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Lesson Study in Pre-Service Biology Teacher Education at Universitas Riau

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Abstract
The Teacher Professional Education (TPE) Program aims to train qualified teachers by providing structured training and learning programs through Field Experience Practice (EP), which was implemented in schools in two cycles: EP 1 and EP 2, using the Lesson Study format. Both cycles of EP involved 1 tutor teacher, 2 observer teachers, 1 supervising lecturer, and 5 TPE students. Each cycle goes through 3 phases: Plan, Do, and See. The results of profiling showed that the students' characteristics were kinesthetic and audio-visual. The learning model used is problem-based learning, and based on observations of independent learning activities and collaboration in completing their assignments, all deficiencies are addressed during reflection activities. In the final stage of the learning activities, each party involved in the Lesson Study activities obtained valuable lessons. The supervisors received insights to apply improvements to courses related to the TPE program

Keywords: Lesson study, pre-service teachers, Teacher Professional Education program

Introduction

Increasing the professionalism and quality of teachers to improve the quality of education is manifested in the Teacher Professional Education (TPE) Program. The TPE Program is a professional education program for bachelor's degree graduates in educational and non-educational fields who have the talent and interest to pursue a career as a teacher. The TPE program for teachers is divided into two channels: in-service TPE for teachers already registered at an institution and pre-service TPE for prospective teachers who have completed an educational study program but have not yet registered at an institution. The TPE program aims to produce teachers who are professional, pious to God Almighty, have noble character, and are knowledgeable, creative, innovative, adaptive, and competitive in carrying out their main tasks, such as educating, teaching, guiding, directing, training, assessing, and evaluating students (Ministry of Education and Culture, 2023). These graduates of teacher education are expected to become educators who adhere to Pancasila (the five principles of the Republic of Indonesia), possess fundamental teaching skills, develop into devoted, exemplary individuals, and pursue lifelong learning.

The entire Pre-Service TPE Program lasts for two semesters or one year. Structured learning is conducted through lectures that follow the acronym of an Indonesian word "*MERDEKA*", that is ***M**ulai dari diri sendiri, **E**ksplorasi, **R**uang kolaborasi, **D**emonstrasi, **E**laborasi, **K**oneksi antar materi, and **A**ksi nyata* (starting from oneself, exploring, working in groups, seeing examples in context, elaborating, making connections between the materials, and taking real action). Educational activities carried out in semester 1 are practice-oriented lectures and Field Experience Practice 1 (EP 1). EP 1 activities consist of observing students and teaching and learning subjects. Students will participate in Field Experience Practice 2 (EP 2) in semester 2, which consists of teaching innovation projects, case study projects for students with problems, practice-oriented lectures, and leadership projects in the community. Lesson Study and Classroom Action Research were used to carry out EP 2 student activities.

Lesson study is a method for guiding educators to help students or teachers learn at school. By giving teachers opportunities to observe and reflect on each other's learning, lesson study's primary goal is to enhance teacher professional development (Saito & Atencio, 2015). Moreover, implementing lesson study in EP activities can provide TPE students, teachers, and lecturers with a forum for collaboration to raise the standard of student learning. The implementation of lesson study helps teachers find the best ways to implement learning models, overcome ineffective teaching practices, and build a learning community (Suwartono, Abdulloh, and Khomsatun 2022). Lesson Study activities have three stages: 1) Planning session (plan), which is the learning planning stage; 2) Open lesson (do), which is an implementation activity involving the implementation of learning by a model teacher and observation of learners by observers; and 3) Reflection session (see), which is a reflection stage where the teacher will convey reflections on learning, and other learning communities, such as observers and students, will also participate (Gunawan, 2023). The Lesson Study makes a positive contribution by encouraging teachers to become more open to learning and aware of how they can improve themselves to meet learning objectives (Santia, 2016). By expanding their knowledge as professionals, teachers can use their collective expertise and experiences to improve students' academic performance through lesson study (Andriani et al., 2016; Smith & Robinson, 2020). Besides, the participants are also involved in or create a learning community that can collaborate to produce better learning outcomes (Soto et al., 2019).

