PROMOTING STUDENTS’ MOTIVATION AND CRITICAL THINKING SKILL THROUGH PROJECT BASED LEARNING-SCAFFOLDED INVERSE BLENDED LEARNING

Ari Wahyu Saputro¹*, Hari Sutrisno²
¹ Postgraduate Student, Yogyakarta State University, Indonesia, a.wahyusaputro@gmail.com
² Prof. Dr., Yogyakarta State University, Indonesia, sutrisnohari@uny.ac.id
*Corresponding author

Abstract

The study aims to investigate the effect project based learning-scaffolded inverse blended learning (PjBL-SIBL) on students’ motivation and critical thinking skill of acid base topic. This quasi-experimental study used pretest-posttest design. There were 35 students of 11th grade selected for experimental and control class. Random sampling was used to select the students. The experimental class implemented project based learning-scaffolded inverse blended learning, while the control class applied scientific approach that used in Indonesian National Curriculum. The acid base critical thinking skill test consisted of 10 items open-ended questions and 25 items of motivation’s questionnaire. These instruments were validated by a group of experts to ensure the content validity. Furthermore, the empirical test of this instrument was applied to 144 students and it showed have good validity and reliability. MANOVA was used to analyze the data of this study. The results indicated a statistically significant difference between the motivation and critical thinking skill levels simultaneously of the experimental and control groups. Thus, due to its potential improving the students’ motivation and critical thinking skill levels, the implementation of PjBL-SIBL is suggested in chemistry learning.

Keywords: Project based learning, Inverse blended learning, motivation, critical thinking skill, acid base topic

1. INTRODUCTION

Online learning was temporarily used around the world in the COVID-19 pandemic. In Indonesia, over a period of two years students were forced to learn by their gadget (Pradana & Syarifuddin, 2021). Since the Ministry of Education and Culture of Indonesia issued decree number 2/2022 about the 50% face-to-face (F2F) teaching - learning process in the pandemic situation, a new teaching method was used by teacher to deliver their material. Combining online platform and traditional teaching was applied to support teaching process, or it was named as blended learning (BL) (Snyman & Kasirye, 2021; Swartz et al., 2018). The advantages of the blended learning are supporting students independent learning, giving flexibility (time and place), and encourage students to find self-experience (Martin et al., 2015). Although blended learning implementation was not mature enough and poses some problems (Chekour et al., 2022; Sparrow et al., 2020), it improved teachers’ skills significantly in the using of online platform (Arif & Azhar, 2021).

Project based learning is one of the popular learning models that used in the COVID-19 pandemic. It has several advantages: asking for questions to find solutions, design, and plan project with the team, explaining how to manage the project, assigning different tasks, also organizing an idea to create a project (Choi et al.,...
According to Chu et al., (2017), PjBL can promoting critical thinking skill, problem solving, personal communication, data literacy, creativity, innovation, and team work. Unfortunately, the implementation PjBL in the blended learning approach still has a lack in applying the face-to-face learning and online learning. It has some problem to put the part of PjBL syntax and the approach used. For the result, teachers have various perception on project-based learning that make various implementation of this model (Cintang et al., 2018).

Inverse blended learning is online learning which is supported by face-to-face learning. In teaching learning process, students are required to complete online learning before they attend face-to-face learning (Ally et al., 2019). Ang, (2020) stated that scaffolded inverse blended learning (SIBL) approach was described for an online chemistry learning enhanced with face-to-face interactions that enables self-paced, independent learning by combining different levels of learning activities based on the difficulties level of the chemistry topic. It is implemented by separating lower order thinking skills (LOTS) and higher order thinking skills (HOTS) of chemistry topics into online learning and face-to-face learning.

Motivation is defined as the desire of students to pursue their goals with full enthusiasm and assertiveness, which can occur depending on the self-efficacy and performance of students when learning (Önen & Ulusoy, 2014). During the COVID-19 pandemic the decreasing motivation among the students caused by school closures, remote learning, and social isolation. The lack of face-to-face interactions with teachers and peers has diminished the sense of connection and community, which plays a crucial role in motivating students to learn. The blurring of boundaries between home and school life has led to difficulties in maintaining a productive learning routine, further diminishing motivation (Corpus et al., 2022). Motivation also plays a crucial role in the development and application of critical thinking skills. A high level of motivation enhances individuals’ willingness to engage in critical thinking activities and seek deeper understanding of concepts. Motivated individuals are more likely to explore multiple perspectives, question assumptions, and evaluate evidence critically. A lack of motivation can hinder the development of critical thinking skills, as individuals may be less inclined to invest the necessary cognitive effort and intellectual curiosity (Jatmiko et al., 2021).

