The Teachers’ Experiences in Implementation of Project Based Learning during Teaching and Learning of Biology in Senior High Schools in Yogyakarta District

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Abstract. This study aimed to; (1) find out how often teachers use PjBL during the teaching and learning process of biology, (2) assess the teachers experiences during guiding students on aspects involved in project designing, project implementation, and presenting the project results, and (3) find out how often the students were guided by their teachers on the aspects of project designing, project implementation, and presenting the project result. The research used the qualitative methodology to study 21 biology teachers and 250 teachers from tenth and eleventh grade of 10 state senior high schools in Yogyakarta district between March and May of the academic year 2018 / 2019. The data obtained from teachers’ and students’ questionnaires were analyzed using SPSS version 23. The results showed that; (1) most biology teachers (71.4%) frequently use PjBL, (2) majority of the teachers, (59.4%) project designing, (76.9%) project implementation, and (56.4%) presenting of project results felt it relatively easy to guide students on the aspects of PjBL and (3) most students (67.6%) are often guided by their teachers on aspects involved in the project designing, project implementation, and presenting of project results.

Keywords: Project-based learning, Implementation, Teachers’ experiences, and Biology

1. Introduction

Biology is a natural science subject that deals with the study of living things. [13, 22] Studying biology is of a great importance in our daily lives and our future because enables students to acquire the essential biological knowledge, skills and develop good attitude to solve the problems such as; diseases like Cancer, HIV/AIDS, unemployment, environmental problems, etc, that are currently affecting human life and even those to come in the future.[11] Biology is a core subject to many science related study programs such as; biotechnology, biophysics, pharmacy, biochemistry, etc, and students intending to pursue any of those programs at tertiary institutions are expected to have acquired good grades at their senior high schools. The great importance of biology made it occupy a high position in the curriculum 2013 of senior high school where it forms part of the compulsory science subjects taught from tenth through eleventh to twelfth grade. The materials taught in biology includes; introduction to biology, the cell, genetics, evolution, ecology, plants, invertebrates, vertebrates, and human biology. The time allocated for learning biology per grade is 3, 4, and 4 hours per week in tenth, eleventh, and twelfth grades respectively. [12]

In this 21st century where the world is on tension of global risks like; diseases, increased population, water crises, unemployment, etc.,[23] there is a great need to ensure a 21st century innovative and supportive education system that engages learners in applicable knowledge and skills, appropriate technologies, and real-world connections to make learning relevant, personalized, and engaging so that
learners can be in position to overcome these challenges.\cite{17, 19} The 21st century education system is one comprised of several elements such as a 21st century curriculum and instruction which supports use of innovative learning methods that support deeper learning.\cite{18}

The curriculum 2013 of Indonesia was developed on some basic principles which include; (1) to move from the content based to a competence based curriculum that encourages students not to just memorize content but demonstrate their ability to do things and (2) to push teachers to move away from the traditional teacher-centered instructional approaches towards student-centered teaching and learning approaches which engage learners into active learning and helping them build their knowledge, skills, and values.\cite{16} In the implementation of the curriculum 2013, the ministry of education and culture recommends a number of instructional methods and project based learning (PjBL) is one of these methods.\cite{12} According to \cite{8} “Project-based Learning is a systematic teaching method that engages students in learning important knowledge and 21st century skills through an extended, student-influenced inquiry process structured around complex, authentic questions and carefully designed products and learning tasks.” \cite{10} Explain that, PjBL is made up of 8 essential elements which include; a challenging question, sustained inquiry, authenticity, student voice and choice, key knowledge, understanding, and success skills, reflection, critique and revision, and a public product.

Due to its growing popularity in the education area, a number of studies have been carried out on PjBL. These studies include those assessing its effects towards students’ academic achievements, challenges faced in its implementation, its effectiveness as an instructional method, and others on the important features required for its implementation.\cite{3, 5, 9, 15, 20} According to \cite{8} an important feature in implementation of PjBL is the role of the teacher as “a project manager.” The teacher has a “project manager” plays a number of roles which can be described under 3 main phases including; (1) project designing, (2) project implementation, and (3) presenting of project results.\cite{11} Therefore, this study focused on the implementation of PjBL during the teaching and learning process of Biology in state senior high schools purposely; (1) to determine the frequency of its usage of during the teaching and learning process of biology, (2) to assess the teachers’ experiences during guiding their students on aspects involved in the three phases, project designing, project implementation, and presenting project results and (3) to find out how often students are guided by their teachers on the aspects involved in PjBL.