Lesson study is used in pre-service students' EP activities as part of an effort to develop professionals who are knowledgeable about teaching. To create cooperation in learning activities and raise the standard of learning, model teachers, observers, supervisors, and tutor teachers can collaborate in lesson study. It is anticipated that EP activities for Pre-Service TPE students will be able to address other educational issues, such as the number of teachers who are not yet qualified to teach the assigned subjects by implementing lesson study. Additionally, teachers who are not from educational study programs typically have non-linear educational backgrounds and a lack of pedagogical knowledge. In response to this, the Indonesian government has developed several initiatives and programs to help educators improve their knowledge and abilities (Fani Prastikawati et al., 2021; Khoeriyah & Mawardi, 2018; Rosy et al., 2018).

The use of lesson study, according to Priyambudi (2014) and Yulianto, Aris, and Fatchan A (2017) also has the effect of improving teachers' communication and teaching skills. Model teachers can provide feedback on the learning plans that have been created and reflect on learning outcomes through lesson study activities. Pre-service TPE students may have the chance to learn important lessons (lessons learned) and gain meaningful experiences (best practices) from these activities through lesson study in EP activities. Based on the outcomes of student profiling, teaching is applied according to the student's ability level (teaching at the right level) in the Lesson Study EP activity for pre-service TPE students. Through this activity, researchers will analyze the implementation of learning and best practices found in lesson study activities. It is hoped that the results of the lesson study will be a turning point and reflection for prospective professional teachers to improve their quality and the quality of the learning carried out.

Method

The implementation of EP 1 and EP 2 for Pre-Service TPE Students is carried out every semester, with EP 1 in semester 1 and EP 2 (Classroom Action Research) in semester 2. EP activities involve 30 Pre-Service TPE Students from the University of Riau at SMAN 2 Pekanbaru, SMAN 4 Pekanbaru, SMAN 8 Pekanbaru, SMA Plus Riau Province, and SMA Babussalam Pekanbaru. The research activity is Classroom Action Research (CAR) with 2 cycles. This activity involves 1 tutor teacher, 2 observer teachers, 1 supervising lecturer, and 3 students. Each cycle goes through the stages of Plan, Do, and See. Learning activities at the assistance and guidance stage are carried out by tutors and teachers (TPE students) who act as model teachers and observers. Plan, Do (implement), and See (reflect) are the three steps of the continuous, never-ending process of teaching that is based on lesson study. In the table below, you can see the practice schedule for TPE student teachers that has been implemented.

Tabel 1.TPE Student Lesson Study Practice Schedule

Stages	Implementation Day and Date	Place
Plan	• Monday, 15 May 2023 • Monday, 22 May 2023	SMAN 4 Pekanbaru
Do	• Monday, 22 May 2023 • Monday, 29 May 2023	SMAN 4 Pekanbaru Teacher: Lusi Purnawati
Stages	**Implementation Day and Date**	**Place**
See	• Monday, 22 May 2023 • Monday, 29 May 2023	SMAN 4 Pekanbaru

The research tools used were student worksheets, learning media, observation sheets of learning activities (PBL models), teaching modules, chapter design, lesson design, and teaching modules. Lesson study was also put into practice. Descriptive data analysis was done in relation to the execution of each stage of the problem-based learning model and lesson study activities.

Results and Discussion

Based on the Plan, Do, and See stages, the outcomes of EP activities through lesson study are described. Students designed their studies in the Plan stage, worked on learning activities and observations in the Do stage, and then evaluated and reflected on the outcomes of the learning in the See stage, along with tutors and supervisors. The following is a description of the EP Lesson Study activities for Riau University's Pre-Service TPE students:

1. Plan Stage

The Plan stage was completed two days before students began their classes or learning activities (Do). The Plan stage was carried out offline through direct discussions at the practice school, SMAN 4 Pekanbaru. One student serving as a model teacher, one tutor teacher, and a lecturer supervising Pre-Service TPE activities at Universitas Riau worked together as a Lesson Study Team to complete the Plan stage. The results of the profiling mapping of the students' kinesthetic and audio-visual learning styles are presented at the start of this stage. Model teachers explained how learning would be carried out based on the findings of student profiling through chapter design, lesson design (learning design), teaching modules, and evaluation design. The essential and non-essential material to be delivered by the model teacher was selected and discussed together based on the scheme in the chapter design (Figure 1).

