Wirahayu et al., 2022).

Developing a detailed project work schedule is an important step that not only improves project management skills but also supports the development of student's creative thinking skills (Lechler, T. G., & Dvir, 2010). By managing time resources and monitoring progress, students learn to think systematically and flexibly in dealing with various challenges that arise during the project process (Mumford & Gustafson, 1988). They are required to plan strategic steps, adapt to change, and explore alternative solutions if obstacles occur. This ability trains students to think creatively in a structured way, where they need to combine analytical and exploratory thinking to achieve optimal results (Turner, J. R., & Müller, 2005). The time and resource management skills developed from this schedule preparation also prepare students to face future projects, where innovation and efficiency will be the keys to success (Ariani Wirahayu et al., 2022).

The fourth stage is monitoring students and project progress. At this stage, students continue the investigation and investigation activities planned in the previous stage. They collect empirical data relevant to the problems they are solving in the project. Students document the data collected systematically through field notes, photos, or videos. This documentation is essential to facilitate data analysis and report preparation later.

During and after data collection, students use their imagination to develop new ideas or alternative approaches that they may not have considered before. This creativity helps in finding more effective and innovative solutions (Blumenfeld et al., 1991)If students find that the data they have collected is inadequate or that the collection methods are error-prone, they make necessary adjustments and may collect additional data.

The fifth stage in monitoring students and the project's progress is crucial to ensure that students remain on the right track in the inquiry process. Such a structured approach helps students organize their thinking and opens up space for developing creativity and innovative solutions. The teacher plays an active role in providing guidance and constructive feedback, as well as providing opportunities for further consultation, which helps students overcome challenges that may be encountered during the project (Bell, 2010).

Project work monitoring activities provide students with the opportunity to report on the progress of their projects. The teacher gives project work reports feedback. Students also create products based on the results of the project. Making products requires students to think creatively and constructively. This is in line with (Efendi et al., 2020), which states that in project activities, students become creative and constructive through various projects and create work from their project assignments.

The sixth stage is the assessment of results. At this stage, students present the results of their project work in the form of artifacts, which are the final products of their projects. This stage encourages students to use their imagination and creativity to the maximum in producing valuable work (Kolodner et al., 2003).

Students begin by creating an artifact, a compost product, to address the problem of soil degradation. They combine all the elements they have learned and the data they have collected to create a final product that reflects their research and innovation.

Students use their imagination to design products that are not only functional but also visually appealing. In making compost, students develop new methods or additional materials that improve fertilizer quality. Creativity in choosing materials or manufacturing techniques is vital to producing better products.

Students prepare presentations in which they demonstrate the products they have created. They explain the process of making them and the challenges they faced. Students might demonstrate how to use products such as compost and explain its benefits. They show the product's results, such as fertilizer's effect on plant growth. Other students provide feedback on the presented artifacts, which helps improve the final product. This process also trains students to give and receive constructive criticism (Larmer & Mergendoller, 2010). The focus is on continuous skill development and improving the quality of the work (Holm, 2011).

This stage is critical because it marks the culmination of all the efforts made by students during the project. The presentation of the artifact not only shows the result of their hard work and ability to apply the knowledge and skills they have learned. The assessment provided a clear picture of the success of the project and areas for improvement (Barron & Chen, 2008)(Kolodner et al., 2003).

The seventh stage is the evaluation of experience. Students are directed to reflect and organize the knowledge they have gained during the project into more profound and meaningful concepts. They also summarize important concepts learned to strengthen understanding and make the knowledge more meaningful and applicable. Students identify the main lessons they have learned during the project. This includes new skills learned, knowledge gained, and challenges faced and how they overcame them (Sumarmi et al., 2021).

Students integrate the new knowledge they have acquired with their prior knowledge. This process helps students form a more holistic and contextual understanding. Students use critical and creative thinking to evaluate the relevance and validity of the knowledge they have learned. They consider how this knowledge can be applied beyond the project, as well as how it enriches their overall understanding (Abas et al., 2024)(Maknuunah et al., 2023). Students formulate a follow-up plan based on what they have learned. This could include ideas for future projects, applications of newly acquired knowledge, or improvements that need to be made in their learning approach.

