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Improving cognitive learning outcomes and communication skills through problem-based learning with lesson study

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Abstract
Students' communication skills must be empowered by habituating discussion to increase learning and understanding. This habit can be trained by applying Lesson Study (LS) activities in Problem-Based Learning (PBL). This study analyzed the effectiveness of PBL learning with LS activities in improving cognitive learning outcomes and communication skills of Masters of Biology Education students at Universitas Negeri Malang. This type of research uses a mixed method with a quantitative research approach and a one-group-pretest-posttest research design. The sampling technique used purposive sampling. Data collection uses test, non-test, observation, and documentation techniques. Data analysis used descriptive qualitative, descriptive statistics, and inferential statistics t-tests. The results showed that the PBL learning syntax had been implemented well, and there were significant differences in the learning outcomes of the two cycles, with a significance value of 0.000 (cycle I) and 0.001 (cycle II) < 0.05. Furthermore, the results of student communication skills also experienced an increase in scores from cycle I to cycle II by 0.5%. This shows that PBL learning with LS activities can effectively improve students' communication skills and can be recommended for learning.
Keywords: cognitive learning outcomes, communication skills, lesson study, problem-based learning

Memperbaiki pembelajaran kognitif dan keterampilan komunikasi melalui pembelajaran berbasis masalah dengan lesson study

Abstrak
Pemberdayaan keterampilan komunikasi siswa perlu dilakukan dengan pembiasaan diskusi sebagai upaya peningkatan pemahaman belajar. Kebiasaan ini bisa dilatih dengan menerapkan kegiatan Lesson Study (LS) dalam model pembelajaran Problem Based Learning (PBL). Tujuan penelitian ini adalah untuk menganalisis efektivitas pembelajaran model PBL dengan kegiatan LS dalam meningkatkan hasil belajar kognitif dan keterampilan komunikasi mahasiswa Pascasarjana Pendidikan Biologi Universitas Negeri Malang. Jenis penelitian menggunakan mixed method dengan pendekatan penelitian kuantitatif dan desain penelitian one-group-pretest-postest. Pengambilan sampel menggunakan teknik purposive sampling. Pengumpulan data menggunakan teknik tes, non-test, observasi dan dokumentasi. Pada siklus pertama materi yang digunakan adalah penyusunan hipotesis dan siklus kedua menggunakan materi statistik dan analisis data. Analisis data menggunakan deskriptif kualitatif, statistik deskriptif dan statistik inferensial uji t-test. Hasil penelitian menunjukkan sintak pembelajaran PBL telah terlaksana dengan baik dan terdapat perbedaan nyata hasil belajar kedua siklus dengan nilai signifikansi 0,000 (siklus 1) dan 0,001 (siklus 2) < 0,05. Selanjutnya hasil keterampilan komunikasi mahasiswa juga mengalami peningkatan skor dari siklus 1 ke siklus 2 sebesar 0.5%. Hal tersebut menunjukkan bahwa model PBL dengan kegiatan LS secara efektif dapat meningkatkan keterampilan komunikasi mahasiswa dan dapat direkomendasikan untuk pembelajaran.
Kata Kunci: *Hasil belajar kognitif, Keterampilan komunikasi, Lesson study, Problem based learning*

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INTRODUCTION

The learning outcomes for education students to be skilled in carrying out educational and learning development procedures (design, teaching materials, assessment, laboratory management, teaching practice, and educator professional development) that are by transformative education based on potential and local wisdom in the field of biology in a comprehensive way, systematic, creative, and innovative. So, apart from understanding quantitative research design, students are also expected to be able to develop their pedagogical professionals. A quantitative Research Methodology course in Education is a course that discusses quantitative research design, starting with an introduction to research and searching for problem formulation to produce a research design or proposal. One of the essential components in quantitative research is the hypothesis. In fact, for students at the university level, it is necessary to develop professionalism, interpersonal relationships, and self-reflection (Molina-Torres, 2022; Morales et al., 2005).

