Problem-based learning and problem solving model: which is more effective in improving student learning achievement?
Modelo de aprendizaje basado en problemas y resolución de problemas: ¿cuál es más eficaz para mejorar el rendimiento de aprendizaje de los estudiantes?

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Abstract. Identifying the syntax of student learning experiences in learning models helps lecturers be more selective in determining the relevance of learning models and student learning achievements that lecturers have previously formulated. This research aims to determine the increase in student learning achievement, using the problem-based learning (PBL) learning model and the problem-solving (PS) learning model, testing the differences in the application of the PBL and PS models on student learning achievement, and finding out which learning model is more effective in improving Student learning outcomes in sports sociology courses. This research is a quasi-experimental research with a pre-test-post-test non-equivalent comparison-group design. The research sample consisted of 60 students (30 PBL and 30 PS groups) taking sports sociology courses. The research instrument includes ten learning achievement essay test questions developed from critical thinking indicators. The data was analyzed descriptively, testing differences using the independent sample t-test and N-Gain analysis to see the effectiveness of the PBL and PS models on student learning achievements. The research results prove an increase in learning achievement for both groups using PBL and PS. Meanwhile, from the results of statistical tests, there are significant differences in learning achievement between the PBL and PS groups. Furthermore, from the results of the N-Gain test, it turns out that PBL is more effective in improving student learning achievement than the PS model.
Keywords: Problem-based learning, problem solving, learning achievement, sport sociology

Resumen. Identificar la sintaxis de las experiencias de aprendizaje de los estudiantes en los modelos de aprendizaje ayuda a los profesores a ser más selectivos a la hora de determinar la relevancia de los modelos de aprendizaje y los logros de aprendizaje de los estudiantes que los profesores han formulado previamente. Esta investigación tiene como objetivo determinar el incremento en el rendimiento de aprendizaje de los estudiantes, utilizando el modelo de aprendizaje basado en problemas (ABP) y el modelo de aprendizaje de resolución de problemas (PS), probando las diferencias en la aplicación de los modelos ABP y PS en el rendimiento de aprendizaje de los estudiantes. y descubrir qué modelo de aprendizaje es más eficaz para mejorar los resultados de aprendizaje de los estudiantes en los cursos de sociología del deporte. Esta investigación es una investigación cuasiexperimental con un diseño de grupo de comparación no equivalente pretest-postest. La muestra de la investigación estuvo compuesta por 60 estudiantes (30 grupos ABP y 30 PS) que cursaban cursos de sociología del deporte. El instrumento de investigación incluye diez preguntas de prueba de rendimiento de aprendizaje desarrolladas a partir de indicadores de pensamiento crítico. Los datos se analizaron descriptivamente, probando las diferencias utilizando la prueba t de muestra independiente y el análisis N-Gain para ver la efectividad de los modelos PBL y PS en los logros de aprendizaje de los estudiantes. Los resultados de la investigación demuestran un aumento en el rendimiento del aprendizaje para ambos grupos que utilizan ABP y PS. Mientras tanto, a partir de los resultados de las pruebas estadísticas, existen diferencias significativas en el rendimiento del aprendizaje entre los grupos ABP y PS. Además, de los resultados de la prueba N-Gain, se desprende que el PBL es más eficaz para mejorar el rendimiento de aprendizaje de los estudiantes que el modelo PS.
Palabras clave: Aprendizaje basado en problemas, resolución de problemas, logros de aprendizaje, sociología del deporte.

Introduction

Learning is defined as increasing, through experience, the ability to achieve goals despite obstacles (Washburne, 1936) and ontogenetic adaptations resulting from regularities in the organism's environment (De Houwer et al., 2013). Individuals who experience learning experiences will make relatively stable modifications in the stimulus-response relationship developed as a consequence of functional environmental interactions through the senses (Lachman, 1997), resulting in changes in behavior (Barron et al., 2015). Learning process changes manifest in various forms, such as increasing knowledge, understanding, attitudes and behavior, skills, habits, and changes in other aspects (Ardiansyah & Nana, 2020; Damopolii et al., 2018). Changes and improvements in individual learning experiences can be said to be learning outcomes or achievements. Learning achievement is proof of learning success or a student's ability to carry out learning activities according to the

weight they have achieved (Solissa, 2020). Suppose a student's final score is good. In that case, this indicates that their learning achievement is good, and the process of transfer and transformation of knowledge between teachers and students has proven successful. This increase shows that individuals are active, serious, and total when participating in learning (Blegur et al., 2019). It means lecturers successfully carry out their competency demands by making effective and efficient approaches, methods, and learning strategies to help students increase their potential, including skills, knowledge, and attitudes (Blegur et al., 2017).