This experiential evaluation stage is a crucial part of learning because it helps students organize the knowledge they have gained into something more meaningful and applicable. It also allows them to reflect on their overall learning process, increase self-awareness, and develop strategies for future learning (Kokotsaki et al., 2016).

This learning model encourages students to participate actively during the learning activities. In addition, the PJBL learning model can train students to express ideas better with factual and contextual investigations that can eliminate selfishness in dominant groups and be willing to accept other people's ideas or opinions. This is in line with previous research on online project-based learning systems, which shows that the ability of students to adapt to the existing learning environment is very important. Students' ability to regulate themselves is very much needed in online learning. Students who are independent learners with metacognitive skills will be able to take

advantage of greater flexibility and control in online project-based learning. Meanwhile, students who do not have good metacognitive and self-regulation skills have lower learning outcomes. (Widodo et al., 2023)

In addition, PjBL emphasizes the importance of teamwork. Students must collaborate with their peers to complete the project. This group work process allows students to develop critical social skills, such as communicating effectively, resolving conflicts, and sharing ideas with teammates. These collaboration skills are essential in Geography learning, especially when students are involved in field surveys or geographic data analysis activities.

Through collaboration in PjBL projects, students can share different perspectives and experiences, which enriches their learning. Each student can contribute uniquely according to their learning style and interests, ultimately improving the project's quality. In this case, PjBL not only enhances individual learning outcomes but also builds social skills that are important for lifelong learning (Rahayu et al., 2022)(Wibowo et al., 2024).

The Influence of Learning Styles on Geography Learning Outcomes

The results of data analysis using two-way ANOVA show that learning styles significantly affect student learning outcomes. The analysis results for the test indicate this: the F value is known = 6.870 and sig. 0.002, so $p < 0.05$. It can be decided in this experiment that Ho is rejected and Hi is accepted as the result of the study. This means that learning styles affect students' Geography learning outcomes.

Learning styles influence learning outcomes because 1) every student has a different way of learning, and 2) the PJBL learning model in its stages can facilitate students with visual, auditory, and kinesthetic learning styles.

Students' learning styles can increase their motivation because they are by their preferred way of learning, which affects learning outcomes. Students with a visual learning style will find getting information through the eyes easier. Students with an auditory learning style find it easier to get information through sound. Students with a kinesthetic learning style find it easier to get information through physical movement.

The PJBL learning model, in its stages, can facilitate students with visual, auditory, and kinesthetic learning styles. The stage of presenting the material facilitates students with a visual learning style because, at this stage, students get a material presentation from the teacher with exciting video media. In addition, this presentation also really focuses on the PJBL unit. So that students pay full attention during class presentations. Students take notes on the materials presented to help them work on their projects. This is due to the characteristics of a visual learning style.

The characteristics of visual learning styles put forward by DePorter are as follows: 1) orderly, paying attention to everything, maintaining appearance; 2) remembering with pictures, preferring to read rather than being read to; and 3) requiring a comprehensive picture and purpose and capturing in detail what is seen (DePorter, 2000).

At the team/group work stage, all three student learning styles can be facilitated. After the activity sheets are distributed, students work together as a team. When they are making essential questions, they are responsible for making the answers as a group. When students solve problems individually, they will think about the answers to the questions, thus fostering an independent attitude; students play an active role in the learning process. Students at this stage read more books in thinking about the answers to questions on the activity sheets. This activity facilitates a visual learning style. When they cannot answer, they will ask their teammates. This stage involves dialogue or discussion to explain and match the answers. This activity facilitates the auditory learning style.