2. Methodology

2.1. Research design

This qualitative study employed an intrinsic case study approach to obtain a deeper understanding of teachers’ experiences, \cite{7} during the process of implementation of PjBL in the teaching and learning of biology.

2.2. Research participants

The participants of this study included 21 biology teachers and 250 students of the tenth and eleventh grade from 10 state senior high schools during the academic year 2016-2017 in Yogyakarta district, Yogyakarta special region province, Indonesia. The teacher participants were selected by using the purposive sampling technique, while the student participants were selected randomly by using the cluster sampling technique in order to obtain a representative, acceptable and cost manageable sample, \cite{7} from the large population of students in the 10 state schools involved in the study. The characteristics of the teacher and student participants in the study are as shown below in the table 1 below.
Table 1. Characteristics of the research participants.

| Participants | Characteristics          | Categories                | Number (f) | Percentage Frequency (%) |
|--------------|--------------------------|---------------------------|------------|--------------------------|
| a. Teachers  | i. Gender                | Female                    | 17         | 81.0                     |
|              |                          | Male                      | 4          | 19.0                     |
|              | ii. Highest Qualification level | Bachelor's degree    | 13         | 62.0                     |
|              |                          | Master's degree           | 7          | 33.0                     |
|              |                          | Doctoral degree           | 1          | 5.0                      |
|              | iii. Certification status | Certified                 | 19         | 90.5                     |
|              |                          | Not yet certified         | 2          | 9.5                      |
|              | iv. Experience in teaching | less than 5 years   | 4          | 19.0                     |
|              |                          | 6-10 years                | 2          | 9.5                      |
|              |                          | 11-15 years               | 2          | 9.5                      |
|              |                          | More than 15 years        | 13         | 62.0                     |
|              | v. Training on implementation of PjBL | Ever attended | 12         | 57.1                     |
|              |                          | Not ever attended         | 9          | 42.9                     |
| b. Students  | i. Gender                | Female                    | 150        | 60.0                     |
|              |                          | Male                      | 100        | 40.0                     |
|              | ii. Class level          | Tenth grade               | 160        | 64.0                     |
|              |                          | Eleventh grade            | 90         | 36.0                     |

From the table 1 it can be seen that the research sample of biology teachers consisted of 19.0% males and 81.0% females. According to qualification level, majority of the teachers were bachelor’s degree holders (62.0%) while master’s degree were 33.0% and doctoral degree were only 5.0%. in terms of certification status, majority of the teachers were certified (90.5%) and only 9.5% were uncertified. In terms of teaching experience, the sample consisted of 19.0% teachers with teaching experience less than 5 years. 9.5% with 6-10 years experience, 9.5% with 11-15 years’ experience (9.5%), and majority (62.0%) had an experience of more than 15 years. Also, in terms of training attended on implementation of PjBL, 57.1% had ever attended training while 42.9% not ever attended any training on implementation of PjBL. On the other hand, the research sample of students consisted of 60.0% females and 40.0% male. In terms of class level, 64.0% were students of tenth grade and 36.0% were from eleventh grade.

2.3. Data collection and analysis
The data were collected using teacher and student questionnaires which were developed by the researcher. The teachers’ questionnaire consisted of 3 sections. The first section included questions about the respondents’ background (gender, age, teaching experience, highest level of education, certification status, and training programs attended implementation of PjBL). In the following section, the respondents were asked about how often they used PjBL in their teaching activity and the last question asked teachers about their experience in guiding students’ on alternative aspects involved at the three phases in PjBL. The students’ questionnaires contained 2 sections. The first part asked about the student’s background information (gender and class). This was followed by the section where students were asked about how often they are guided by their teachers on the alternative aspects involved at the three phases of PjBL. The validity of the research instruments was ensured by assigning the questionnaires to experts for review and then upgrading according to the given comments. The instrument reliability was controlled by ensuring that the questionnaires included detailed instructions and unambiguous specific questions.

The collected data was analyzed descriptively using the Statistical Package for the Social Sciences (SPSS) version 23 to determine the frequencies, percentage frequencies and mean of the respondents on each aspect given in teachers’ and students’ questionnaire.
3. Results
The following are the results obtained from each research question involved in the study.

