Universitas Muhammadiyah Malang, East Java, Indonesia

JPBI (Jurnal Pendidikan Biologi Indonesia)

p-ISSN 2442-3750, e-ISSN 2537-6204 // Vol. 5 No. 1 March 2019, pp. 41-50

Research Article

Project-based learning: Improving students' activity and comprehension through lesson study in senior high school

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ARTICLE INFO

Article history
Received January 16, 2019
Revised February 14, 2019
Accepted February 24, 2019
Published February 27 2019

Keywords
Comprehension on concepts
Learning resources
Lesson Study
Project-based learning

ABSTRACT

Fostering teacher's creativity can be facilitated by conducting Lesson Study (LS) which implementing Project-Based Learning (PjBL) using designing learning resources. This descriptive qualitative research was using a model teacher who did three open classes on 'human reproduction system' material and targeting the twelfth grade of senior high school students in Sumberpucung Malang as the research subject. The observers comprised three teachers and three lecturers. As for reflection in every open class, four students involved as the informants. The implementation of the model was considered very effective to improve the students' learning activities, due to several reasons, namely: (a) almost all of the students were actively get involved in the learning process; (b) there was an improvement in the number of active students; (c) the instruction was positive to uplift the quality of classroom management; (d) the students were stimulated in formulating questions and giving opinions; (e) joyful learning was created; (f) most of the students had gained prior knowledge and comprehension of the given problems and concepts before they were presenting it.

How to cite: Rofieq, A., Latifa, R., Susetyarini, E., & Purwatiningsih, P. (2019). Project-based learning: Improving students' activity and comprehension through lesson study in senior high school. *JPBI (Jurnal Pendidikan Biologi Indonesia), 5*(1), 41-50. doi: https://doi.org/10.22219/jpbi.v5i1.7456

INTRODUCTION

On February 2017, an observation of pre-Lesson Study (pre-LS) was conducted, which showed that there were as many as 20% of the twelfth graders of SMAN (*Sekolah Menengah Atas Negeri* or State Senior High School) Sumberpucung in Malang Regency at the East Java Province of Indonesia actively involved in Biology instructional activities; while the rest 80% were shown to be less. Instead, the 80% tended to keep talking to their chairmates, joking, and susceptible to any distractions. In accordance with the result of Focus Group Discussion (FGD) with the teachers and observers, it was assumed that it happened due to improper implementation of classroom discussion method and the absence of instructional media.

Making use of learning resources for instruction constitutes one of teachers' efforts to improve the level of students' comprehension on learning materials (Cohen, Raudenbush, & Ball, 2003; Hightower et al., 2011;

Rosenshine, 2012; Walberg, 2010). Learning resources, in essence, refer to any objects or situations that are existent around learning environment (Blazar & Kraft, 2017; Bouzeghoub, Do, & Lecocq, 2007; Coe, Aloisi, Higgins, & Major, 2014; Guardino & Fullerton, 2010; Koper, 2003) and can functionally accommodate and optimize learning outcomes (Khalil & Elkhider, 2016; Lento et al., 2014; Masino & Niño-Zarazúa, 2016). Many learning resources can stimulate students' brain to draw out a concept more concretely so as to trigger easier comprehension and better knowledge mastery. The selection of learning resources is to be planned by teacher 'by design' based on particular needs (Fullan & Langworthy, 2014; Kamina & Iyer, 2009; Karamustafaoglu, 2009; Niemi, 2009). Accordingly, need assessment is to be administered to syllabus, basic competences, learning objectives, and students' needs (Bryson, 2013; Cartwright, Weiner, & Streamer-Veneruso, 2010; Hunt, 2015). For that reason, Hodge and Anderson (2007) proposes the term 'instructional media' as learning resources.