Based on the description above, incorporating the PjBl with a novel instructional design called scaffolded inverse blended learning has emerged as a promising approach to enhance learning outcome. Project-based learning offers a compelling solution for enhancing both motivation and critical thinking skills among students. By engaging students in real-world, hands-on projects, project-based learning taps into their intrinsic motivation, as they become actively involved in meaningful and authentic learning experiences. The opportunity to explore topics of personal interest and relevance within projects stimulates students’ curiosity and drives their motivation to delve deeper into the subject matter. Through project-based learning, students are encouraged to apply critical thinking skills, such as evaluating information, making connections, and synthesizing knowledge from various sources.

2. METHODS

2.1. Research Design

This quasi-experimental study used pretest-posttest design. The experimental class implemented project based learning-scaffolded inverse blended learning, while the control class applied scientific approach that used in Indonesian National Curriculum. The resig design show in the table 1.

Table 1. Research Design

<table>
<thead>
<tr>
<th>Group</th>
<th>Pretest</th>
<th>Perlakuan</th>
<th>Posttest</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-experimental</td>
<td>M</td>
<td>CTS</td>
<td>X</td>
</tr>
<tr>
<td>Control</td>
<td>M</td>
<td>CTS</td>
<td>Y</td>
</tr>
</tbody>
</table>

Information:

- M : Motivation questionnaire
- CTS : Critical thinking skill test
- X : Project based learning-scaffolded inverse blended learning
- Y : Scientific Approach
2.2. Research Sample

The sample of this study had the same basic knowledge about acid-base chemistry topic and it was taught by the same teacher. There were 35 students of 11th grade selected for experimental and control class. Random sampling was used to select the students.

2.3. Treatment

Seven sessions of teaching interventions were applied in this study. At the first and the last sessions, the students completed pretest and posttest of acid-base topic. The same teacher taught the same topic in the experimental and control class. The intervention in experimental class used PJBL-SIBL that covered five project-based learning sequence (selecting topic, project designing, project creating, project presentation, evaluation). Since the experiment class used Scaffolded Inverse Blended Learning (SIBL), it implemented 3 sessions of online learning and 2 sessions of face-to-face learning. The control class instructed by scientific approach (observing, questioning, collecting information, associating, communicating).

2.4. Research Instruments

There were two instruments that used to collect data. The first instrument is motivation questionary and the second one is critical thinking test. The acid base critical thinking skill test consisted of 10 items open-ended questions and 25 items of motivation’s questionaire. These instruments were validated by a group of experts to ensure the content validity. Furthermore, the empirical test of this instrument was applied to 144 students and it showed have good validity and reliability.

2.5. Data Analysis

MANOVA was used to analyze the data of this study. To analyze whether there is a significant difference in students’ motivation and critical thinking skill levels, n-Gain score of each instrument was analyzed and then determined the significant score in MANOVA test. The data analyzing has considered nine test assumptions of MANOVA (Hair et al., 2019). If the significant score less than 0.05, it means that there is a significant difference in the using of PJBL-SIBL Model (Field, 2018). Effect size of the implementation of PJBL-SIBL also was analyzed by Partial eta square test in MANOVA. To impetrate this result, Cohen’s effect size was used as the reference. If the the score less than 0.2 it means low effect size, 0.6 means middle effect size, and 1.4 or greater means large effect size.

3. RESULT & DISCUSSION

Data were collected from the results of the pre-test and post-test. The test was conducted by administering a questionnaire to find out their level of motivation while taking part in the experiment, compared to their level of motivation in their daily teaching-learning process. The critical thinking skill test also conducted in the same step. Data was collected from the result of pre-test and post-test on the experimental and control class. The comparison data result shows in the figure 1.

![Figure 1. Pretest vs posttest data result](image)
The result was analysed by MANOVA test by comparing n-gain score of each variable of instrument. The analysis shows in the table 2.

