



Application of Lesson Study Using PBL to Improve Information Literacy and Collaboration Skills of Prospective Biology Teacher

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Abstract. The 21st century is known as the century of knowledge or the century of information which is marked by the ease and abundance of scientific information from various sources such as the internet and social media. Students must have information literacy to determine available information based on reliable data and information taken from credible research. PBL is a commonly used methodology for teaching or for creating collaborations with classroom faculty. The implementation of PBL models in the learning activity also gave the opportunity to students to work together with other groups in doing an investigation, so that it can develop their learning process and collaboration skills. This study aims to determine the implementation of the PBL based on Lesson Study to improve students' information literacy and collaboration skills. This research using a mixed-method using a convergent design in triangulation model. The instrument applied aims to measure students' information literacy using Information Literacy Value Rubric by Association of American Colleges and Universities that consist five indicators. Information literacy is measured through an assessment of the bulletin content made in groups. Students' collaboration skills are measured using observation sheets referring to collaboration indicators by Greenstein Assessing 21st Century Skills. The result show that an improvement in the information literacy of the prospective biology teacher, increasing from 51.66 in Cycle I to 91.66 in Cycle II, falling within the medium category. The aspect of collaboration skills also experienced enhancement, rising from 71.67 in Cycle I to 89.17 in Cycle II, categorized as medium. The conclusion is that the PBL based on Lesson Study can improve students' information literacy and collaboration skills.

Keywords: Lesson Study, Information Literacy, Collaboration Skills

1 Introduction

The 21st century is recognized as the age of knowledge or the era of information, characterized by the convenient and ample availability of scientific knowledge from a

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variety of channels like the internet and social media. In 21st-century education, the focus is on positioning students as the focal points of learning, enabling them to explore, process, and convey information independently, not only receiving from teachers or lecturers. The availability of various sources of information needs to be filtered so that the information collected can develop students' potential [1]. Competence in accessing and understanding information is a key factor in lifelong learning. Attaining information literacy serves as the initial stride towards accomplishing educational objectives, and the cultivation of information literacy skills should endure throughout individuals' lifetimes, particularly during their educational phases (school years) [2]. Hence, students need to possess information literacy to discern accessible information rooted in dependable data and information sourced from reputable research [3].

The commencement of information literacy skills starts with recognizing the necessity for information related to a subject, and being able to identify, evaluate, find, use, and share this information effectively and responsibly to solve the problems encountered [4]. Different types of managed information are used and communicated effectively, legally, and ethically [5]. Developing the capacity for coexisting harmoniously involves recognizing that educational and life experiences demand not only individual growth but also social processes that occur when each person relates to others and builds shared understanding and knowledge [6]. Collaboration is not just working together, this encompasses the skill to respect others, communicate ideas, active listener, cooperate and compromise to achieve a goal [7].

Fives et al. [8] stated that science must be a process of investigating, asking, and then asking more questions recursively and dynamically so that information literacy skills are needed. Akinoglu & Tandogan also suggest that an active learning process centered around the students will prompt them to be responsible and involved in the learning process [9]. Utilizing active learning methods will inspire students and hold their focus by encouraging their direct participation in the course material [10]. Many teaching strategies apply to science education, including Discovery-Inquiry Learning, Problem-based Learning (PBL), Project-based Learning, and similar methodologies. These techniques foster a student-centric educational environment, ensuring their active participation in learning endeavors. Specifically, PBL commences with a problem scenario, framing the learning experience. According to [11] PBL starts by presenting the problem and ends with reflection. In this phase, students are presented with a problem scenario. They formulate and analyze problems by identifying relevant facts. The fact that identification step helps students represent the problems. Upon achieving a deeper comprehension of the problem, students formulate hypotheses regarding potential solutions. Subsequently, students proceed to recognize gaps in their knowledge, often referred to as learning obstacles, which prompt them to seek information for resolving the issues.

In building the theory represented by problems in PBL, students work collaboratively using various sources of information [9]. The information is sourced from diverse outlets like books, online resources, periodicals, or direct consultations with specialists. As a result, students need to possess information literacy to adeptly sift through the information they acquire via the Internet, TV, newspapers, and other mediums. Information literacy is equally vital for students to proficiently locate, assess, and apply information, particularly within scientific subject matter [12].