In general, learning resources must be prepared by teachers or have been existent in schools (Carr, 2007; Carroll, 2012; Coe et al., 2014; Kohl et al., 2013). Most of teachers have prepared and determined some sorts of learning resources they are going to make use of for instruction by referring to lesson plans. Alluding to 2013 Curriculum, teachers are required to make use of learning resources for scientific quality improvement. With respect to the observation result (on February 2017), it was reported that all Biology teachers had performed any attempts to procure and make use of learning resources in every instructional session. The learning resources could be the media that had been existent in the school or designed by the teachers; or it could be any situations around learning environment. However, in fact, not all available learning resources covered the intended materials. Hence, the teachers were demanded to be far more creative in planning learning resources to use. One of possible solutions offered was to assign the students to independently design their own learning resources in a group through elaborative study on learning objectives, literature review, and learning needs.

The implementation of assigning the students to design their own learning resources required proper method or model of scientific learning (Anderman, Sinatra, & Gray, 2012; Bušljeta, 2013; Coil, Wenderoth, Cunningham, & Dirks, 2010; Dunlosky, Rawson, Marsh, Nathan, & Willingham, 2013; Movahedzadeh, Patwell, Rieker, & Gonzalez, 2012). The main consideration to take into account was that the model was equipped with syntax, consisting of group working, time allotment for designing learning resources, consultation with the teacher, and presentation. All in all, one of scientific approaches with that sort of syntax is Project-Based Learning or PjBL (Arce, Miguez, Granada, Miguez, & Cacabelos, 2013; Bell, 2010; Fadly & Wasis, 2017; Greenstein, 2012; Shinde, 2014; Sumarti, Cahyono, & Munafiah, 2015). The PjBL model was implemented by assigning the students, in groups, to independently design and elaborate learning resources from some assorted literatures. According to Dickinson and Jackson (2008) and also Sani (2014) students automatically comprehend and learn prior materials before an instructional activity starts.

Based on the issue that arose on the observation and FGD (on February 2017), LS was piloted as a practice of teacher's professional training for Biology subject on the twelfth graders of senior high school level. Further, the focus of the LS was 'to implement PjBL model through a project of independently designing learning resources in groups outside the classroom meeting hours to improve the students' activities and comprehension on Biology concepts.

METHOD

This descriptive qualitative research was implemented LS on the twelfth graders of the senior high school attending Natural Science (or *Ilmu Pengetahuan Alam*/IPA), specifically on class XII IPA-1 (31 students) and XII IPA-2 (30 students) during even semester on academic year 2017/2018 under 'Human Reproduction System' material. The one appointed as a model teacher was a Biology teacher for the twelfth graders of the senior high school. Meanwhile, three lecturers from Department of Biology Education, the Faculty of Teacher Training and Education-University of Muhammadiyah Malang and three teachers from the same school as that of the model teacher were set as observers. Thereunto, LS was run in three instructional activities, March to May 2017.

The instruction was initiated by pre-LS on February 2017 by administering observation and FGD about instructional activities commonly performed by Biology teachers. Next is LS implementation in which it was administered in three instructional activities: open class-1 in class XII IPA-1 by means of pictures in the students' book as learning resources; open class-2 in class XII IPA-1 by means of PowerPoint created by the students; open class-3 in class XII IPA-2 by means of media independently designed by students. In open class-1, the instructional model used was Problem Based Learning (PBL), and in the next open class, PjBL was chosen. The syntax of PjBL used in the LS was referred to a guideline from the Ministry of Education and Culture comprising six phases, to name: (1) problem delivery; (2) planning a project; (3) setting a schedule; (4) monitoring; (5) testing on results; and (6) evaluation on experience. Withal, a scheme of LS implementation is shown in Table 1.

Table 1. A Series of activities and schedule of the instructional

No	Scheme	Open Class-1	Open Class-2	Open Class-3
1.	Month(s)	March 2017	March 2017	April 2017
2.	Material(s)	Plant Reproduction System	Human Reproduction System	Human Reproduction System
3.	Model(s)	*Problem Based Learning* (PBL)	*Project-Based Learning* (PjBL)	*Project-Based Learning* (PjBL)
4.	Class(es)	XII IPA-1	XII IPA-1	XII IPA-2
5.	Learning Resources (media)	Pictures in the Students' Book	PowerPoint created by the students	Media designed by the students
6.	Method(s) of Data Collection	Observation, FGD, and Interview	Observation, FGD, and Interview	Observation, FGD, and Interview

RESULTS AND DISCUSSION

There were three open classes of instructional activities. Open class-1 constituted preliminary phase of LS (Pre-LS). Meanwhile, open class-2 and open class-3 were conducted by means of LS.