In evaluating student assignments regarding analysis of current sports issues, the author found that only 20% of students submitted assignments with in-depth theoretical studies, analyzing, concluding, and providing solutions. Students' ability to complete tasks oriented towards critical thinking skills is still lacking because the learning process tends to be focused in one direction. Students consider lecturers the primary source of knowledge and experts in their

field, so they only obtain knowledge notes without analyzing processes and solving problems that occur during learning. Students cannot formulate the main issues, explore the facts in detail, and have not yet built logical arguments. In response to the abovementioned problems, lecturers must structure their students' learning experiences to help them develop critical thinking. Developing students' critical thinking is a primary educational goal in societies around the world (Larsson, 2017) because it is part of the higher-order thinking skills needed in the 21st century (Kocak et al., 2021; Mitani, 2021; Rahardhian, 2022; Saleh, 2019; Shanti et al., 2022; Utami et al., 2019; Yu & Zin, 2023). Students who have critical thinking can: 1) identify conclusions, reasons, and assumptions; 2) assess the quality of an argument, including the acceptability of reasons, assumptions, and evidence; 3) develop and defend a position on an issue, and 4) draw conclusions, if necessary, but with caution (Ennis, 1993; Larsson, 2017). Thus, learning achievements emphasizing critical thinking skills are precious for students' futures because they can prepare them to overcome various challenges, including personal life, career development, and duties as responsible citizens (Ridwan et al., 2022; Tsui, 2002).

No single learning model can be used to solve learning problems in a complex and complete manner, so identifying the goals and syntax of student learning experiences in learning models helps educators be selective in determining the relevance of learning models and achieving student learning achievements. This research compares two learning models to improve student learning achievement: the Problem-based Learning (PBL) and Problem Solving (PS) models. These two models emphasize real problems that occur in sports that require problem-solving. Through the PBL learning model, students learn to solve problems according to scientific work procedures, which is hypothesized to be suitable for improving sports sociology learning achievement. PBL is a learning approach that uses everyday problems to train students' critical thinking skills by allowing students to investigate and evaluate the situations presented in learning. Students' PBL experiences are presented in syntax, including: 1) providing problem orientation to students, 2) organizing students to conduct research, 3) requiring students to carry out analysis independently and in groups, 4) motivating students to develop and present analysis results, and 5) educators and students analyze and draw conclusions based on the results of problem-solving (Ansari et al., 2015; Kek & Huijser, 2011; Nasution et al., 2018; Puspita et al., 2023; Shishigu et al., 2017). At least PBL has also been proven successful in improving university students' critical thinking skills (Darhim et al., 2020; Jamilah et al., 2023; Ningrum et al., 2021).

Apart from that, the second learning model that can be used is PS. Problem solving is a cognitive-affective-behavioral procedure in which an individual or group attempts to categorize, determine, or formulate effective ways of handling problems that arise in everyday life. PS are interconnected through cognitive procedures such as concepts,

search, knowledge, decision-making, implication, analysis, and synthesis based on core knowledge representation (Gusau & Mohamad, 2018). This model can stimulate students to think, from searching for data to formulating conclusions so that students can draw meaning from learning activities (Shoimin, 2017). PS is also defined as a mental and intellectual process of finding and solving problems based on accurate data and information to draw appropriate and careful conclusions (Maulidya, 2018). Educators can train university students' critical thinking skills through PS syntax, as follows: 1) planning, 2) collecting data, 3) organizing data, 4) data analysis, 5) generalization, and 6) concluding (Alberida et al., 2018; Carin, 1989). Like PBL, the PS model has also been proven successful in improving university students' critical thinking skills (Ahmady & Shahbazi, 2020), including interpreting, analyzing, concluding, evaluating, explaining, and self-regulating (Utami et al., 2019).

Problem-based learning and PS modes both use problems in learning activities. Both learning models require students' thinking skills to solve problems so that they will encourage students to practice their critical thinking skills in understanding the material being studied well. The difference is that PBL only analyzes and evaluates the problem-solving process and focuses more on the implementation process. In contrast, PS focuses on students' freedom to express opinions and is not only evaluated, but students must implement suitable strategies to solve problems given by the lecturer. The lecturer's task in the PBL and PS models is to provide cases or problems for students to solve. Referring to the phenomenon, development, and success of the PBL and PS models, the research aims to investigate the influence and differences in student learning outcomes who use the PBL and PS models in sports sociology courses.