Some previous research results show that PBL can improve the information literacy of students [13]. Students who engage in PBL can utilize this approach as a chance to develop information literacy, enabling them to rearrange information, integrate it into understanding, and apply it effectively [14]. Then, based on the research results of Cardetti & LeMay [15] elaborate on the fact that students possessing strong information literacy can successfully employ scientific content knowledge in support of their claims. PBL can also improve the collaboration skills of students, it based from the previous research show that the PBL model can train students to think critically and improve cooperative student attitudes [16]. Carriger discovered that the PBL approach might be more efficient in enhancing knowledge attainment through cooperative learning and enhancing collaborative abilities [17]. PBL exercises commonly encourage students to exchange and interact with peers and express their opinions [18].

Lesson study represents a coaching approach in the field of education, achieved through collaborative and ongoing evaluation rooted in the principles of collegial interaction. It unfolds in three sequential phases: planning, execution, and observation. The central emphasis of Lesson Study centers on the engagement of students within the classroom. This approach operates under the premise that student engagement is intricately linked to the actions of the teacher during instructional sessions. In light of this context, the objective of this educational endeavor is to investigate the application of the Problem-based Learning model within the framework of Lesson Study, to enhance students' prowess in information literacy and foster their collaborative abilities.

2 Methods

This mixed-methods approach employs a convergent design within a triangulation model. Triangulation generally refers to a combination of different elements (theories, methods, data, or observer perspectives) in empirical research [19]. The convergent triangulation model entails the collection and examination of data from each study, followed by a subsequent comparison of the outcomes [20]. To depict observer activities, qualitative data analysis methods were utilized while assessing students' information literacy and collaboration skills involved quantitative data analysis. Content analysis was applied for qualitative analysis, while descriptive statistics and percentages were employed for quantitative analysis. The researcher's objective revolves around triangulating the methods by directly juxtaposing quantitative statistical findings with qualitative observations. In the research process, two datasets have been obtained, analyzed separately, and compared. The research process in this study is given in Figure 1.

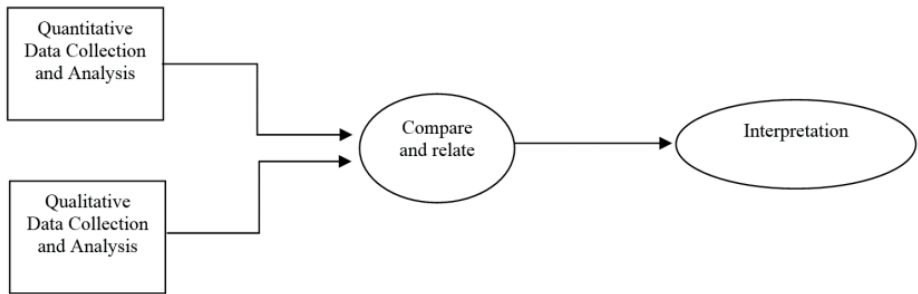


Fig. 1. Convergent triangulation model [21]

The subjects of this study were all 18 postgraduate students in biology education offering A/2022 who took part in the qualitative research methodology course at Universitas Negeri Malang, East Java, Indonesia. This quasi-experiment was conducted in the even semester of the 2022/2023 academic year. The instrument applied aims to measure students' information literacy using Information Literacy Value Rubric by AACU [4] which consists of (1) Determining the extent of information needed, (2) Accessing the needed information, (3) Evaluate the information and its sources critically, (4) Use information effectively to accomplish a specific purpose and (5) Access and use information ethically and legally. Information literacy is measured through an assessment of the bulletin content made in groups. Students' collaboration skills are measured using observation sheets referring to collaboration indicators by [7], student collaboration data obtained from observations by three observers with a reference score as in Table 1.