The characteristics of people who have an auditory learning style, as stated by Deporter, are as follows: 1) attention is easily divided; 2) speaking in a rhythmic pattern; 3) learning by listening, moving lips, or making sounds when reading, and 4) having internal and external dialogues (DePorter, 2000). Meanwhile, students with a kinesthetic learning style are also indirectly facilitated as they take turns observing the problems of the geosphere environment and the process of project activities. This is by the characteristics of the kinesthetic learning style according to DePorter as follows: 1) touching people and standing close together, moving a lot; 2) learning by doing, pointing to writing while reading, responding physically, and 3) remembering while walking or seeing (DePorter, 2000).

There are differences in the geography learning outcomes of students with visual, auditory, and kinesthetic learning styles. Students with an auditory learning style get better learning outcomes than groups with visual and kinesthetic learning styles. Thus, students with an auditory learning style prefer the PjBL model to understand the geosphere environment.

This indicates that students with an auditory learning style are more suited to the teaching materials and learning situations they follow because, in PjBL, students are required to think to find answers to essential questions asked. Students are involved in many activities that explain the answers to problems. Auditory students find it easier to understand the material through discussion and verbal explanations. Discussion allows them to speak and listen to other people's opinions, while presentations train them to convey ideas verbally. In PjBL, they can play an important role in group discussions, conveying ideas, or oral presentations. Auditory students often excel in understanding Geography concepts through conversation or debate. They usually remember information that is heard more easily than read or seen. By participating in discussions and presentations, they can absorb the ideas explained

Students with a visual learning style tend to understand material more easily through images, graphs, maps, or diagrams. In PjBL, visual students will be more productive if the project involves visual representation of geographic data, such as map analysis or satellite images. Collaboration between group members allows visual students to contribute to aspects related to the visual presentation of data, while kinesthetic students learn most effectively through physical actions and direct experiences. In PjBL, kinesthetic students will be more involved in projects that involve field activities, such as field geography research or environmental experiments. They tend to understand Geography material better when directly observing natural phenomena and collecting data from the studied location. This study is in line with previous studies on project-based learning with inaRISK and biopore technology, which have a positive effect on students' psychomotor aspects, as indicated by good perception, manipulation, precision, articulation, and naturalization abilities (Khusna et al., 2022).

This aligns with research conducted on students studying learning skills courses through adaptive e-learning based on learning styles, which shows that adaptive content positively impacts individual achievement and student engagement. These results are especially evident in various learning styles, such as kinesthetic, auditory, visual, and reading/writing. The main factor supporting this success is the design of electronic content, designed to create an ideal learning environment and provide flexibility for students to adjust the learning process to their learning style preferences. This approach not only encourages active engagement but also facilitates independent knowledge construction while creating a fun learning experience (El-Sabagh, 2021).

Several factors influence differences in learning outcomes based on students' learning styles. One of them is external factors. Teachers are essential in increasing students' motivation to learn in this external factor. In the experimental class, the teacher uses the PJBL learning model, which is very motivational. While in the control class, the teacher uses lectures and discussions. Differences are also shown in each learning style between the experimental and control classes. Students with visual,

auditory, and kinesthetic learning styles between the experimental and control classes show different learning outcomes.

Interaction between PJBL Learning Model and Learning Style on Geography Learning Outcomes

The two-way ANOVA analysis showed that the PJBL learning model with learning styles did not interact significantly with students' geography learning outcomes. This is indicated by the F value = 1.360 and sig 0.264. Thus, it can be concluded that in this experiment, Hi is rejected, and Ho is accepted as the study's result.

The study showed no interaction between the PJBL learning model and learning styles on Geography learning outcomes. This means that the learning model and style work independently on learning outcomes. According to the average Geography learning outcomes, students with an auditory learning style are higher than students with a visual and kinesthetic learning style, both in the PJBL learning model and the group of students using the lecture and discussion methods.

However, graph 5 shows that the gain score of learning outcomes in the PjBL class for the visual, auditory, and kinesthetic groups is 40.25, 45.77, and 37.56, respectively, higher than the control class's 34.5, 35.5, and 31.5. This shows that the PjBL strategy can potentially increase student learning outcomes in all groups.