Methods

This research uses a quantitative type with a quasi-experimental method. This research does not create new classes but uses existing classes. In the experimental process, observations were made on two learning groups with almost identical characteristics. The first group used the PBL model, and the second used the PS learning model. This research design is a quasi-experiment with a non-equivalent comparison group design (pre-test and post-test), according to Johnson and Christensen (2019), as in Table 1.

Table 1.
Pre-test-post-test design

Group	Information		
Problem-Based Learning (PBL)	O_1 (Pre-test of PBL)	X (Learning process/ treatment)	O_2 (Post-test of PBL)
Problem Solving (PS)	O_3 (Pre-test of PS)		O_4 (Post-test of PS)

The PBL model group will apply the following learning steps: 1) provide problem orientation to students, 2) organize students to conduct research, 3) require students to carry out analysis independently and in groups, 4) motivate students to develop and present the results of the analysis,

and 5) educators and students analyze and draw conclusions based on the results of problem-solving (Ansari et al., 2015; Kek & Huijser, 2011; Nasution et al., 2018; Puspita et al., 2023; Shishigu et al., 2017). Meanwhile, the PS group used steps such as 1) planning, 2) collecting data, 3) organizing data, 4) data analysis, 5) generalization, and 6) drawing conclusions (Alberida et al., 2018; Carin, 1989).

This research used 60 students from the Physical Education, Health and Recreation Study Program, Faculty of Teacher Training and Education, Universitas Pattimura. They were each divided into two groups, namely 30 for the PBL treatment group and 30 for the PS group. The time for carrying out this research is from October 20 to December 4, 2022. The research instrument uses ten learning achievement essay questions developed using critical thinking indicators from Ennis (2018), primary clarification, bases for a decision, inference, advanced clarification, and non-constitutive but helpful. The pre-test was marked by the sample answering ten essay questions (critical thinking skills) before the treatment was carried out to know the initial condition of students in each experimental group. Meanwhile, in the post-test, the researcher again gave the sample ten essay questions to answer after the treatment.

The data analyzed in this study were pre-test and post-test data before and after being treated. Researchers used descriptive analysis and t-tests using Microsoft Excel and SPSS version 24. Before testing the hypothesis, the data was first tested for normality and homogeneity. The hypothesis test was an independent two-sample t-test and an N-gain test to determine the differences and scores on student learning outcomes from the two research classes. The effectiveness of N-Gain in percent form is guided by Nasir's (2016) classification, namely <40 (not effective), 40-55 (less effective), 56-75 (quite effective), and >75 (effective). Data analysis before treatment was carried out to determine the type of statistical test used to test the comparative effect of learning approaches. The assessment guidelines used in this research are the Benchmark Reference Assessment guidelines with a scale of 5, according to Ratumanan and Laurens (2015).

Results

Table 2 explains the pre-test and post-test scores for student learning achievement using the PBL and PS learning models in the sports sociology course. In the pre-test scores, the two groups had the same low qualifications: 22 students (73.3%) and eight (26.7%) with medium qualifications. In the post-test, the moderate qualifications for the PBL class were ten students (33.3%), while the PS class had 20 students (66.7%). For high qualifications, there were 20 students (66.7%) in the PBL group, while in the PS group, there were 10 students (33.7%).

Still, based on data from Table 2, the average pre-test score for student learning achievement in the PBL group = 59.13, for the PS class = 58.17. Meanwhile, the average post-test score for students' learning achievement in the

PBL group = 78.6, and in the PS class = 74.67. Thus, the PBL group experienced an increase of 19.47, and the PS group experienced an increase of 16.5.

Table 2.
Description of students' learning achievement

| Qualification | Value | Pre-test | | | | Post-test | | | |
| | | PBL | | PS | | PBL | | PS | |
		f	%	f	%	f	%	f	%
Very high	x > 90	0	0	0	0	0	0	0	0
High	75 < x ≤ 90	0	0	0	0	20	66.7	10	33.7
Medium	60 < x ≤ 75	8	26.7	8	26.7	10	33.3	20	66.7
Low	40 < x ≤ 60	22	73.3	22	73.3	0	0	0	0
Poor	x < 40	0	0	0	0	0	0	0	0

The prerequisite test for analysis of student learning achievement using the PBL and PS learning model in the sports sociology course includes normality and homogeneity tests. The normality test using Shapiro Wilk proves that the four variable data have Sig values. >0.05. Each PBL pre-test value = 0.109, PS pre-test value = 0.736, post-test value = 0.079, and PS post-test value = 0.080. Thus, it is concluded that the data distribution in the four data groups or variables is usually distributed.