Hypotheses are needed in quantitative research as a reference for determining data analysis. Data analysis is essential in quantitative research to answer the problem formulation and test hypotheses. However, related to this topic, it is known that not all researchers can formulate hypotheses and research data analysis designs properly and correctly, especially for novice researchers. Several errors are often found in preparing hypotheses and selecting research designs (Daniel & Taneo, 2019). Another problem in the learning process that triggers student incomprehension is the lack of student communication with lecturers regarding asking or responding, so students do not understand the concept of learning. Communication between teachers and students is essential in learning, where this skill builds interaction between students and teachers to understand the material (Hussain et al., 2017). Game activities can improve communication skills (Astuti, 2013; Dharmayanti, 2013). Storytelling activities can also develop communication skills (Aulia et al., 2018). The drawback of this study is that the concept applied is not very suitable for classroom learning activities. In addition, there are still many shortcomings in research that improve cognitive learning outcomes and communication skills with PBL learning.

PBL learning allows students to find problems related to learning materials, and by working with group friends, students can find solutions to these problems. PBL learning has characteristics, namely, the initiation of learning starts from a problem; issues are taken from real life to motivate students to solve problems; and collaborative learning (Farhan & Retnawati, 2014; Rongbutsri, 2017). Research by Lufri (Lufri et al., 2022) showed that Problem-Based Learning (PBL) with technological interventions significantly improved students' communication skills. Still, the categories that have been achieved have not been explained in more detail. Another research conducted by Afifah (Afifah et al., 2016), namely the development of letter-sharing media to improve students' communication skills, shows that it is still in a small-scale trial, so there are no explicit calculations and categories to interpret students' communication skills. Meanwhile, cognitive learning outcomes have been explained in the research results by Abarang (Abarang & Delviany, 2021), namely, the less optimal implementation of online PBL learning impacts student learning outcomes. Dwiastuti (Dwiastuti et al., 2019) also explained that there is a need for careful planning in PBL learning to optimize cognitive learning outcomes. Still, this study has not clearly explained how to evaluate and improve teacher performance in designing PBL learning. Based on this problem, a solution is needed to develop student communication skills and understanding of material topics through practical learning, one with PBL and Lesson Study (LS) activities.

PBL learning syntax with LS activities can significantly improve cognitive learning outcomes and communication skills. The PBL learning syntax is problem orientation; student organizations find problems, assist individual or group investigations, develop and present artifacts, and analyze and evaluate a problem-solving process (Arends, 2012). PBL learning can allow students to work with a group to solve problems and build knowledge through active communication (Maridi et al.,

2019). PBL implementation can improve student learning outcomes at school (Alisa et al., 2017; Rerung et al., 2017). In addition, LS activities that implement group learning can help students develop their communication skills (Indriwati et al., 2018). LS activities will create collaboration to improve learning (Soto et al., 2019). Thus, it is essential to implement lesson study activities to enhance students' communication skills and cognitive learning outcomes.

LS is a learning process that educators can carry out as an effort to improve their pedagogical abilities. LS originates from Japan, where this activity invites teachers to be active in the learning design process, carry out learning activities, observe students based on learning, and reflect on the learning that has been carried out (Coenders & Verhoef, 2019). Learning using LS invites teachers to conduct a joint learning process to develop their professionalism. LS activities apply four stages that are carried out on an ongoing basis, namely (1) setting collaborative goals and learning plans; (2) conducting and observing demonstration lessons; (3) group reflection and criticism; and (4) subsequent revision of the objectives and lesson plans, whereby the cycle is repeated (Rappleye & Komatsu, 2017). LS activities have a role in improving the learning process and students' communication skills in constructivist learning (Priyambudi, 2014). LS activities with the PBL learning model can improve student performance and communication skills (Oktaviani, 2022). To answer this problem, students can collaborate with supporting lecturers by applying PBL learning and implementing LS activities to teach hypothesis material and data analysis.

Based on this background, this study aims to 1) analyze the implementation of PBL learning syntax with LS activities based on observer observations, 2) analyze the effectiveness of using PBL learning with LS activities to improve student cognitive learning outcomes, and 3) analyze the effectiveness of using the PBL learning with LS activities to improve the communication skills of Offering B-2021 students in Biology Education Study Program, Universitas Negeri Malang in quantitative research methodology courses. It is hoped that through Lesson Study activities, students can work together in groups effectively, help supporting lecturers design better learning, develop pedagogical abilities, increase understanding related to material topics, and develop communication skills. Therefore, a solution is necessary: implementing PBL learning with LS activities.

METHOD

Research Design

This type of research is pre-experimental with a one-group-pretest-posttest design (Table 1). Pre-experimental is a research design with one treatment group or class given a pretest and posttest (Sugiyono, 2014). The class used in this research is only one class with PBL learning treatment with LS activities. The research was implemented in two learning cycles: the first was on material for preparing hypotheses, and the second was on statistics and data analysis. At the end of the lesson, a pretest and posttest were given.