This proves that the influence of the PjBL learning model and learning styles work independently on student learning outcomes. It shows that the PjBL model's advantages are that it can facilitate all student learning styles, including visual, auditory, and kinesthetic, to get higher Geography learning outcomes than groups using lecture and discussion methods.

The absence of interaction between learning models and learning styles on Geography learning outcomes is thought to occur because (1) the PJBL learning model does not depend on student's learning styles, meaning that the PJBL model can facilitate auditory, visual, and kinesthetic learning styles; (2) the learning method in the control class, namely lecture-discussion, can facilitate students with auditory, visual, and kinesthetic learning styles, resulting in no interaction; (3) no theory has been found that certain learning styles cause students to have higher learning outcomes compared to other learning styles. According to (DePorter, 2000)Everyone learns in different ways, and not all methods are equally good. Each method has its strengths. (4) The existence of other variables that have not been controlled, for example, other characteristics in students other than learning styles. This study ignores several factors that may or tend to influence student outcomes, including intelligence, talent, and learning experience.

CONCLUSION

Based on the results of data analysis and discussion, the conclusions in this study are:

1. The PJBL learning model significantly influences the Geography learning outcomes of class X SMA Negeri 1 Ngadiluwih Kediri. The results of learning Geography using the PJBL learning model are average compared to learning results using the conventional model.
2. Learning styles affect students' Geography learning outcomes. This can be seen from the differences in learning outcomes between students with visual, auditory, and kinesthetic learning styles. On average, the learning outcomes of students with auditory learning styles are better than students with visual or kinesthetic learning styles.
3. The PJBL learning model and learning styles do not interact with students' Geography learning outcomes. Learning models and learning styles work independently on learning outcomes. Based on the average geography learning outcomes, students with an auditory learning style are higher than students with a visual and kinesthetic learning style, both in the PJBL learning model and the group of students using the conventional model.

IMPLICATIONS

1. Our research results underline that variations also influence the success of PjBL implementation in students' learning styles (visual, auditory, kinesthetic). Thus, teachers must identify students' learning styles and adapt learning approaches to be more effective and inclusive.
2. Since PjBL integrates various learning activities, evaluating learning outcomes is insufficient when done only with written tests. Teachers must use various evaluation methods, such as portfolio assessments, project reports, and presentations, to measure learning outcomes holistically.

RESEARCH LIMITATIONS

This study has several limitations, namely as follows.

1. The number of samples originating from one high school, SMAN 1 Ngadiluwih, Kediri Regency, is limited.
2. The research was conducted on one material in one semester, namely the geosphere environment.

SUGGESTION

In the conclusion above, the suggestions that can be put forward are:

1. A long-term (longitudinal) study is recommended to determine the sustainable impact of PjBL implementation on student learning outcomes and the development of 21st-century skills, such as creative thinking, collaboration, and critical thinking.
2. It is advisable to conduct research that integrates technology, such as learning software, online collaboration applications, or other digital media, to support the implementation of PjBL and evaluate its impact on student learning outcomes.
3. For further researchers, it is recommended that PJBL be developed using the SCAMPER creative thinking technique to examine its influence on learning outcomes.
4. The PJBL model should be adapted to the learning environment conditions in various schools, both in urban and rural areas. The adaptation can involve adjusting the project to be more relevant to the local context and resources available in the school. Environmental or local resource-based projects can be an effective alternative for schools with limited technology access.

AUTHORS' CONTRIBUTION

This is to confirm the contribution of all co-authors in preparing this manuscript. Dewi Nur Azizah prepared its conceptual framework, methodology, and data analysis; Dewi Nur Azizah, Sumarmi, Purwanto, Yusuf Suharto, and Mita Intan Sari reviewed and edited the manuscript and sent it for publication. The corresponding author ensured the manuscript was given the final shape until it was published.

CONFLICT OF INTEREST

The authors confirm that this manuscript has no conflict of interest with schools,

groups, data, and any individual in writing of this manuscript.

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