Figure 1 . Plan Activities with Teachers and Supervising Lecturers

The learning material presented in the 2-cycle research was the Immune System, covering the body's specific and non-specific defense system material and disorders of the body's defense system. At this Plan stage, the Lesson Study Team designed learning that could encourage students to learn in a pleasant atmosphere, ensuring that the desired goals could be achieved effectively through active and creative learning activities. The Plan stage marked the beginning of the collaboration between model teachers, tutor teachers, and supervising lecturers in making learning designs that suit students' needs (Akiba et al., 2019). Learning development with input from various parties provides better quality teaching and learning (Coenders & Verhoef, 2019). Some notes obtained from the Plan stage for improving the learning design are as follows:

a. Teachers must pay attention to the selection of stimuli given to students at the orientation stage, hoping to stimulate students to identify problems.

b. The selected essential material topics should be readjusted to the Learning Outcomes and Learning Objectives.

c. Learning media should help students understand the material being taught by the teacher.

2. Do stage

In each Biology subject schedule, the model teacher allocated 2x45 minutes for learning activities (Do stage). Offline learning activities were conducted using the material from cycles 1-2, specifically the specific and general body defense systems and the disorders of the body's defense system. Applying the Problem-Based Learning (PBL) model makes learning at the Do stage student-centered. The use of active learning models provides valuable learning experiences for students, particularly in the problem-solving process. Students can actively and critically collaborate in group discussion activities (Almulla, 2020; Syahriridani, Susilo, and Ibrohim, 2022). The problems raised by the model teacher were authentic problems related to daily activities that can stimulate the body's defense system. Examples of cases included the effect of insect bites on the body's defense system, viral or bacterial infections, and others. The activities were carried out by students in turns according to a predetermined schedule. Every student had the opportunity to become a model teacher and observer. An example of an open class learning schedule (Do) is described in Table 2.

Table 2 . Sample Schedule of Learning Activities (*Do*) for TPE Students

Lecturer Model: Lusi Purnawati, S.Pd
Class : XII IPA 5, Material : Immune System

No	Cycle/ (PTK)	Execution time	Material Topics	Model used	Observers
1	Cycle 1	Monday, 22 May 2023	Class XI MIPA 1 Non-Specific Body Defense System	PBL	• Ravika Amelia • Sri Nur Khalifah • Evi Suryawati (Supervisor) • Hj. Maryati (Teacher Teacher)
2	Cycle 2	Monday, 29 May 2023	Body Defense System Disorders Class XI MIPA 1	PBL	• Dwi Tira Nengsih, • Mitha Tarsia • Evi Suryawati (Supervisor) • Hj. Maryati (Teacher)

Two observers monitored learning activities in accordance with the planned schedule. The model teacher was observed and evaluated for each learning activity they carried out using an observation sheet. Apperception and motivational activities set the stage for learning. To pique students' interest in the lesson material, the teacher reviewed prior material and submitted trigger questions. The next step in PBL learning was for the teacher to introduce the students to the problem. Students were given stimuli in the form of articles, videos, and images that relate to cases involving the body's defense system. In large classes, students first analyzed the teacher's stimulus before coming up with their own issues or inquiries (Figure 2).

Figure 2. Learning activities (Do)

The second stage of PBL was organizing students to learn. At this stage, the teacher divided students based on their level of ability and learning styles that had been mapped through previous student profiling activities. The model teacher gave different worksheets to each group according to the learning styles of the group members. This method was known as teaching according to the level of students' abilities (teaching at the right level). The teacher also provided an explanation regarding the flow of student activities based on the problems that had been identified. The third stage of PBL was conducting individual and group investigations. At this stage, students in each group conducted information searches based on the instructions in the worksheet to answer the problems that had been identified. Each student had the freedom for

information search activities, where they could use learning resources such as books, websites, articles, and others. The teacher also facilitated several learning resources in the form of learning videos and PPTs for students to access for investigation activities. Students and group members discussed together to record important points from the results of the investigation as a basis for solving problems.

The fourth stage of PBL was developing and presenting the work. Here, students and group members made solutions to problems based on the ideas of each member. The results of the discussion of solutions were written in worksheets and student notebooks. Then students submitted solutions to problems in class forums to be discussed with the teacher and other groups. The final stage of PBL was analyzing and evaluating the problem-solving process. At this stage, the students, accompanied by the teacher, analyzed the results of problem-solving submitted by the presenter group. In the class forum, each student had the opportunity to ask questions, respond, or provide suggestions for improving solutions. For example, students in class forums asked the presenter about data sources related to the solutions described, and the presenter explained the results of the investigation carried out by the group. Another group offered advice for the presenting group to include information on how to prevent Immune System disorders. The presenter group then provided a summary of the problem's effective solutions based on the conclusions of the last stage's discussion.