Table 1. *Research Design of One-Group-Pretest-Post-test Design*

Group	Cycle I		Cycle II	
Eksperimental class	E_1	O_1	E_2	O_2

Note: E_1 = Pretest 1 O_1 = Posttest 1
E_2 = Pretest 2 O_2 = Posttest 2

Population and Samples

This research was implemented at Malang State University in the odd semester of the 2021-2022 academic year. The population in the study consisted of students from the Biology Education Master's Degree Program, which consisted of three classes totaling 45 students. The sampling technique used a non-probability sampling technique by purposive sampling with the specific objective of implementing the PBL learning with LS activities in conjunction with lectures on quantitative research methodology in Offering B class. The research sample consisted of only one class, Offering B, and 15 students who implemented PBL learning with LS activities.

Instrument

Data collection techniques include test, non-test, and observation techniques. The test technique involves students answering five essay questions to measure cognitive learning outcomes. The results are then interpreted as categories or scales (Table 2).

Table 2. *Category of Cognitive Learning Outcomes*

Value Range	Category
80 – 100	Very Good
70 – 79,99	Good
60 – 69,99	Enough
50 – 59,99	Not Enough
0 – 49,99	Very Less

Source : (Fitri et al., 2017)

In addition, non-test techniques are also provided to support measuring cognitive learning outcomes, such as students filling in student worksheets. Observations were made on the ongoing learning process to see the implementation of the PBL learning syntax in LS activities. The Category of students' activities results in PBL learning (Table 3).

Table 3. *Category of Student Activity Results in PBL Learning*

Value Range	Category
85% – 100%	Good
75% – 84%	Enough
60% – 74%	Not Enough
0 – 59%	Very Less

Source : (Simamora et al., 2017)

The non-test techniques are also given to students in the form of peer assessment to measure the student's communication skills. The results of communication skills are then interpreted as categories or scales (Table 4).

Table 4. *Category of Communication Skills*

Value Range	Category
$80\% < x$	Very Good
$60\% < x \leq 80\%$	Good
$40\% < x \leq 60\%$	Enough
$20\% < x \leq 40\%$	Not Enough
$x \leq 20\%$	Very Less

Source : (Asih & Ellianawati, 2019)

Procedure

The procedure for carrying out this research consisted of 3 stages: planning, implementation, and post-implementation. The planning stage begins with preparing learning tools in chapter designs, lesson designs, lesson plans, student worksheets, pre-test and post-test questions, and observation sheets adapted to the lecture material. LS activities are carried out in quantitative research methodology courses in education, which are carried out in two cycles (Figure 1) to see an increase in communication skills during the lecture process. In the first cycle, the material used is the preparation of hypotheses, followed by statistical material and data analysis in the second cycle. The implementation phase of the first cycle was carried out in March 2021 through a Zoom meeting with model lecturer Putri Rahma Dianti. Meanwhile, the second cycle was implemented in November 2021 through a Zoom meeting with model lecturer Ning Rahayu Handayani. In the post-research phase, the data collection results for each cycle were analyzed, presented, and then reported.

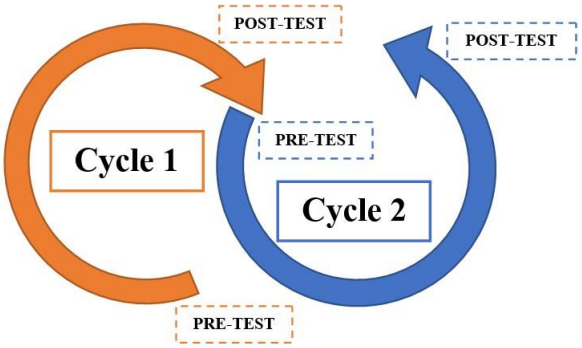

Figure 1. Research cycle design

Data Analysis Techniques

The results of data on the implementation of PBL learning with LS activities were analyzed using descriptive qualitative statistics. In contrast, the results of communication skills, student worksheets, and sample data representation were analyzed using standard deviation and data mean descriptive statistics. The inferential statistical analysis used was the t-test to see the significant differences in the pre-test and post-test values of the Offering B class. Before testing, the data had to be subjected to assumptions or prerequisite tests, namely normality and homogeneity.