Open class-1

Open class-1 constituted Pre-LS, which was administered in class XII IPA-1. Pre-LS was a phase in which the teacher accommodated a regular instruction without any LS implementation on 'Human Reproduction System' material by implementing PBL model. The essential aim of the program was to identify instructional characteristics, such as overall situation, common habit and behavior shown by the Biology teacher in terms of classroom management, the students' activities during class, and classroom overall condition.

During the instruction, the teacher started the class by distributing worksheet with four pictures of how plant underwent its reproduction process along with several problems and questions written next to them. After all the students received the worksheet, the teacher explained the pictures with several examples of reproduction process that happened around the students' environment. The teacher, then, divided the students into six groups. Each of the groups was to discuss the problems and questions based on the pictures before jotting down their answers. The next phase was that the students were involved in classroom discussion in order to analyze and synthesize problems and the most correct answers. At last, the teacher, together with some of the students, performed a critical analysis to clarify the answers.

Alluding to the observation result in terms of classroom conduciveness, it was shown that there were 15 of the students actively focused on the instruction; while the rest 16 were shown to be less attentive. Some following details were tapped: the classroom condition was crowded; many students kept talking to their chair-mates; many moved from their own chairs to other chairs (from row to row); some did not really get involved in the discussion; and some seemed to open and read some other books. Moreover, in classroom discussion session, as many as a quarter of the students showed their critical thinking process in formulating questions or sharing their thoughts, through analysis and synthesis on the concepts served in the material.

In FGD session with the model teacher, observers, and six representatives of the students, it was identified that some of the students did not fully comprehend the problems. As the consequence, neither were they interested in group nor classroom discussion. All the students claimed that the learning situation and condition were still the same as usual. One detectable drawback of conventional instruction is that students are shown to be less contributive to the instruction. One of determinant factors that causes students' learning outcomes to be less optimal is abstractly conducting instructional activities (Dickinson & Jackson, 2008). For that reason, teachers are demanded to be more innovative and selective to take into account, choose, and implement scientific models of instruction (Cajkler, Wood, Norton, Pedder, & Xu, 2015; Isabekov & Sadyrova, 2018). Further, scientific model of instruction is believed to give students a chance to perform life-based learning through life experiences.

Implementing scientific model of instruction completely requires teachers' skill and experiences in managing the instruction. Indeed, they are demanded to be well-experienced in collaborating with other teachers or lecturers to optimize learning outcomes. Consequently, the LS team agreed to set open class-2 by design with LS as a model of professional training program. According to Saito and Atencio (2015), LS constitutes a model of teachers' professional training through collaborative instructional review.

Open class-2

In open class-2, LS was implemented in the same class, XII IPA-1. It focused on 'Human Reproduction System' material. The open class-2 was designed by referring to the reflection on the previous instructional activity. The main facets to concern on for betterment were instructional model and learning resources. The LS team agreed to make use of PjBL as the instructional model; while learning resources were to be treated as the students' group project.

Planning

This stage was initiated by 'planning'. The LS team, comprising three lecturers from UMM, a model teacher, and four teacher observers, had conducted a workshop to set a lesson plan on 'Human Reproduction System' material and to design the syntax of PjBL. The design was made collaboratively in the forms of chapter design and lesson design by considering basic competence, material indicators, substances of lesson plan, as well as the students' and teacher's needs for instruction. The results of chapter design and the lesson design are displayed in Figure 1. The LS team decided that the chosen material, 'Human Reproduction System', was divided into three subcategories, namely: 'male and female reproduction organs', 'physiological process of reproduction', and 'reproduction health'. For the project, the students were assigned to create instructional media for presentation by means of Microsoft PowerPoint program. The instructional activity was run by means of PjBL syntax based on the guideline from the Ministry of Education and Culture.