Table 1. Collaboration Skills Rubrics

Indicator	Category	Score	Descriptor
Work productively	Exemplary	4	We effectively managed our time to stay focused on the task and produce the required work. Each individual fulfilled their assigned duties and sometimes more.
	Proficient	3	We collaborated effectively and mostly remained focused on our tasks until we finished our work. Each individual carried out almost all of their responsibilities.
	Basic	2	We worked together sometimes, but not everyone participated or fulfilled their role, causing difficulties in completing our tasks.
	Novice	1	We didn't work together very well. Each person had their agenda and was more interested in giving directions to others rather than concentrating on the task at hand.
Demonstrates respect	Exemplary	4	All individuals attentively listened and engaged in conversations regarding the shared ideas.
	Proficient	3	Members listened and interacted respectfully most of the time.
	Basic	2	Some people found it challenging to show respect for the ideas of others.

Indicator	Category	Score	Descriptor
Compromised	Novice	1	Team members displayed a lack of willingness to listen to their peers and often engaged in arguments with their teammates.
	Exemplary	4	All individuals showed adaptability in collaborating toward a shared objective
	Proficient	3	We typically managed to find a middle ground to advance our work.
	Basic	2	If more people compromised we would have moved forward faster.
Shared responsibility; everyone contributes	Novice	1	There was a significant amount of conflicting opinions and some individuals wanted it only their way.
	Exemplary	4	Everyone put forth their utmost effort and completed the tasks they were assigned.
	Proficient	3	Most people followed through on their part.
	Basic	2	It was hard to get everyone to do his or her part.
	Novice	1	We really couldn't depend on everyone to do his or her part

3 Results and Discussion

Learning outcomes using the Problem-Based Learning (PBL) model based on lesson study consist of students' information literacy and collaboration skills. The assessment results of the information literacy aspect in the first cycle and second cycle can be seen in Table 2.

Table 2. Increased Information Literacy between Cycle I and II

	Indicator	Cycle I (%)	Cycle II (%)	Escalation	N-Gain	Category
Information Literacy	Determine the extent of information needed	75.00	100	25	1	High
	Access the needed information	58.33	75.00	16.67	0.40	Medium
	Evaluate the information and its sources critically	83.33	83.33	0	0	Low
	Use information effectively to accomplish a specific purpose	75.00	100	25	1	High
	Access and use information ethically and legally	100	100	0	0	Low
	Mean		51.66	91.66	40	0.48

Based on these data, it shows that there is a significant improvement in students' information literacy, especially in the aspects of determining the extent of information needed and using information effectively to accomplish a specific purpose. In the first

cycle, the obtained score was 75.00, which increased to 100 in the second cycle, categorized as high. The indicator access to the needed information also saw an increase, from 58.33 in the first cycle to 83.33 in the second cycle, categorized as medium. However, there was no improvement or consistency in the indicators to evaluate information and its sources critically and access and use information ethically and legally, both of which remained in a low category.

The results of the assessment measured from collaboration skills in terms of each relevant aspect in cycle I and cycle II can be seen in Table 3. Based on these data, it is evident that there has been an enhancement in students' collaborative abilities across each indicator of collaboration. The work productively indicator exhibits the highest improvement, with a score of 66.67 in the first cycle, which further increases to 88.33 in the second cycle, categorized as medium.

Table 3. Increased Collaboration Skills between Cycle I and II

	Indicator	Cycle I (%)	Cycle II (%)	Escalation	N-Gain	Category
Collaboration Skills	Work productively	66.67	88.33	21.67	0.65	Medium
	Demonstrates respect	71.67	90.00	18.33	0.65	Medium
	Compromised	73.33	86.67	13.33	0.50	Medium
	Shared responsibility; everyone contributes	75.00	91.67	16.67	0.67	Medium
	Mean	71.67	89.17	17.50	0.62	Medium

Lesson study is a structured process adopted from Japan that allows a small group of teachers to plan, observe, analyze, and improve actual learning [22]. In lesson study, the teacher prepares learning, makes observations, and evaluates learning carried out by small groups teacher [23]. In small groups, teachers engage in collaborative work centered around four main phases: recognizing an educational challenge and outlining student learning objectives; initial preparations and designing a lesson for a student group (referred to as the research lesson); delivering the lesson to this group under the observation of a team consisting of teachers and researchers; and analyzing the aspects of student learning noticed by the team [24]. Consequently, lesson study, due to its evolutionary and intentional nature, is rooted in and fosters teamwork and introspection as educators cooperate and bolster each other, all the while having the opportunity to learn from others' practices while sharing their own. As a result, educators enhance their knowledge and reevaluate their professional convictions and attitudes, ultimately leading to modifications in their teaching approach.