Next, homogeneity was tested using Levene's test. The test results prove that the significance value obtained from the two classes in the pre-test data = 0.715 and post-test = 0.205, which means more than 0.05. It means that the two data classes are declared homogeneous, or the data sample is taken from a population with the same variance.

The results of the independent sample t-test analysis prove that the Sig. (2-tailed) = 0.003 (<0.05), with t-count = 3.119. Thus, it can be concluded that there is a significant difference between the learning achievements of students who use the PBL and PS learning models.

Table 3.
Independent sample t-test (post-test)

		t	df	Sig. (2-tailed)	Mean difference
Post-test	Equal variances assumed	3.119	58	0.003	3.93333

Next, to determine the magnitude of the increase in implementation between PBL and PS by calculating the sample pre-test and post-test data using the normalized gain (N-Gain) test. The results of the N-Gain score calculation in the PBL group show that the minimum N-Gain score = 27.5 (28%) and the maximum value = 64.71 (65%). Meanwhile, the average N-Gain score for the PBL group = 47.75 (48%), included in the less effective category. Meanwhile, the minimum N-Gain score value in the PS group = is 13.16 (13%), and the maximum value = 58.97 (59%). Average N-Gain score = 39.67 (40%), included in the less effective category (see Table 4). Thus, it can be concluded that using the PBL model is more effective in increasing student learning achievement, as evidenced by the average score of the ¬N-Gain test for the PBL group being more significant than the group taught using the PS model.

Table 4.
N-Gain test

Problem-Based Learning				Problem Solving			
X_{min}	X_{max}	$\bar{x}$	s	X_{min}	X_{max}	$\bar{x}$	s
27.5	64.71	47.75	9.37	13.16	58.97	39.67	11.37

Discussion

The research results prove that the PBL and PS models increase student learning achievement in sports sociology courses. Statistical analysis also confirms a significant difference between the application of the PBL and PS models on student learning achievement. From these differences, it turns out that the PBL model is more effective in improving student learning achievement than the PS model. Thus, the results of this research support previous research carried out by Fidan and Tuncel (2019), Pratiwi and Wuryandani (2020), and Munawaroh et al. (2022) that the PBL model has a significant effect on student learning achievement. Apart from that, by the context of learning achievement, which prioritizes critical thinking, the results of this research also still support previous research from Darhim et al. (2020), Ningrum et al. (2021), and Jamilah et al. (2023), where PBL succeeded in improving university students' critical thinking skills. It means that there are significant differences in statistical testing. However, both learning models (PBL and PS) can be used by teachers to improve student learning achievement (including critical thinking) because they both prioritize critical reasoning processes during student exploration. Problems and conclude the causes of problems. It is also confirmed by the difference in the N-Gain test between the two groups being only 8%, both of which are still in the less effective category based on the classification from Nasir (2016).

Problem-based learning (PBL) has been widely adopted in various educational fields and contexts to encourage learners' critical thinking and problem-solving in authentic learning situations (Yew & Goh, 2016). PBL provides learning experiences that trigger students to become more active learners in education because problem-solving requires students to express opinions and exchange ideas (Ernawati et al., 2023). Educators present a problem to students in various media (including videos, articles, statements, or other cases) and allow them to work together to solve it. During the construction and implementation process, problems become a significant variable for the success of PBL. Educators must be able to stimulate participants in various problem-solving experiences in order to motivate students to use critical thinking constructs when analysing problems (Abed et al., 2023). The application of PBL can improve students' critical and creative thinking abilities. The cases or problems that students solve go through a precise analytical process regarding problem indicators, as well as providing alternative solutions to the problem. In this experience, students are challenged to solve simple, medium, and complex cases. Thus, PBL has proven to be a logical and proven method for improving students' critical and creative thinking abilities (Ahmady & Shahbazi, 2020; Anggraeni et al., 2023).