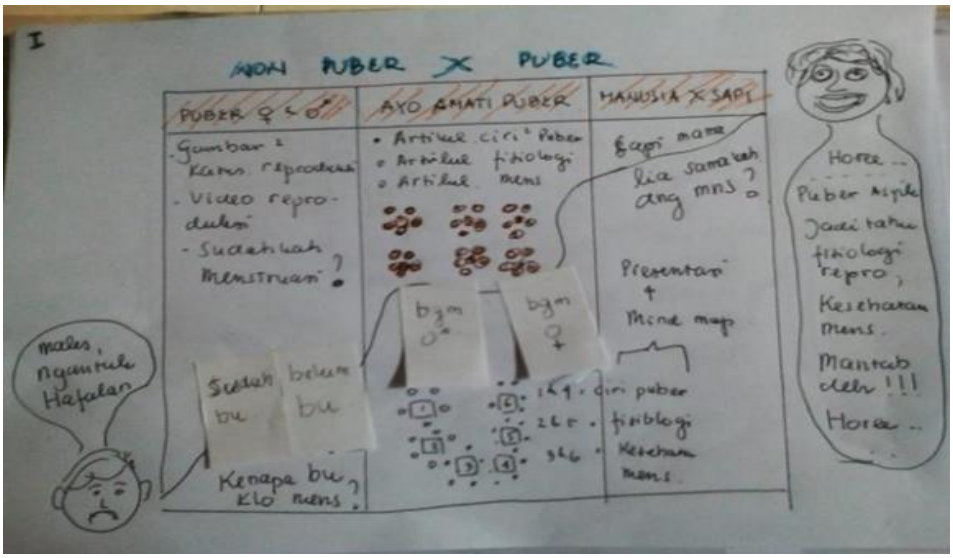

Figure 1. The results of lesson design for open class-2

Implementation

In the implementation, the teacher implemented PjBL model to accommodate the instruction as agreed by the LS team. The first, second, and third syntaxes were implemented in the first meeting (during the classroom meeting hours) for about 30 minutes. The fourth syntax was administered outside the classroom meeting hours for six days. Next, the fifth and sixth were administered during the classroom meeting hours for 2 x 45 minutes. In detailed, the followings are the descriptions of each stage performed in class: (1) syntax-1: problem delivery which constituted the first phase where the teacher shared some common problems in respect to 'Human Reproduction System'; (2) syntax-2: planning the project in which the teacher divided the students into six groups – with two groups working on learning resources about physical characteristics of puberty, two groups on reproduction physiology, and two groups on reproduction health. The teacher explained to the students that the project was to be completed outside the classroom meeting hours in six days; (3) syntax-3: setting the schedule where the teacher and students, altogether, made an agreement about consultation for project development; syntax-4: monitoring, which allowed the teacher to intensively observe the students' progress in finishing the project outside the classroom meeting hours based on the stipulated schedule; and syntax-5: testing on the results in which each of groups was to present the result of the project (Figure 2).

