Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 6, June 2021: 1603-1612

Comparing the Effectiveness of Information Technology-Based Problem Based Learning and Project Based Learning on Student Motivation

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Abstract

The 2017 Batch of the Economics Study Program in STKIP PGRI Jombang shows low motivation in entrepreneurship subject as seen from the students' low achievement. This study aimed to examine the different learning motivation students had on the post-test and explain the different gains on learning motivation between students taught using Information Technology-Based Problem Based Learning (IT-based PBL) and Project Based Learning (PjBL). The study was quantitative using a quasi-experiment method. The design was a non-equivalent group pre-test and post-test. The independent variables were IT-based PBL and PjBL, while the dependent variable was student motivation. Data were analyzed using an independent sample t-test. Findings confirmed differences in student motivation taught using IT-Based PBL and PjBL and different gains on learning motivation between the two groups. Thus, the following conclusions are presented. (1) There was different learning motivation on the post-test between the two groups taught using IT-Based PBL and PjBL. (2) There were different gains on learning motivation between the two groups taught using IT-Based PBL and PjBL. The suggestion is to implement IT-based PBL and PjBL by considering the teaching material suitability, the facilities and infrastructure, and the time allocation..

Keywords: motivation, IT-based PBL, PjBL

1. Introduction

Nowadays, teaching and learning processes in higher education must focus more on students, while teachers or lecturers act as a facilitator and motivator during those processes. However, the reality shows the other way around, where lecturers still become the center of the teaching and learning processes. Students are used to listening to lectures—merely listening and writing what their lecturers say in classes. This one-way learning process will never help students to develop their critical thinking skills.

Students learn online during the Covid-19 pandemic, making IT play such a crucial role in teaching and learning processes. The consequence is that lecturers must provide learning methods that are fun and encouraging students to develop the ability to think and analyze critically, creatively, systematically, and logically. Two of the models to reach such goals is Problem Based Learning (PBL) and Project Based Learning (PjBL). The two models help students to think critically and work independently rather than just memorizing facts.

PBL puts students at the center of learning. PBL encourages students to think critically and logically in solving a problem based on the knowledge they already have. PBL helps students find alternatives and solutions to the given problems, and then students are asked to choose the best solution to solve the existing problems.

PBL is a learning approach that confronts learners with practical problems or learning that starts with problems within the real-world context (Tan in Gunantara et al., 2014:2).

PBL is a learning model that challenges students to learn and work together to find solutions to real problems (Amir, 2009:21). Thus, it can be concluded that PBL is a learning model that can encourage and stimulate students to learn to find solutions to practical problems in the learning process.

One alternative learning method that allows students to develop thinking skills (reasoning, communication, and connections) in solving problems is Problem Based Learning (PBL) (Rusman, 2011:229). It means that PBL has the potential to develop students by solving meaningful problems.

PBL is a learning model that makes problems the basis of learning. It uses ill-structured real-world problems as a context for students to motivate learning and problem-solving skills and acquire essential knowledge and concepts from the course material. PBL comes in two levels, which correspond to the learning objectives when using this model (Eggen and Kauchak, 2012).

MySQL and PHP are applications used in the management of various aspects of learning related to providing, organizing, and disseminating information. First, students must solve a specific problem and understand the related material. Learning material storage is done digitally via video or pdf that students can download. Second, students must develop problem-solving skills and become independent students.

Communication and interaction with students can be done either directly (offline) or online via the internet, e-mail, Whatsapp, and other chatting applications. This is how PBL works (Sockalingam and Henk, 2011:7). Students first discuss and analyze problems in groups. Students then find more information through the internet, either in journals or e-books, to answer or solve problems during the independent study period. Students gather and organize the information collected. It provides an opportunity to integrate their new knowledge in solving the problem (Hmelo-Silver, in Sockalingam and Henk, 2011).

Some experts emphasize the value of PBL, where content is presented indirectly through rich simulations of real-world, environmental-centered problems (Hmelo-Silver et al. in Chen and Chia, 2012). PBL is a contextual approach where learning is oriented to concrete problems (Evenson and Hmelo in Chen and Chia, 2012). Despite much literature on PBL, the core of PBL is the idea that learning should take place in concrete situations having a relationship with students' prior knowledge and experience (Barrows in Chen and Chia, 2012).

Research by Hmelo et al. (in Silver and Howard, 2006) revealed that students who used PBL had better abilities to apply their knowledge to new problems and utilize self-directed learning strategies that were more effective than students who learned using the traditional curriculum. Along with the rapid development of technology and communication, especially in education, many technology and communication applications currently allow the creation of a global learning environment.

It is closely related to the network that places students in the middle of the learning process, surrounded by learning resources and electronic learning services. One of the applications developed today is e-learning. E-learning is learning through electronic media and technological advances such as computer programs, video conferencing, virtual classes, and the internet (Sulcic and Lesjak in Al-Saai et al., 2011). E-learning has created new phenomenon and trends in education.

E-learning is expressed in digital format through internet technology. It is a technique to improve learning and teaching experiences and is used to educate students with or without instructors (lecturers) through all types of digital media (Christie and Ferdos in Penny, 2011). Educators or lecturers in traditional classroom learning are considered to be all-knowing and simply transfer knowledge to students, while the main focus in e-learning is students (Rusman et al., 2011). Students must be responsible for their learning. The e-learning atmosphere can accommodate students to take a more active role in learning. Students make designs and look for materials with their efforts and initiatives. PBL can take advantage of e-learning facilities collaboratively in the problem-solving process (Rusman, 2011).

PBL e-learning takes advantage of problems as triggers for interactive learning. E-learning media in PBL can help students develop critical thinking skills and grow their interest in solving problems. The use of e-learning applications is expected to increase student learning motivation.