Lesson study centers around the growth and progress of students. It offers a unique and valuable opportunity for educators to be present in a classroom with the sole purpose of examining student progress, free from the responsibilities of student management or instructional delivery [25]. Because the emphasis lies on the effectiveness of the lesson itself and the acquired knowledge of students, rather than solely on the performance of an individual teacher, this approach aids in alleviating the apprehension and reluctance that some teachers experience when being observed [24]. Each cycle of lesson study comprises three stages: designing a lesson (plan), observing student responses to the lesson (do), and subsequently analyzing those responses (see).

The primary objectives of the planning phase involve establishing the learning objectives for both the research lesson and the broader unit, drawing from standards, research findings, and the current grasp of students. Create a lesson blueprint that connects the existing comprehension of students to the newly identified learning objectives and contemplate or experiment with crucial segments of the lesson [26]. In addition to lesson plans, chapter designs, lesson designs, worksheets, and evaluation questions are also prepared. Chapter design contains essential material that will be learned during learning. Chapter design is displayed in the form of a mind map. Lesson design contains expectations about the learning achievements obtained by students in one learning meeting. Lesson design also includes the material to be taught, the learning model used and the assessment to be used. It is hoped that students will get a positive response from the learning that will be carried out. The lesson plan contains what material will be taught, the learning model that will be applied, and the learning syntax consisting of opening, main learning, and closing.

After meticulously planning the lesson, including the steps, potential challenges, and teacher interventions, the teams proceeded to execute the research lesson. The distinctiveness of lesson study emerges during the observation of student responses, which deviates from conventional teacher observation practices. Instead of concentrating solely on the teacher's actions, the observers gathered data about behaviors or specified goals outlined during the planning phase. Within the realm of information literacy education, PBL stands as a frequently employed approach for both teaching and fostering partnerships with classroom educators. As far back as 2001, Macklin was outlining diverse approaches to integrating PBL within information literacy instruction. Kenney furnishes a structure for incorporating PBL within the conventional "one-shot" library session [27]. Through the application of PBL, she asserts that all stakeholders involved in the information literacy journey reap benefits—students acquire enhanced knowledge, librarians gain increased interaction opportunities with students, and classroom faculty witness positive outcomes.

In this research, students are required to utilize their learning resources and tools to search for and read literature relevant to the studied topic. Reading is highly crucial within the learning process, as it allows students to process the information they've received through readings and literary studies [28]. The introduction of problems can be easily tackled by reading and interpreting the reading outcomes using one's language. Reading to gather literature involves a complex process that combines text and cognitive abilities, which empower the capacity to integrate textual information [29]. Students are instructed to utilize the collected information as supporting arguments to solve the problems. This is supported by an explanation stating that as part of the problem-solving process, students engage in argumentation to justify a proposed solution given available evidence [30].

The outcomes of this problem-based learning are presented in the form of a bulletin as a medium to convey the solutions collected collaboratively according to the format provided by the instructional model. The bulletin can serve as an effective solution for communicating and evaluating processed information. The teacher's role in training information literacy students is by teaching students how to interpret information correctly and re-checking the accuracy of information obtained from bulletins [31], while this

learning activity is designed not only to check information but to compile accurate information in the form of bulletins, relates to the indicator of use information effectively to accomplish a specific purpose. Bulletins can convey messages from message sources to message recipients through a particular media [32], related to indicators of information literacy determine the extent of information needed. This is reinforced by [33], who state that evaluation is necessary to obtain feedback to deepen the information related to the problem-solving process. Moreover, it enhances students' comprehension of applying suitable solution strategies for continuous utilization.