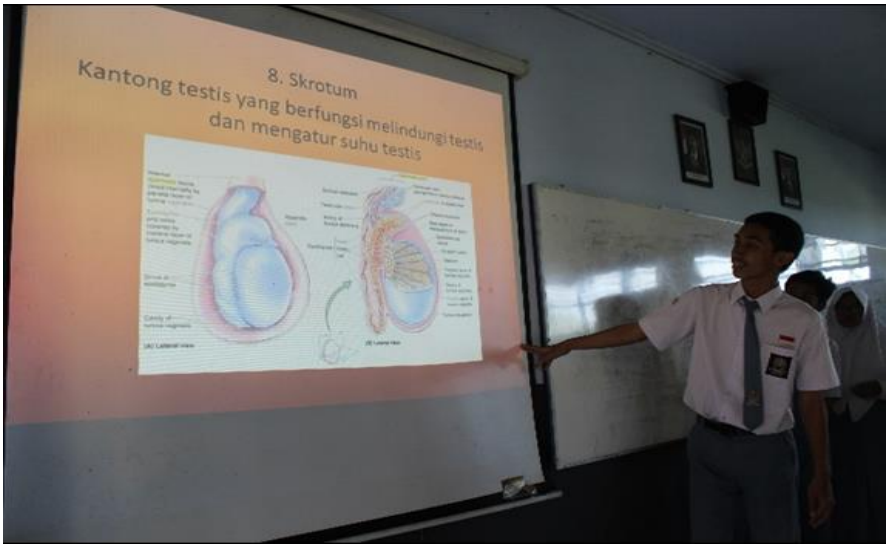

Figure 2. A group of students of XII IPA-1 presenting their learning resources for 'Human Reproduction System' material

The teacher invited the students to discuss some problems that had been shared and explained in syntax-1 by means of media they had designed. During the meeting, the teacher gave a chance to the students to analyze and evaluate three materials delivered about reproduction system. The teacher also set time allotment to criticize and give feedbacks on the substances of the material included in the media designed by other groups. In syntax-6, the teacher gave a chance to all the students to evaluate their experiences in designing the project. However, the last syntax could not be implemented for the time had almost been running out, remaining 15 minutes. Consequently, the teacher switched to instructional reflection and follow-up. The LS team observed all stages implementing PjBL, excluding syntax-4, monitoring. The session of monitoring was executed by the model teacher outside the classroom meeting hours. Besides, the LS team conducted an interview with the model teacher and six students (representing each of the groups). The observation took place during the instructional activities; while the interview was conducted after the instructional activities were completed.

Reflection

The LS team made a reflection after the instructional activities. The method for reflection was based on two techniques, namely: evaluating the instruction and comparing to open class-1. The LS team revealed that, based on the observation on classroom conduciveness, the number of active and attentive students (23) higher than the previous session did (17). It explicated that as many as 8 students were shown to be less active as the learning atmosphere was somehow unconducive as that in open class-1. It was illustrated by the followings: some of the students preferred talking to their chair-mates; some of them kept moving from one to another chair (row to row); some seemed 'not really' involved in group and classroom discussions; some opened some other books other than Biology book; and there were two groups busy to revise and improvise their PowerPoint slides in their laptops. In classroom discussion, students were more stimulated in formulating questions and sharing their thoughts, from 10 to 16 students. The students were confident to analyze, synthesize, and evaluate the concepts, which had been a serious problem in learning, all this time.

The result of FGD with the model teacher, observers, and student representatives resulted in a fact that there were some of the students with the lack of comprehension on the problems under discussion. They felt uninterested in analyzing and discussing the project, either in a group or classroom context. In addition, the reasons why they were less participative on the project was that they could not operate PowerPoint program, they did not have any laptop, and only few students operated the PowerPoint slides during presentation. All the students admitted that the learning situation or condition was better than that in open class-1, with the joyful learning increase. The model teacher also assumed that there was a syntax in PjBL model seeming unfeasible. The burden the teacher might have to face was when she was to visit her students' houses one by one to observe the progress of media creation. As there were six different groups, the teacher was to monitor, at least, six times in total. In addition, the LS team concluded that syntax-6, evaluation on experiences in designing the project, was not effective to foster the students' mastery on the learning material. According to Saito and Atencio (2015), in implementing LS, it is necessary that teachers choose the most effective activity.

Based on the result of reflection, it was recommended that the fore-coming PjBL instructional activities be more effective in terms of learning process, quality of learning resources, and the students' participation in developing learning resources. PjBL model would give a broader chance to students to partake and be responsible for instruction (Arce et al., 2013; Fadly & Wasis, 2017; Greenstein, 2012; Kokotsaki, Menzies, & Wiggins, 2016; Savery, 2006). According to Holubova (2008) and Kokotsaki et al. (2016), PjBL could raise a constructive investigation and reflection on the real life. For that reason, designing instructional activity should focus more on students.