The results of the activities conducted in the Do stage demonstrate that implementing the PBL model can improve the average student performance, as evidenced by the increase from Cycle 1 to Cycle 2 (Figure 3).

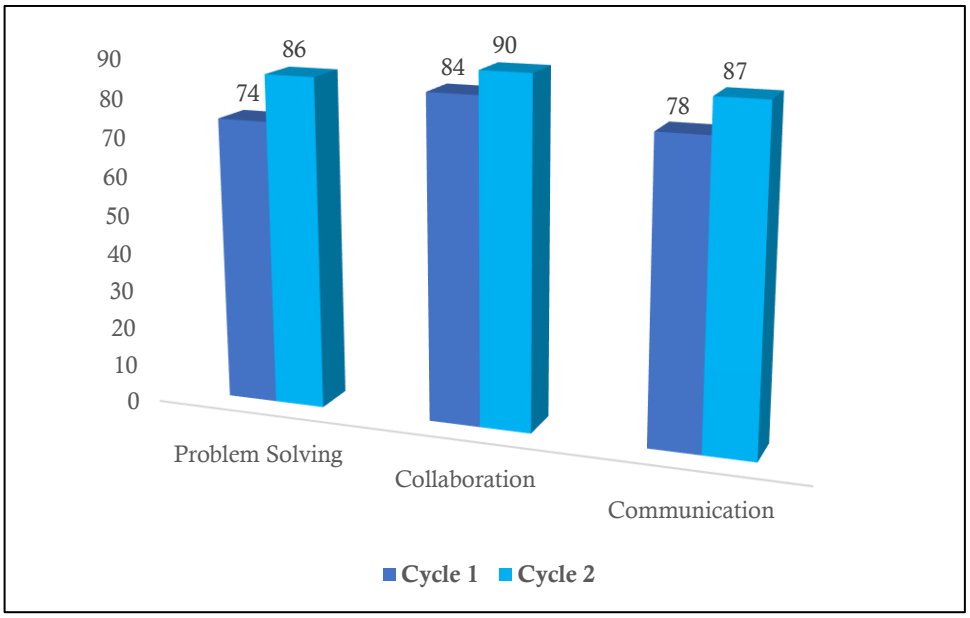

Figure 3. Students Learning Activity Scores in Cycle 1 and Cycle 2

ased on the diagram, it is evident that an increase in student performance occurred across all indicators (Problem Solving, Collaboration, Communication) from Cycle 1 to Cycle 2. The implementation of the Problem-Based Learning (PBL) model in this activity has proven effective in training students to think critically, develop analytical skills, and solve problems efficiently. Engaging students in problem-solving during the learning process enhances their ability to critically evaluate phenomena in their surroundings and improves their proficiency in finding solutions (Yusal *et al.*, 2021). Problem solving activities train students to solve authentic problems in the worksheet. Collaboration skills are developed in problem solving discussion activities. Further student communication is also trained in presentation activities. Problem-based learning activities can also develop students' reflection skills to understand the context of the problem before formulating the problem. The findings of this study are also consistent with those of Robi et al., (2024) , which demonstrated that applying PBL over two cycles of lesson study activities significantly improved average learning outcomes.

The observer evaluated the application of each PBL model stage based on the overall learning activities (Do). Assessments made by observers included the suitability of the teacher's stimulus at the problem-orientation stage, the state of the students during discussions at the investigation and development stage, and group collaboration based on profiling results. In the implementation of learning (Do), teachers developed pedagogical competencies to guide students in collaboration and discussion (González et al., 2023; Wood,

2020). The observer also made notes regarding valuable lessons learned and meaningful experiences (best practices) found while observing learning from model teachers.

3. See Stage

The See stage was completed on the same day as the learning implementation (Do) for 60 minutes, with the help of model teachers, observers, tutor teachers, and supervisors. The model teacher shared reflections on the learning that took place at each meeting. The model teacher discussed the successes and failures of the learning innovations implemented and shared worthwhile experiences (best practices) and lessons learned (lessons learned) from carrying out teaching and learning activities. For example, in Cycle 1, the model teacher learned the value of considering time management for each learning activity and the need to develop more effective time management. This was revised in Cycle 2. In Cycle 2, the model teacher discovered that the use of orientation-stage stimuli and topic-appropriate learning media could support students' active discussion (Figure 3).