<table>
<thead>
<tr>
<th>Effect</th>
<th>Value</th>
<th>F</th>
<th>Hypothesis df</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pillai’s trace</td>
<td>.203</td>
<td>8.514</td>
<td>2.000</td>
<td>.001</td>
<td>.203</td>
</tr>
<tr>
<td>Wilks’ lambda</td>
<td>.797</td>
<td>8.514</td>
<td>2.000</td>
<td>.001</td>
<td>.203</td>
</tr>
<tr>
<td>Hoteling’s trace</td>
<td>.254</td>
<td>8.514</td>
<td>2.000</td>
<td>.001</td>
<td>.203</td>
</tr>
<tr>
<td>Roy’s largest root</td>
<td>.254</td>
<td>8.514</td>
<td>2.000</td>
<td>.001</td>
<td>.203</td>
</tr>
</tbody>
</table>

It indicates that the significant score is less than 0.05. It means that there is significant difference between the motivation and critical thinking skill levels simultaneously of the experimental and control groups. The score of partial eta square show 0.203. It belongs to be large size effect based on Cohen’s effect size (Panmei & Waluyo, 2023).

The implementation of PJBL-SIBL consisted of seven sessions. First and last sessions were used as the pre-test and post-test. For the rest is the intervention of the teaching-learning process. The sequence of implementation can be seen in the Table 3.

<table>
<thead>
<tr>
<th>Session</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Class (PJBL)</td>
<td>Pre-test online online online F2F F2F</td>
<td>Post-test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Class (Scientific Approach)</td>
<td>Pre-test F2F F2F F2F F2F F2F Post-test</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Pre-test and post-test activities were done by F2F learning. The same instruments were used in the pre-test and post-test. Overall, 35 students of each class joined all the session of the implementation. In experimental class, session 2, 3, and 4 was applied SIBL approach. In which online learning was supported by F2F learning (session 5 and 6). In the online session, all the students joined class by using Zoom video conference with the chemistry content in the level lower order thinking skills (LOTS). The students learned about acid-base in daily life, theory of acid-base, natural indicator, calculating pH of solutions, planning, and designing final project about acid-base. In the F2F session higher order thinking skills (HOTS) was applied. They learned topic about making a product of acid-base from natural indicator, practicing how to check pH use some acid-base indicator, presenting and giving evaluation their project. PJBL model was used in the whole of the session in the experimental class. In contrast, control class instructed by scientific approach (observing, questioning, collecting information, associating, communicating). This approach was used in Indonesian National Curriculum (K13).

Comparing the data pre--posttest from experimental and control class, the students of each class had the same basic knowledge about acid base topic. It indicates by the pre-test score of each class that has no significant different. Experiment class had the mean pre-test score 0.29 (out of 100) better than the control class. Students’ motivation both classes do not have any significant different. It shows the control class have mean score 0.49 (out of 125) better than experimental class. It assumes that they have the same basic motivation.

The implementation PJBL-SIBL gives a significant impact compare to Scientific approach in the critical thinking aspect. It indicates more than 5.03 points different mean score of acid-base critical thinking skill. The difficulties level of chemistry material in teaching learning process affected the understanding of the students (Ang, 2020) also the increasing interaction in the online learning process correlated with students’ achievement (Coll & Coll, 2018). In line with the critical thinking score, the students’ motivation in PJBL-SIBL class shows the higher mean score than control class. It indicates 2.34 better. PJBL application seems attract the students’ desire to learning more (Blumenfeld et al., 1991; Hira & Anderson, 2021; Shin, 2018). The learning sequence of PJBL (selecting topic, project designing, project creating, project presentation, evaluation) tend to make pupils curious about the topic learned. Starting from the session 2 to 6, even in the
online environment they have a good learning behavior to finish their project (figure 2). It proved that the use of PJBL-SIBL promote the students' motivation and critical thinking.

Figure 2. Sample of Final Project

4. CONCLUSION

In summary, there is a significant difference between the motivation and critical thinking skill levels simultaneously of the experimental and control groups. The score of students in the experimental class is better. Furthermore, its implementation indicates effect size with 0.203. It belongs to be large size effect based on Cohen's effect size. The implementation of PJBL-SIBL is suggested in chemistry learning since it has been proved to improve motivation and critical thinking skill levels.

5. ACKNOWLEDGEMENT

We would like to express the highest gratitude to The Center for Education Financial Services (PUSLAPDIK) the Indonesia Educational Scholarships (BPI), and The Indonesia Endowment Funds for Education (LPDP) as the funders so that the first author (A.W.S.) is able to publish this article.

6. REFERENCE LIST