Problem-based learning has evolved into various modalities and is vital in modern education. PBL is believed to have strong relevance and will continue to exist in student learning in the future (Tan et al., 2023). It is motivated by the fact that PBL is generally consistent in the efficacy of knowledge application and long-term knowledge retention (Yew & Goh, 2016). Several practices make PBL able to contribute maximally to current and future learning because PBL has been proven to be able to improve students' higher-order thinking skills (including critical thinking) (Mitani, 2021; Rahardhian, 2022; Saleh, 2019; Shanti et al., 2022; Utami et al., 2019; Yu & Zin, 2023), it is known that these skills are necessary to help individuals to be able to overcome various life problems productively in the 21st century. This thesis is reasonable because PBL designs and familiarizes students with problems during learning activities. Problems become the lecturer's orientation to students, not just providing students with textual information that is far from contextual problems so that student adaptation after learning to various fundamental problems in life is limited. Diagnosing this problem requires a critical process because they verify or select Numerous priority problems to find the causal factors and, at the same time, project solutions.

Critical skills/problem-solving are ranked first (mean = 4.7 on the 5-point scale) together with professionalism/work ethics by employers as career readiness competencies (Changwong et al., 2018). At the same time, students' critical thinking will not form naturally, so lecturers need to design a series of student learning experiences to optimize their critical reasoning. Steps to student learning experiences in PBL such as problem orientation, conducting research, conducting analysis, developing and presenting analysis results, and analyzing and drawing conclusions based on problem-solving results (Ansari et al., 2015; Kek & Huijser, 2011; Nasution et al., 2018; Puspita et al., 2023; Shishigu et al., 2017) provides high opportunities for students to develop their critical reasoning since starting to implement PBL. Through this process, students no longer give high priority to sources of knowledge to lecturers and also sources from books. However, information and lecturers, as well as reading books and articles, must be contextualized by students in their own research experiences (simple or complex) to form critical experiences about the problem and how to solve it. It is not enough there; students then communicate their experiences in dissemination to account for them to others, such as lecturers and class colleagues, and form critical conclusions about the various discussions.

Lecturers can meet students' learning needs through various ways of expression and provide adequate learning opportunities with various learning content approaches (Blegur & Hardiansyah, 2024; Gibbs, 2022). Lecturers must also care about improving the quality of their students so that they actively and productively diagnose their students' potential while simultaneously concocting, integrat-

ing, and even developing various learning models in a sustainable manner to bridge their students' life skills experiences (Razali et al., 2024). For example, applying PBL because this model has been proven effective in improving student learning outcomes (Fidan & Tuncel, 2019; Munawaroh et al., 2022; Pratiwi & Wuryandani, 2020; Purnomo et al., 2024). If we read the study by Molina García et al. (2024), the principal results report that the most critical competencies for students are problem-solving, social skills and collaboration. Purnomo et al. (2024) also emphasized that problem-solving skills are essential in life. Therefore, problem-solving skills must be included in every learning. Thus, PBL is practical not only for students' academic interests in class but also in their daily lives by transferring problem-solving experiences in class to more real-life contexts to help them overcome the problems they encounter every day.

Conclusion

The learning achievement of students taught using the PBL model has increased, as evidenced by the average score on the pre-test of 59.19 to 78.6 on the post-test. Apart from that, the pre-test scores for low qualifications were 22 students, eight students for medium qualifications became 10 students with medium qualifications and 20 students with high qualifications in the post-test scores. Likewise, students' learning achievement using the PS learning model has increased, as evidenced by the average score on the pre-test of 58.17 to 74.67 on the post-test. Apart from that, the pre-test score for low qualifications was 22 students, eight students for medium qualifications became 20 students with medium qualifications and 10 students with high qualifications in the post-test score. There is a significant difference in the post-test scores for student learning achievement taught using the PBL and problem-solving model as proven by the independent t-test, namely Sig. (2-tailed) of 0.003 <0.05.

The N-Gain test for the PBL group was 47.75 or 48%, which was in the less effective category, and the N-Gain score for the PS group was 39.67 or 40%, which was included in the less effective category. Even though, based on the N-Gain score, both groups are in the less effective category, it can be seen that the group using the PBL learning model is more effective in improving student learning achievement, namely 47.75> 39.67. Meanwhile, from the results of statistical tests, there are significant differences in learning achievement between the PBL and PS groups. Furthermore, from the results of the N-Gain test, it turns out that PBL is more effective in improving student learning achievement than the PS model.

Conflict of Interest

There is no conflict of interest.

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