Open class-3

Open class-3 was designed to highlight and accommodate what was recommended by open class-2. The targeted foci of instructional training to be maintained were the syntax of PjBL and technique of learning resource development.

Planning

The LS team held a workshop to design a scheme of new instruction based on what was gained in open class-2. The syntax of PjBL was compressed from six to four. The four agreed syntaxes comprised planning, creating, presenting, and evaluating. The consideration to cut the syntax was based on Savery (2006) and also Saito and Atencio (2015) who underpin that instructional activities have to be designed as effective as possible. In the syntax of newly designed PjBL, two syntaxes were removed, namely monitoring and evaluation on experiences during the project. Further, the technique for material development by groups of students was replaced by learning resources, in the form of visual media, independently created by the students. The learning material was set the same as that in open class-2, 'Human Reproduction System', but the class was made different, which was on class XII IPA-2. For chapter design and plot of lesson design, the material was still adopted from the design used in open class-2 (see Figure 1). Notwithstanding, the draft of lesson plan was changed as shown in Figure 3.

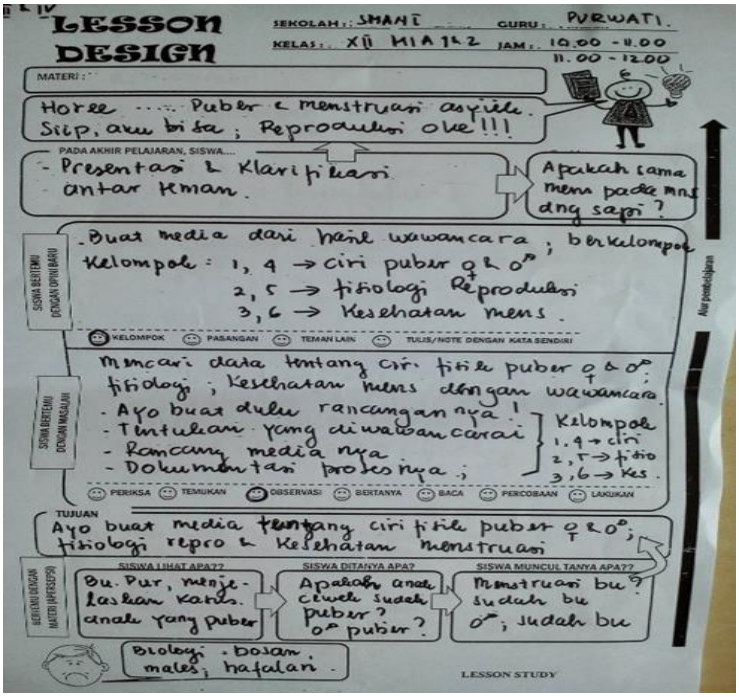

Figure 3. The illustration of lesson plan summary during the lesson design in open class-3

Implementation

In its implementation, the teacher applied the syntax of newly designed PjBL comprising four syntaxes. Syntax-1 was implemented by the teacher and students in the classroom on the first meeting for 30 minutes. Syntax-3 and syntax-4 were conducted by the teacher and students altogether in 2 x 45 minutes. Meanwhile, syntax-2 was piloted outside the classroom meeting hours for six days by the students in groups. Syntax-1 was planning, in which the model teacher delivered problems related to human reproduction system and invited the students to get involved in interactive discussion. Next, the teacher gave the students project to

design media and divided them into six different groups–with two groups concerning on physical characteristic of puberty, two groups on reproduction physiology, and two others on reproduction health. The teacher informed that the project had to be completed outside the classroom meeting hours within six days. The teacher and students, therefore, agreed to set a schedule of classroom consultation for the progress.