3.1 How often do teachers use PjBL model during teaching and learning process of biology?

Table 2. The number (f) and percentage frequency (%) of PjBL usage.

| Responses | Number (f) | Percentage Frequency (%) |
|-----------|-----------|--------------------------|
| Never     | 3         | 14.3                     |
| Rarely    | 3         | 14.3                     |
| Frequently| 15        | 71.4                     |
| Total     | 21        | 100.0                    |

The results of table 2 indicate that, of the 21 respondents, most biology teachers (71.4%) frequently use PjBL, while 14.3% frequently use it, and 14.3% never used PjBL.

3.2 What are the teachers’ experiences during guiding students’ during implementation of PjBL?
To answer this question, the teachers were presented with a number of alternative aspects that are expected to be guided to the students during project designing, project implementation, and presenting of project results. Also, four kinds of experiences, i.e. Almost impossible, difficult, relatively easy, and easy were given to the teachers and were asked to select what they had experienced during guiding students on each given aspect at each phase in PjBL.

The aspects examined at each phase of project based learning were;

a. Aspects guided by the teacher at the phase of project designing.
   i. Designing the challenging question or problem.
   ii. Identifying the variables in the challenging question/problem.
   iii. Identifying the relationship between variables in an investigation.
   iv. Identifying the background of the importance of an investigation.
   v. Formulating the objectives of an investigation.
   vi. Formulating the benefits of an investigation.
   vii. Establishing the scope of the investigation.
   viii. Establishing the sources of data.
   ix. Designing the formats of final products.
   x. Establishing the procedures for data collection in an investigation.
   xi. Determining the type of data that must be collected in the investigation.
   xii. Determining the forms for presentation of data from the investigation.
   xiii. Designing the techniques for analysis of data from investigation.

b. Aspects guided by the teacher at the phase of project implementation
   i. Identifying the data from the sources
   ii. Collecting data from the identified sources
   iii. Maintaining the set guidelines for the investigation
   iv. Handling the challenges during the project
   v. Obtaining correct data during the investigation
   vi. Recording all the obtained data from the investigation

c. Aspects guided by the teacher at the phase of presenting the project results
   i. Presenting the results of the investigation in the form of diagrams, tables, or graphs
   ii. Present conclusions from the results of investigation
   iii. Presenting a discussion of the results of an investigation
iv. Determine the truth of the results of the investigation
v. Draw general conclusions from the results of the investigation
vi. Presenting the results, discussions, and conclusions of investigations by writing a report
vii. Presenting the results, discussions, and conclusions of investigations orally in an exhibition, presentation to audiences such as classes, parents, students, and communities.

Table 3. The results showing the number (f), percentage frequency (%) and mean of teachers’ experiences during guiding students on aspects involved in project designing, project implementation, and presenting of project results.