RESULTS AND DISCUSSION

Result

Implementation of the PBL learning syntax

Observers observed the implementation of the PBL Learning Syntax. The results of this observation were obtained from the average value of the two learning cycles. The results of implementing the PBL learning syntax through students' activities are as follows (Table 5).

Table 5. *Observation Result of Implementing PBL Learning Syntax by Students Activity*

No	Observer	Score
1.	Cycle I	83%
2.	Cycle II	87%
Mean score		85%
Category		Good

Table 5 shows the results of students implementing PBL learning syntax, with an average score of 85%. These results are included in the excellent category, so this study's results indicate that students' application of PBL learning is good.

Student cognitive learning outcomes

Student learning outcomes are calculated based on the average for the pre-test and post-test of the two cycles and the average completion of the student worksheet. The pre-test and post-test results were then in the t-test to determine the significance of the difference in the scores of the two cycles. The following describes the descriptive analysis of pre-test and post-test scores from the two cycles (Table 6).

Table 6. *Standard Deviation Calculation Results*

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pre-Test 1	72	10	7,528	2,38
	Post-Test 1	84,5	10	6,852	2,167
Pair 2	Pre-Test 2	80,5	10	7,976	2,522
	Post-Test 2	92	10	7,149	2,261

Based on Table 6, the results of the descriptive analysis regarding the Standard Deviation (SD) have shown that the value of $\overline{X}$ > SD. These results indicate that the data used represents the entire data well. Based on the average score of the pre-test and post-test implementation, it was found that there was an increase in scores in the second cycle. So, it can be stated that implementing PBL learning with LS effectively increases learning outcomes. This decision is strengthened through the t-test results (Table 7).

Table 7. *Results of T-Test*

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	Pre Test1 - Post Test1	-12,5	6,346	2,007	-17,04	-7,96	-6,228	9	0
Pair 2	Pre Test2 - Post Test2	-11,5	7,835	2,478	-17,105	-5,895	-4,641	9	0,001

Based on Table 7, it is known the t-test results of the two cycles show a significance value of 0.000 (cycle I) and 0.001 (cycle II) < 0.05; it can be concluded that there are fundamental differences in learning outcomes in the two cycles before and after the implementation of the PBL learning with LS activities. In addition, from the results of this analysis, it can be seen that there is an increase in the significance value from cycle I to cycle II of 0.001; this indicates that PBL learning with LS activities effectively improves student cognitive learning outcomes.

Student communication skills

The communication skills assessment score results were obtained from filling in the communication skills instrument based on observer observations. The results are then averaged in the form of a percentage. The percentage score is then compared to the communication skills criteria. The following is an analysis of the student communication skills assessment score (Table 8).

Table 8. *Result of Communication Skills Assessment*

Skills	Cycle I		Cycle II	
	Percentage	Category	Percentage	Category
Communication	94.5%	Very good	95%	Very good

The results of the percentage rating scores in Table 8 show that student communication skills in cycle I (94.5%) and cycle II (95%) are included in the very high category. Based on the results of this analysis, the acquisition score increased by 0.5% from cycle I to cycle II. This increase in value indicates that PBL learning with LS can effectively improve students' communication skills.

Discussion

PBL learning in LS activities can improve the quality of lecturers and students. PBL learning is a learning model based on actual problems. PBL learning places more emphasis on learning that is based on problems encountered in everyday life (Kemendikbud, 2014). PBL learning can provide opportunities for students to integrate knowledge with real problems, provide more profound understanding, and increase learning effectiveness (Castrillon et al., 2023). The syntax of PBL learning is five stages. The PBL syntax is student orientation to problems, organizing students to learn, guiding individual and group investigations, developing and presenting results, and analyzing and evaluating problem-solving processes (Arends, 2012; Kemendikbud, 2014). The results of implementing the PBL learning in cycles I and II show that the PBL syntax is implemented well at each stage, and no problems were found. The implementation of this syntax is known from the sequence of syntax implementation, the provision of an apparent stimulus and problem orientation, the development of works in both cycles and the finding of solutions to the formulation of the problems presented at the beginning of learning.

