



Project-Based Learning: A Hands-On Activity to Improve Students' Scientific Writing Skills through Lesson Study in Microtechnique Course

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Abstract

Project-based learning has been recognized as a dynamic classroom approach in which students actively explore real-world problems to obtain deeper knowledge. This study aimed to describe the implementation of project-based learning to improve students' scientific writing skills. This action research was conducted based on Lesson Study (LS), which incorporated the plan-do-see phase. The descriptive research was done on 40 undergraduate students in the sixth semester of Biology Education Department, Faculty of Teacher Training and Education, Universitas Muhammadiyah Malang, who attended Microtechnique course. The students' scientific writing skills were measured using a students' worksheet, which asked them to develop a scientific article. The observed parameters were how students proposed introduction, problem statement, method, result, discussion, conclusion, and reference. The data were analyzed descriptively. The result showed that students' scientific writing skills were improved after implementing project-based learning. Some of the obstacles to implement LS were related to the schedule and preparation. It can be resolved by conducting more intense coordination and regular discussions involving all research members.

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INTRODUCTION

Project-based learning (PBL) is a student-centered pedagogy that involves a dynamic classroom approach in which students gain knowledge and skills by working for an extended period of time to investigate and respond to an authentic, engaging, and complex question, problem, or challenge (Baker *et al.*, 2011; Bell, 2010; Kokotsaki *et al.*, 2016; Takeda, 2016). PBL prepares students for academic, personal, and career success, and readies young people to rise to the challenges of 21st-Century (Baker *et al.*, 2011; Bell, 2010; Takeda, 2016; Talat & Chaudhry, 2014). In PBL, teachers make learning come alive for students (Kokotsaki *et al.*, 2016). Students work on a project over an extended period – from a week up to a semester – that engages them in solving a real-world problem or answering a complex question (Holubova, 2008; Schwartz *et al.* 2013). They demonstrate their knowledge and skills by developing a public product or presentation for a real audience (Bell, 2010).

As a result, students develop in-depth content knowledge as well as critical thinking, creativity, and communication skills in the context of doing an authentic project. Communication skills can be expressed in the form of scientific writing (Deng *et al.*, 2019). Scientific writing is designed to communicate scientific information to other scientists. Writing scientific papers is based on the ability to use written language as communication. The use of written words is influenced by one's ability to use linguistic elements such as spelling, diction, grammatical, paragraphs (Dirrigl & Noe, 2014). The result of scientific writing has several characteristics, namely, logical, systematic, and objective. Logical writing means an essay that has data, arguments, and scientific reasoning delivered can be accepted by logic. Systematic means the problems conveyed are arranged regularly, coherently, and do not overlap. Objective means that the explanation expressed is not excessive and does not originate from one's perspective (Archilav, 2018; Bird & Yucel, 2013; Dirrigl & Noe, 2014).

However, scientific writing skill in Indonesian people is still low. This is evidenced by the low ranking of the Indonesian in the SJR (Scimago Journal and Country Rank) with a ranking of 48 (Scimago, 2019). The low level of scientific writing skills needs to be improved by applying learning models that can accommodate this skill, such as project-based learning. Project-based learning could support the construction of knowledge and competence development of productive learners who appear in the forms of skill occupational/technical skills, and skill as good workers that are needed in real life (Baker *et al.*, 2011; Kokotsaki *et al.*, 2016). Project-based learning can be applied to lectures that produce products, one of which is microtechnique. The competence of this course is the student may make preparations microtechnique and use it in making research articles based on microtechnique and histology.

The preliminary observation was conducted in learning process of microtechnique in undergraduate student of Department of Biology Education Universitas Muhammadiyah Malang (UMM), the result obtained were: 1) students were able to follow the procedure of making preparations but cannot explain the analysis and evaluation of the method, 2) the student has not been given a challenging task or problem, 3) the students can not correlate the learning process with its application, 4) students tend not make reflection after learning process to identify difficulties faced by them, 5) the learning objectives mostly limited to low-level cognitive. The observation result showed that classroom action result is essential to be conducted. This study aimed to describe the implementation of project-based learning to improve students' scientific writing through Lesson Study.

Lesson Study (LS) is a Japanese model of teacher-led research in which a triad of teachers works together to target an identified area for development in their students' learning (Saito & Atencio, 2014). Using existing evidence, participants collaboratively research, plan, teach and observe a series of lessons, using ongoing discussion, reflection, and expert input to track and refine their interventions *et al.*, 2018; Saito & Atencio, 2014). LS implementation includes several phases, namely planning (plan), implementation (do), and reflection (see). LS can learn to the undergraduate students (as a future teacher), because the LS has done regularly and to improve the competence and professionalism of lecturers. Implementation of LS in learning activities not only as an effort to enable students but also resulted in a review of the performance of lecturers and the development of students' academic abilities and cultivate an attitude of cautious and responsible in the study (Saito & Atencio, 2014). LS observed and reflected jointly by the student, observer or by the lecturer.