Figure 3 . Reflection activities (See) with Teachers and Supervising Lecturers

The next activity at the See stage was the elaboration of the results of observations by the observer. Based on these observations, it was known that the overall learning carried out by the model teacher had been well-executed in accordance with the stages of the PBL model. For example, in Cycle 1, the observer noted that the model teacher must pay more attention to time allocation and should continue to guide students in each group at the investigation and development stages of their work. The valuable lessons (lessons learned) and meaningful experiences (best practices) obtained by observers during learning activities in Cycle 1 were:

1. The use of the PBL model could improve students' ability to collaborate and communicate; this learning model was recommended for implementation in the classroom.
2. Division of groups based on students' ability levels and learning styles could support students' collaboration and communication in the process of solving problems and developing solutions.
3. The provision of diverse learning resources could help students in carrying out the stages of individual and group investigations effectively.

At the See stage, the Lesson Study Team discussed and reflected on the successes and failures of learning activities, along with the best practices (valuable lessons and meaningful experiences) that could be applied to the next learning activity (Cycle 2). The analysis results of observations in Cycle 1 showed that the implementation of the PBL model in the overall learning process could improve students' effectiveness in discussions, such as active listening, respecting other people's perspectives, developing shared understanding, and being able to develop statements and compare ideas between members (Owens and Hite, 2020). The follow-up in Cycle 2 included arrangements for more effective time allocation and increased teacher assistance to each group during the investigation and development stages of work results.

The results of observations in Cycle 2 showed an increase in student activity in the process of problem formulation and discussion to develop solutions to problems. These results aligned with several studies that explained that applying the PBL model by selecting appropriate problem topics could increase student activity (Dewi et al., 2016; Eko Setyowati et al., 2015; Kemendikbud, 2014). The model teacher in this cycle had allocated time more effectively and had been more intense in providing assistance to students in each group. Notable practices in Cycle 2 included:

1. Trigger questions at the start of the learning process helped students focus on the material that would be studied that day.
2. Providing students access to a variety of learning resources during the individual and group investigation stages assisted them in their information-seeking efforts, offering an alternative to merely consulting books and other printed materials.

3. The instructor's consistency in showing enthusiasm from the start of the lesson until the end benefited the students.

Collaboration at the See stage between model teachers, observers, tutor teachers, and supervisors, including group discussion activities and sharing ideas for enhancing learning for each practical student, was crucial. Each student's role could be changed, giving them the chance to learn important lessons and have meaningful experiences (best practice), whether they were acting as a model teacher or an observer. For teachers or tutors, the lessons learned from this activity were learning innovations carried out by students to be applied in other classes. For supervising lecturers, Lesson Study results became a reflection and benchmark for improving courses related to the TPE program. Lesson Study in EP 2 activities was a means for mutual learning for educators, supervisors, and professional teacher candidates to improve learning and the quality of education. Supervision of model teachers in the processes of planning, implementing, and evaluating learning activities in lesson study had a positive impact on knowledge reconstruction, practical skills, and the ability to reflect on learning (Sepúlveda Ruiz et al., 2022).

The implementation of lesson study in teacher training could enhance the professionalism of young teachers and provide valuable learning feedback for the lesson study team (Sepúlveda Ruiz et al., 2022). Lesson study in the TPE program has been proven to significantly enhance students' abilities in designing learning materials and conducting teaching practices (Hidayati, Rahmah, and Gusnadi, 2022). The implementation of Lesson Study in the TPE program is a means to develop the competencies, skills and experiences of pre-service teachers (Schipper et al., 2022). Additionally, another study highlighted that the application of Lesson Study for pre-service teachers can improve the quality of learning by enhancing personal, contextual, pedagogical, and social competencies (Moorhouse & Harfitt, 2021). This study is a class action research that is only limited to one treatment class, with one topic of material applied in the TPE Program activities. Future research can continue the research with several treatment classes to see the effectiveness of Lesson Study assistance on learning quality. Researchers may also expand the scope by analyzing the implementation of Lesson Study across several schools to gain a more comprehensive understanding of its impact.

Conclusion

Based on the research results, it can be concluded that the implementation of Lesson Study in EP activities has a positive impact on TPE students, improving the quality of learning. The effectiveness of model teacher learning improved from Cycle 1 to Cycle 2. Collaboration between practical students, tutor teachers, and supervisors in Lesson Study activities develops teacher pedagogical abilities in designing, implementing, and evaluating learning. Through Lesson Study activities, practical students gain valuable lessons (lessons learned) and meaningful experiences (best practices) while serving as model teachers or observers

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