The results of the analysis of implementing PBL learning syntax by students in Table 5 show that students' application of PBL learning syntax is good. The effectiveness of implementing the PBL syntax is also supported through the implementation of LS activities. Applying PBL learning in learning as a whole can increase the effectiveness of students in discussions by actively listening, respecting the perspectives of others, developing shared understanding, developing statements, and comparing ideas between members (Owens & Hite, 2020). PBL learning can improve intrapersonal skills, which means there is a strengthening in communication and group work skills (Castrillon et al., 2023). In addition, PBL learning is also a learning model that can increase student activity (Dewi et al., 2016; Eko Setyowati et al., 2015; Kemendikbud, 2014). PBL learning is a learning model included in the learning model with a constructivist approach and is student-oriented (Kemendikbud, 2014). PBL implementation can increase student involvement in direct learning and improve learning outcomes (Castrillon et al., 2023).

The analysis of student communication skills in Table 8 shows that the student communication skills in cycle I (94.5%) and cycle II (95%) are included in the very high category. The x value > 80% indicates that the person's communication skills are very high (Asih & Ellianawati, 2019). it is known that there is also an increase in the quality of teaching from educators from cycle I to cycle II by 0.5%. So that the PBL learning with LS can effectively improve students' communication skills, student activity here can be interpreted as active discussion, which also affects student communication skills. Student collaboration in PBL learning helps develop communication between members, the ability to ask questions related to discussion work, and the ability to answer problems to be further translated into a structured concept (Osman & Kriek, 2021). communication skills increased to a suitable category after implementing PBL learning (Wati et al., 2019). Using LS also improves communication skills (Priyambudi, 2014; Yulianto Aris, Fatchan A, 2017). Through LS activities, students can express opinions related to the reflection of learning that has been implemented. This communication skill is essential to develop because it is one of the 21st Century Skills that someone must master to face global competition. Communication skills are critical in the current era; through communication skills, students can convey their understanding to be implemented (Zubaidah, 2010). LS activities can be used to improve the quality of teacher teaching. In essence, Lesson Study is a collaboration between educators to design, observe, evaluate, and reflect on the learning that has been carried out (Lewis, 2003). This improvement was seen as an improvement in the teaching carried out by educators. As for the improvements that educators have made in the implementation of LS, namely attendance that must be done at the beginning of learning, they can handle nervousness by saying a little "hmm," as well as mastery of the material, which is strong enough. Then, the valuable thing that can be learned in teaching educators is to use language that is easily understood and friendly so that students enjoy learning. LS evaluates educator learning to improve teaching performance (Fernandez, 2002). LS can also be used to identify and improve the quality of student learning.

The results of the analysis of the t-test in Table 7 show that the t-test results of the two cycles show a significance value of 0.000 (cycle I) and 0.001 (cycle II) < 0.05, it can be concluded that there are fundamental differences in learning outcomes in the two cycles before and after the implementation of the PBL learning with LS activities. In addition, from the results of this analysis, it can be seen that there is an increase in the significance value from cycle I to cycle II of 0.001; this indicates that PBL learning with LS activities effectively improves student cognitive learning outcomes. PBL can improve learning outcomes because students are trained to solve problems to develop cognitive competence (Anggariana et al., 2017; Supiandi et al., 2016). PBL learning can increase student learning activities and outcomes (Syahri et al., 2023). LS can also be a tool to observe student learning processes and improve student academic abilities. Lesson Study activities can be used to observe the entire learning process in a complex manner so that students can achieve learning objectives and enhance the learning process (Priyambudi, 2014). The analysis of the observer's observations showed that no students had learning difficulties starting from cycle I to cycle II, which indicated that LS could be adequately implemented. So that the implementation of the LS cycle can improve the quality of learning and, of course, improve student learning outcomes. Improving the teaching quality of these teachers through LS can improve students' cognitive learning outcomes (Fernandez, 2002). LS can improve student achievement (Eko Setyowati et al., 2015).

CONCLUSION

Based on this research, it can be concluded that implementing PBL learning syntax using LS Activities is good and running effectively. There is an increase in the learning process by 4% from cycle I to cycle II. PBL learning with LS Activities is effective for improving students' cognitive learning outcomes, as seen from the increase in the average pre-test and post-test results by 4% from cycle I to cycle II. The results of the t-test in the pre-test and post-test scores also showed a significant difference between the two scores in the two learning cycles. PBL learning with LS Activities was also stated to be effective in improving students' communication skills, where the results can be seen from the increased score of 5% in communication skills from cycle I to cycle II.

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