RESEARCH METHOD

This classroom action research study conducted based on Lesson Study (LS), which incorporated the plan-do-see phase. The cycle of LS is presented in Figure 1. The research subject were 40 undergraduate students in sixth semester in Biology Education Department, Faculty of Teacher Training and Education, Universitas Muhammadiyah Malang who attended Microtechnique course. The students' scientific writing skills were measured using student worksheet, which asked them to develop a scientific article. The measured parameters were how students proposed introduction, problem statement, literature used, method, result, discussion, conclusions, and reference. The students' competence in writing a note logbook was also described. The data were analyzed descriptively.

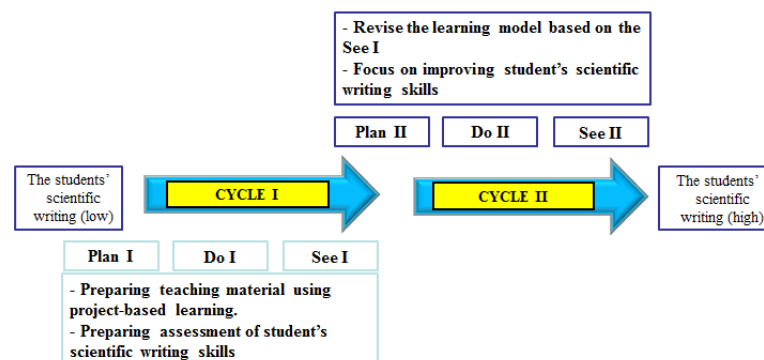


Figure 1 The learning cycle based on LS

RESULTS AND DISCUSSION

Plan I

The researchers (LS team) planned to arrange the lesson design based on project-based learning to improve the students' scientific writing skills in the microtechnique course (Figure 2). There are some assessment which were prepared, namely: (1) the students' worksheet, (2) the instructional guidance, (3) the need assessment, and (4) the observation sheet. The measured parameters of students' scientific writing skills were how students proposed introduction, problem statement, literature used, method, result, discussion, conclusion, and reference. In the plan stages, the researchers also design lessons through collaborative works

that predict the student's response, anticipate and provide students with a necessary assistant. The model lecturer prepared any equipment for instructional activities in the classroom. Meanwhile, the observers do observation during the learning process. Each of the observers noted what the students were learning into the observation sheet for fulfilling the need of coming to see phase in cycle I.



Figure 2 The planning phase in cycle I

Do I

In the do stage, the students made groups based on their works about microtechnique methods for example: (1) wholemount technique for animal, (2) section animal, (3) maceration preparation, (4) pollen, (5) rub preparation, (6) squash technique, (7) smear technique, (8) span technique. (9) section plant, and (10) wholemount technique for the plant. Figure 3 is presenting the students' activity in their project of making preparation. Furthermore, the students discuss the problem and presenting their discussion progresses. Then the summing up the students' works and make an explanation for further activity.



Figure 3 The do phase in cycle I

See I

After Cycle I had been accomplished, the seeing phase was conducted at the end of instructional activity. This aimed at seeing how the instructional activities ran and what the students had learned. The result of the see phase was used to make a revision in the next cycle. The see phase of Cycle I showed that it was necessary to provide a special guidance for those who had not been successful yet in arriving at the expected competency. In the see phase in Cycle I, the lecturer and the observers also assessing the students' preparation product (Figure 4).

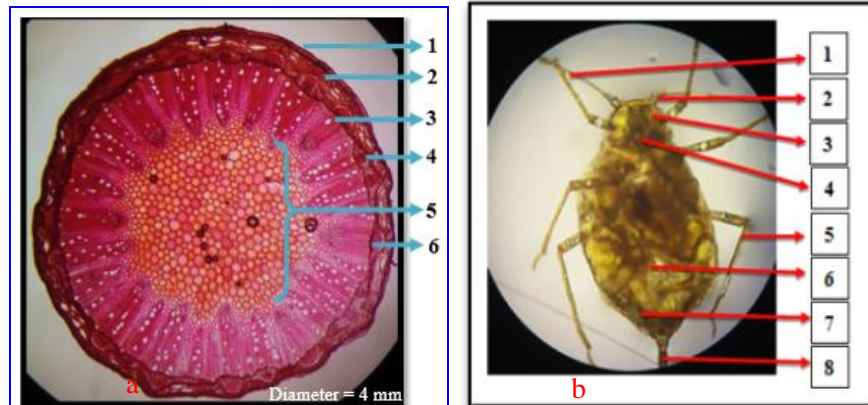


Figure 4 (a) Section preparation of *Pluchea indica* stem showing (1) epidermis, (2) cortex, (3) xylem, (4) phloem, (5) stele, and (6) vascular cambium. (b) Preparation of *Aphis gossypii* showing (1) antenna, (2) tubercle antenna, (3) eye, (4) chepal, (5) 3 pairs feet, (6) abdomen, (7) sifunkuli, and (8) cauda.

Plan II

Plan phase in Cycle II was conducted based on the see phase in Cycle I. The LS team provide a special guidance for the student who had not been successful in producing preparation products. Some of the preparation products can be assessed by observers. Some factors caused the condition were too much staining of preparation and the slice of preparation that are less thin. After that, in Cycle II, students were also ask to make an article based on the preparation technique and material used in the do phase in Cycle I. In this part, the student must explore their skill to make scientific writing articles. The observers and the lecture model will asses the article product.