The significance of information skills or information-seeking abilities, a component of information literacy, about PBL, has been extensively addressed in existing literature. Oker-Blom contended that information skills form the essential foundation for effective independent learning within the framework of PBL [34]. Similarly, Rankin highlighted the pivotal role of "information-seeking skills" in the PBL curriculum, which emphasizes self-directed learning, problem-solving, and lifelong learning capabilities. The comprehensive review of the literature undeniably underscores the paramount importance of information literacy skills in achieving the objectives of problem-based learning. Consequently, students need to receive training in information literacy, not solely to acquaint them with various information literacy skills, but also to enable them to proficiently engage in information literacy. Neglecting the preparation of students in information literacy would undoubtedly impede the effectiveness of PBL. PBL and information literacy are closely related. Given that inquiry-based PBL mandates students to extensively investigate specific matters, subjects, or challenges [35], the role of information literacy becomes pivotal. This is because information literacy aids learners in evolving into "discerning consumers of information and innovative generators of knowledge [36], a skillset indispensable for effective engagement in such a process.

The syntax stages considered to contribute the most to the improvement of students' information literacy are developing and presenting works and exhibitions and analyzing and evaluating the problem-solving process. This is because, during these stages, students endeavor to gather information and define the boundaries of relevant information by employing a series of methods to structure it into alternative solutions. This is supported by explanations stating that during the process of developing solutions, students are required to make assumptions related to the phenomena of the presented problems. Feasible solutions are those that integrate theory and practice while applying knowledge and skills [37]. Various pieces of information are then effectively employed and analyzed as a problem-solving process to determine the optimal solution. The benefit of the problem-solving process is that teachers assist students in analyzing their thinking processes in problem-solving, leading to a clear understanding of solution approaches [38].

The incorporation of PBL models into learning activities facilitated student collaboration across groups, fostering both their learning journey and interpersonal skills. This correlates with the findings of [9], who reported that the collaborative nature of PBL instruction positively impacted students' cooperation and social growth due to its group-based approach. Additionally we noted that PBL involved collaborative groups, allowing students to compare and assess their comprehension against others' perspectives, thus enhancing their academic accomplishments. However, Diekema et al. [39] introduced a nuanced perspective, asserting that Problem-Based Learning proved effective

for select students who engaged in authentic problem-solving, deeply interacted with information, distilled their findings, evaluated their logical and contextual validity, and subsequently applied these insights to refine their research strategy and develop a more profound personal understanding. Supporting this, [10] aligned with these findings by affirming that integrating information literacy through PBL actively engaged students, helping them comprehend how information resources aligned with their assignments.

The syntax phase organizes students and guides individual and group investigations, becoming the stage that contributes the most to enhancing students' collaboration skills. This is because students learn to comprehend their tasks thoroughly and outline the steps to be taken in problem-solving. Students engage in peer discussions to clarify role assignments within the problem-solving process, [40] elaborate that discussions steer students to understand their group, harmonize perceptions, and grasp their roles within a group striving to achieve a common goal. This is evident from the obtained results, which indicate that the work productively indicator becomes one with the most notable improvement throughout the learning process. Students who understand their roles and responsibilities will utilize their time as efficiently as possible to work towards generating the best solutions. In terms of collaborative skills, particularly in the domain of effective teamwork, there was an observable enhancement in displaying respect and a noticeable increase in sharing responsibilities during the second cycle. Students demonstrated enthusiasm for conducting investigations both autonomously and within groups, finding a sense of unity in the process of exchanging ideas and information, which contributed to enriching their overall learning journey.

4 Conclusion

The implementation of the lesson study-based problem-based learning model demonstrated that students achieved optimal information literacy and actively engaged in collaboration during the learning process. This is evident from the observed results, which showed that students made efforts to search for, identify, process, evaluate, and effectively utilize information to solve given problems. Furthermore, students' ability to build collaboration to address problems was also highly commendable, as they focused on their tasks, exchanged ideas, and displayed empathy towards their peers to arrive at the best problem-solving solutions. Therefore, the utilization of the problem-based learning model proved to be effective in enhancing students' information literacy and collaboration skills.

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