| Phases of PjBL | Aspects          | Almost Impossible (f) | Difficult (f) | Relatively Easy (f) | Easy (f) | Total (f) |
|---------------|------------------|-----------------------|---------------|---------------------|---------|---------|
| Project Designing | i.               | 0 0 0 0 14 77.8 4 22.2 18 100.0 |
|               | ii.              | 0 0 0 0 13 72.2 5 27.8 18 100.0 |
|               | iii.             | 0 0 1 5.5 11 61.1 6 33.3 18 100.0 |
|               | iv.              | 0 0 2 11.1 6 33.3 10 55.6 18 100.0 |
|               | v.               | 0 0 0 0 7 38.9 11 61.1 18 100.0 |
|               | vi.              | 0 0 0 0 8 44.4 10 55.6 18 100.0 |
|               | vii.             | 0 0 4 22.2 9 50.0 5 27.8 18 100.0 |
|               | viii.            | 0 0 4 22.2 8 44.4 6 33.3 18 100.0 |
|               | ix.              | 0 0 3 16.7 13 72.2 2 11.1 18 100.0 |
|               | x.               | 0 0 2 11.1 14 77.8 2 11.1 18 100.0 |
|               | xi.              | 0 0 2 11.1 14 77.8 2 11.1 18 100.0 |
|               | xii.             | 0 0 6 33.3 11 61.1 1 5.5 18 100.0 |
|               | xiii.            | 0 0 6 33.3 11 61.1 1 5.5 18 100.0 |
|               | Mean             | 0 0 2 12.8 11 59.4 5 27.8 18 100.0 |
| Project Implementation | i.               | 0 0 1 5.5 16 89.0 1 5.5 18 100.0 |
|               | ii.              | 0 0 1 5.5 15 83.3 2 11.1 18 100.0 |
|               | iii.             | 0 0 7 38.9 11 61.1 0 0 18 100.0 |
|               | iv.              | 0 0 2 11.1 14 77.8 2 11.1 18 100.0 |
|               | v.               | 0 0 0 0 15 83.3 3 16.7 18 100.0 |
|               | vi.              | 0 0 5 27.8 12 66.7 1 5.5 18 100.0 |
|               | vii.             | 0 0 5 27.8 9 50.0 4 22.2 18 100.0 |
|               | Mean             | 0 0 3 14.8 14 76.9 1 8.3 18 100.0 |
| Presenting Project Results | i.               | 0 0 4 22.2 12 66.7 2 11.1 18 100.0 |
|               | ii.              | 0 0 4 22.2 10 55.6 4 22.2 18 100.0 |
|               | iii.             | 0 0 5 27.8 12 66.7 1 5.5 18 100.0 |
|               | iv.              | 0 0 4 22.2 10 55.6 4 22.2 18 100.0 |
|               | v.               | 0 0 3 16.7 10 55.6 5 27.8 18 100.0 |
|               | vi.              | 0 0 5 27.8 9 50.0 4 22.2 18 100.0 |
|               | vii.             | 0 0 7 38.9 8 44.4 3 16.7 18 100.0 |
|               | Mean             | 0 0 5 25.4 10 56.4 3 18.2 18 100.0 |
The results in table 3 indicate that on average, most teachers responded that it is relatively easy to guide students on the aspects at the phase of project designing (59.4%), project implementation (76.9%), and presenting of project results (56.4%), while other teachers replied that it easy for them to guide the students, i.e. project designing (27.8%), project implementation (8.3%), and presenting of project results (18.2%). Also, a number of teachers responded that it is difficult for them to guide the students on the aspects of project designing (12.8%), project implementation (14.8%), and presenting of project results (25.4%). The results indicate no teacher who replied that it is almost impossible to guide the students on the aspects involved in project based learning.

3.3 How often are students guided by their teachers on the aspects involved in PjBL model?

To answer this question, the student participants were given questionnaires containing all the alternative aspects as those in the teacher questionnaires. They were also given three responses, i.e. never, rarely, and often from which they were asked to freely select one response per aspect to answer the question about the number of times they have been guided by their teachers on each aspect given to them. The following were the students’ responses.

Table 4. The number (f) and percentage frequency (%) of teacher guidance to students on aspects involved in PjBL.

| Phases of PjBL | Aspects                  | Students’ Responses |
|---------------|--------------------------|---------------------|
|               | Never (f) (%)            | Rarely (f) (%)      | Frequently (f) (%) |
| i.            | 15 (6.0) 35 (14.0)       | 200 (80.0)          |
| ii.           | 24 (9.6) 58 (23.2)       | 168 (67.2)          |
| iii.          | 15 (6.0) 70 (28.0)       | 165 (66.0)          |
| iv.           | 23 (9.2) 45 (18.0)       | 182 (72.8)          |
| v.            | 14 (5.6) 69 (27.6)       | 167 (66.8)          |
| vi.           | 34 (13.6) 56 (22.4)      | 160 (64.0)          |
| vii.          | 20 (8.0) 40 (16.0)       | 190 (76.0)          |
| viii.         | 16 (6.4) 90 (36.0)       | 144 (57.6)          |
| ix.           | 20 (8.0) 87 (34.8)       | 143 (57.2)          |
| x.            | 16 (6.4) 72 (28.8)       | 162 (64.8)          |
| xi.           | 12 (4.8) 34 (13.6)       | 204 (81.6)          |
| xii.          | 18 (7.2) 49 (19.6)       | 183 (73.2)          |
| xiii.         | 26 (10.4) 76 (30.4)      | 148 (59.2)          |
| i.            | 10 (10.0) 81 (32.4)      | 159 (63.6)          |
| ii.           | 9 (3.6) 73 (29.2)        | 168 (67.2)          |
| iii.          | 29 (11.6) 44 (17.6)      | 177 (70.8)          |
| iv.           | 23 (9.2) 40 (16.0)       | 187 (74.8)          |
| v.            | 10 (10.0) 61 (24.4)      | 179 (71.6)          |
| vi.           | 22 (8.8) 70 (28.0)       | 158 (63.2)          |
| i.            | 19 (7.6) 69 (27.6)       | 162 (64.8)          |
| ii.           | 25 (10.0) 54 (21.6)      | 171 (68.4)          |
| iii.          | 22 (8.8) 89 (35.6)       | 139 (55.6)          |
| iv.           | 18 (7.2) 77 (30.8)       | 155 (62.0)          |
| v.            | 17 (6.8) 56 (22.4)       | 177 (70.8)          |
| vi.           | 23 (9.2) 65 (26.0)       | 162 (64.8)          |
| vii.          | 12 (4.8) 45 (18.0)       | 193 (77.2)          |
| Mean          | 19 (7.6) 62 (24.8)       | 169 (67.6)          |