Do II

In do phase of Cycle II, the student was conducting a discussion to arrange their scientific article group (Figure 5). They learned to write their finding based on the project was done. The lecture model was giving assistance for the student to produce a scientific article. The example of essay is presented in Figure 6.



Figure 5 In the do phase in Cycle II, and students discuss their findings in their project to produce a scientific article.

Identifikasi Struktur Anatomi Irisan Melintang *Radix* dan *Caulis* Empat Spesies Tumbuhan menggunakan Metode Section Tumbuhan sebagai Sumber Belajar Biologi SMA

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ABSTRAK

Metode section tumbuhan merupakan metode pembuatan preparat mikroteknik yang ditujukan untuk objek-objek yang besar dan tebal pada tumbuhan menggunakan teknik parafin sebagai media embedding dengan irisan yang tipis.. Penelitian ini bertujuan untuk mengamati struktur-struktur jaringan tumbuhan dalam bentuk irisan melintang akar dan batang yang dikembangkan menjadi media preparat sebagai sumber belajar biologi pada SMA kelas XI.

Jenis penelitian ini adalah deskriptif kualitatif dengan pendekatan berupa penggambaran keadaan secara naratif Preparat permanen dibuat agar dapat diamati kembali sehingga dapat digunakan sebagai bahan siswa dalam melakukan kegiatan praktikum struktur jaringan tumbuhan. Tanaman yang diidentifikasi yaitu akar dan batang tumbuhan Langsung (*Lansium domesticum*), Beluntas (*Pluchea indica*), Gadung (*Dioscorea hispida*), dan Bunga kupu-kupu (*Bauhinia purpurea*). Data dianalisis dengan analisis diskriptif.

Hasil penelitian menunjukkan bahwa struktur anatomi akar dan batang tumbuhan baik itu dikotil atau monokotil mempunyai bagian-bagian jaringan yang sama seperti empulur, jari-jari empulur, berkas pengangkut (xylem dan floem), berkas penguat (parenkim dan sklerenkim), kambium, korteks, dan epidermis. Perbedaan tanaman dikotil dan monokotil terletak pada struktur berkas pengangkut. Hasil penelitian ini dapat dikembangkan menjadi sumber belajar biologi SMA Kelas XI Bab Struktur Jaringan Tumbuhan

Kata Kunci: Metode section, struktur anatomi, sumber belajar, *Lansium domesticum*, *Pluchea indica*, *Dioscorea hispida*, *Bauhinia purpurea*

Figure 6 The sample of article result which is written by the student (in Indonesian language).

See II

The reflection outcome gained from Cycle II showed that there is an improvement in the students' scientific writing skills (Table 1). The parameters measured including how students proposed introduction, problem statement, literature used, method, result, discussion, conclusion, and reference.

Table 1 The students' scientific writing skills.

No	Indicator	Observation 1 (%)	Observation 2 (%)	Improvement (%)
1	Introduction	2.9	3.1	0.2
2	Problem statement	3.0	3.2	0.2
3	Literature used	2.7	3.0	0.3
4	Research method	3.2	3.4	0.2
5	Results (data and findings)	3.1	3.3	0.2
6	Discussion	2.8	3.1	0.3
7	Conclusion	3.2	3.3	0.1

8	Reference	3.1	3.2	0.1
	AVERAGE	3.0	3.2	0.2

The results of this study showed that the students have the ability to write scientific articles based on the data obtained from the evaluation of the article products. The average of students' scientific writing skill in 8 parameters were 3.0 in Cycle I, and 3.2 in Cycle II. The average improvement for all indicators was 0.2 %. The result showed that the student's scientific writing skills were low. However the implementation of project-based learning can improve these skill. According to Hunget *al.* (2004), project-based learning can promote student to produce learning achievement. In this research, the student product preparation section and also scientific article. The project-based learning stage also provides problem which engages the students' motivation to solve the problem (Badia & Soria, 2017; Bell, 2010; Chiang & Lee, 2016; Habók & Nagy, 2016). In this research, student was solve the problem related to preparation production as learning media.

The collaborative discussion stage in the learning process also helps the student to provoke their reasoning skill. In line with Deng *et al.* (2019) statement, integrating reading, peer evaluation and discussion can influence the student's scientific writing. The collaborative method also helps the student to improve their skill in writing (Gamberi & Hall, 2019; Perrault *et al.*, 2011). However, the result showed that the students' scientific writing skill was still low. Thus the implementation of project-based learning need to be continued by combining various supporting techniques. Some of the obstacles to implementing LS were related to the schedule and preparation. It can be resolved by conducting more intense coordination and regular discussions involving all research members

CONCLUSION

The result showed that students' scientific writing skills were improved after implementing project-based learning. Some of the obstacles to implementing LS were related to the schedule and preparation. It can be resolved by conducting more intense coordination and regular discussions involving all research members.

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