Syntax-2 was creating, where the students, together with their own group, started to design and develop learning resources labelled as the students' creation media. The must-exist guideline for elaboration was human reproduction system material accommodated in the students' book with additional materials from other sources, such as internet and textbooks. As for the elaboration, the students were given a chance to consult with the model teacher during break-time at the school. Syntax-3 was presenting, in which each of the groups was to present the media created. The teacher also invited the students to get involved in solving the problems that arose in syntax-1 by means of media they created (Figure 4). In this meeting, the teacher gave the students a chance to analyze and evaluate three materials about reproduction system. In addition, the teacher set time allotment to criticize and give feedbacks to some substantial aspects of the learning resources created by other groups. Syntax-4 was evaluating, in which the teacher invited the students to make a conclusion and reflection concerning on the instruction. At last, the session was ended by delivering some advices and follow-up from the teacher on the reproduction health material in a real life.

Figure 4. Two examples of learning resources created by the students related to reproductive organ physiology (A) and puberty physical character (B)

Reflection

The LS team did a reflection to evaluate the instructional activities and make a comparison to open class-2. The LS team revealed that, based on the observation, in term of classroom conduciveness, almost of all students were active, reach 27 from 30 students. In other words, only 3 students were categorized as passive, showing that during classroom discussion there were still some of whom who kept talking to their chair mates. However, unconducive situations as those in open class-1 and open class-2, such as moving from one to another chair (row to row), 'not really' getting involved in group and classroom discussions, opening some other books other than Biology book, and being busy to revise and improvise their PowerPoint slides in their laptops, were no longer found. In classroom discussion, it was shown that there was improvement on the number of students with critical thinking in formulating questions and sharing thoughts, which finally reached 24 students. As shown in open class-2, the students were confident to analyze, synthesize, and evaluate the concepts which might be their learning problems, all this time. The excellence of open class-3 was that some of the students from different groups were able to explain and evaluate some issues regarding reproduction health based on their real life by departing from relevant concepts, theories, and learning resources.

Based on the result of FGD during the reflection session, it was probed from the observers and students that most of the students found the answers and comprehended the problems delivered in syntax-1. It was since almost all of the members of the groups actively involved in elaborative activity of designing learning

resources. All the students admitted that the situation and condition of the instruction were far better than that of open class-2 with the joyful learning was created. Evaluating the students' media (see Figure 4), the LS team revealed that the students succeeded in elaborating and developing learning resources despite the dummy version of their creation. The instructional media, withal, had been used by the students to comprehend and memorize biological concepts concretely. From pedagogical perspective, it could be said that the students actively involved in the instructional activities to lower down the teacher's dominance in explaining the materials. According to Bell (2010), Darling-Hammond (2006), and also Greenstein (2012), the most remarkable characteristic of instruction in 21st-Century is that teachers have to reduce their being domineering in class.

The notion related to the reduction of teachers' dominant role upon teaching has provided a scientific foundation to alleviate the syntax of PjBL from six to four (Darling-Hammond, 2006; Fadly & Wasis, 2017; Kokotsaki et al., 2016). The four syntaxes of PjBL in this current research comprised planning, creating, presenting, and evaluating. By doing so, it has activated the teacher to be the learning facilitator. The results of observation, in addition, contribute a scientific support that the students and their groups are play their dominant roles during the instruction in all stages of learning. Many researchers and expert has confirmed that the implementation of PjBL model could be positive to all students, especially to improve their motivation and focus on instructional activities (Chiang & Lee, 2016; Crippen et al., 2016; Husamah & Pantiwati, 2014; Movahedzadeh et al., 2012) .

CONCLUSION

This current Lesson Study has recommended the reduction of the syntax of PjBL model as guided in a book of Ministry of Education and Culture, year 2014, from six to four, comprising planning, creating, presenting, and evaluating. In PjBL model, the students were able to design their own media in groups by elaborating the materials from the textbooks and other supporting sources. The implementation of PjBL through the project of media creation was considered effective to improve the students' learning quality. There were quantitative indicators to prove, as follows: (a) almost all of the students were shown to actively get involved in the learning process; (b) there was an improvement in the number of active students than those in the previous instruction; (c) the instruction was positive to uplift the quality of classroom management; (d) the students were stimulated in formulating questions and giving opinions; (e) joyful learning was created; (f) most of the students had gained prior knowledge and comprehension of the given problems and concepts before they were presenting it.

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