The results in table 4 indicate that on average, most students 169 (67.6%) responded that their teachers often guided them on aspects involved in the project designing, project implementation, and presenting of project results, while 62 (24.8%) replied that they are rarely guided and only 19 (7.6%) responded that they had never been guided by their teachers on these aspects.

4. Discussions

The purposes of this study included; (1) to find out how often the biology teachers used the PjBL in the teaching and learning process of biology, (2) to assess the teachers experiences during guiding
students on aspects involved in the project designing, project implementation, and presenting the project results, and (3) to find out how often the students were guided by their teachers on the aspects involved in the project designing, project implementation, and presenting the project results.

The results in table 2 indicated that most biology teachers frequently used PjBL in their teaching and learning process of biology. Since project based learning is one of the recommended instruction models in the implementation of the curriculum 2013,\cite{11} the results obtained were expected because all the teacher who participated in this study were from state senior high schools which implemented the curriculum 2013. Therefore, teachers had to observe the recommendations from the ministry of education and culture, Indonesia. Also, the frequent use of PjBL in the learning process of biology could be supported by the benefits the model has to both teachers and students.\cite{4, 14, 20} The results also showed that a few teachers rarely used and a few had never used PjBL. These results could be due to some issues related to PjBL such as its nature of being student-centered and yet the teachers are used to the teacher centered approaches.\cite{3}

The results in table 3 showed that, on average most of the biology teachers replied that guiding students on aspects of project designing, project implementation, and presenting results project was relatively easy. Also, a number of them responded that it is easy to guide students on these aspects. These results are in accordance with the fact that most of the teachers had ever attended training on implementation of project based learning (Table 1). Also, results indicated that a few of the teachers felt it difficult to guide students on these aspects. This is possibly because some teachers had never got training on implementation of PjBL (Table 1). Also, some issues like student-centered nature of PjBL, the complex nature of the curriculum, teachers’ assumptions about their of students, and lack of some tools like content development tools for students, knowledge transfer tools for the teachers, etc could be potential reasons for teachers to face difficulty in guiding the students on the aspects of PjBL.\cite{3, 21}

The results on how often the students are guided by their teachers on the aspects involved in project designing, project implementation, and presenting of project results showed that, most of the students replied that they are often guided by their teachers on these aspects (Table 4). These results indicate that the teachers who participated in this study are very much aware that, even though PjBL is a student-centered instructional approach, it does not mean that teachers should not be involved in the learning process. The teachers know that they remain the main focus even when using PjBL in their teaching and learning process of biology because they are expected to play a crucial role as facilitators by providing guidance on the aspects involved in PjBL.\cite{6, 8} The other results showed that some students were rarely guided while others had never been guided on these aspects (Table 4). These results are in accordance with the results which indicated that some teachers rarely used and others had never used PjBL (Table 2). Therefore, possibly the students who rarely received guidance were those whose teachers rarely used PjBL and those who had never been guided could be those whose teachers had never used PjBL during the teaching and learning process of biology.

5. Conclusion
The results indicate that most teachers often use PjBL in the teaching and learning process of biology and they also often guide their students on the aspects involved. However, a few rarely and or never use PjBL and also rarely guide their students. In general, it can be concluded that most teachers use PjBL and find it relatively easy to guide the students during its implementation in learning biology.

6. Recommendations.
For successful implementation of PjBL, it requires possession of planning and management skills. Therefore, since some teachers were found to rarely and or never use PjBL, the researcher recommends that administrators should give more professional training to all teachers on how best to implement PjBL so as to give opportunity for all students to enjoy the good results of using PjBL in the learning of biology.

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