Project Based Learning (PjBL) is a learning model that involves classroom projects for students. The model provides the opportunity for lecturers to manage the class differently. It is widely used to replace traditional teaching methods where the lecturer is the center of learning (Boondee et al. in Rosyidatul et al., 2012:34).

PjBL asks students to think critically and scientifically. It also requires students to learn independently. PjBL provides an authentic learning situation for students in which students must work on a project that will help give

them knowledge. PjBL is a learning model with a constructivist approach that requires students to study independently and to be able to plan and carry out their learning or collaborate with lecturers and peers.

PjBL is a student-centered strategy that encourages initiative and helps students focus on the real world; it can also increase motivation (Guarasa et al., 2006). PjBL is a model that can organize projects in learning (Giilbahar and Tinmaz in Rais, 2010:247). Also, PjBL is a systematic learning model that involves students in learning knowledge and skills through a structured process, having accurate and thorough experiences designed to produce a product (Buck in Sutirman, 2013:43).

Based on the descriptions, it can be concluded that the PjBL learning model can encourage students to be more creative, active, and independent in solving a problem in the form of a project that must be completed. This project also provides real learning and skills for students, as PjBL is a systematic learning model.

Findings from the study by Rais (2010) revealed that the application of PjBL could significantly improve academic results because PjBL provided real learning in the form of projects that allowed students to understand learning better—so, it would be directly proportional to the increase in learning outcomes.

In addition to the learning models applied in the classroom, student motivation can also affect learning outcomes. Students who have high motivation in learning tend to get high learning outcomes; it means that the higher the motivation and the more intensive efforts made, the higher the learning outcomes (Hamdu and Agustina, 2011).

Motivation has a positive impact on learning because it can stimulate, maintain continuity, and direct the activities (Ali et al., 2011). Highly motivated students only need a little guidance from their lecturers and can do much work with a high level of complexity independently. PBL affects motivation, both intrinsic motivation and extrinsic motivation (Ali et al., 2011).

Based on the explanation, PBL and PjBL will be applied in the learning process. It is expected that the two learning models can help students to be more active, creative, independent, and think critically in learning since the two models support the constructivism approach.

Therefore, the present study aimed at doing the following. (1) It would describe different learning outcomes on the Entrepreneurship Subject between students learning using IT-based PBL and students learning using PjBL. (2) The study would describe different learning outcomes on the Entrepreneurship Subject between highly motivated students and low motivated students. The problem-based e-learning is designed by applying the eight (8) learning steps: (1) finding the problems, (2) defining the problems, (3) collecting facts, (4) making temporary arguments, (5) investigating, (6) perfecting the defined problems, (7) collaboratively making solutions or drawing conclusions, and (8) testing solutions.

Within the eight (8) steps, lecturers ask real-world problems, motivate, and provide learning materials and facilities students need to solve the problems. It is expected that students using e-learning with the help of MySQL and PHP can develop their critical thinking to analyze the problems at hand, collect information needed, and use their prior knowledge to solve the problems.

PBL steps combined with MySQL and PHP (IT-based learning) can help students solve entrepreneurship problems and facilitate students to independently use the computer as their facilitator (Ashtian et al., 2012). PBL steps provide a valuable and quality learning experience for students and increase student motivation and achievement in learning.

2.Research Method

This study was a quasi-experiment design with a non-equivalent group pre-test and post-test design. Samples are not randomly designed but are accepted as they are (Ruseffandi, 2005).

The independent variables were IT-based PBL and PjBL, while the dependent variable was student motivation. Data were analyzed using an independent sample paired t-test.

This study revealed the significant difference in the effectiveness of learning models between IT-based PBL and PjBL on student motivation at the Economics Department of STKIP PGRI Jombang on the entrepreneurship subject.

3.Findings

The data collected in this study were scores from the pre-test and post-test on student motivation. The results are as follows.

3.1Pre-Test Description

Two groups took the pre-test—the IT-based PBL group and the PjBL group. We first tested the data normality distribution as a prerequisite for calculating the parametric analysis before testing hypotheses. The research instrument was a test of six (6) items. Table 1 presents the pre-test results for the two groups.

Table 1. Pre-Test Result Analysis for the IT-based PBL Group and PjBL Group

Group Statistics					
	Class	N	Mean	Std. Deviation	Std. Error of Mean
Pre-Test	IT-based PBL	40	75.28	7.387	1.168
	PjBL	40	74.40	7.642	1.208

Table 1 confirms that the IT-based PBL group had an average score of 75.28 with a standard deviation of 7.387 and a standard error of mean of 1.168. The control group using PjBL had an average score of 74.40 with a standard deviation of 7.642 and a standard error of mean of 1.208.

3.2Post-Test Description

A post-test is a test given to students after being given treatment. Different treatments resulted in different results from the experimental class using the IT-based PBL and the control group using PjBL. A post-test was carried out in the experimental and control group to see the increase in student learning motivation. From the results of the post-test, the following data were obtained:

Tabel 2. Post-Test Result Analysis for the IT-based PBL Group and PjBL Group

Group Statistics					
	Class	N	Mean	Std. Deviation	Std. Error of Mean
Post-Test	IT-based PBL	40	91.93	4.643	0.734
	PjBL	40	79.83	5.808	0.918

Table 2 confirms that the IT-based PBL group had an average score of 91.93 with a standard deviation of 4.643 and a standard error of mean of 0.734. The control group using PjBL had an average score of 79.83 with a standard deviation of 5.808 and a standard error of mean of 0.918.

3.3. N-Gain Test

Kolmogorov-Smirnov's normalized gain calculation was used to determine the increase in student motivation in the IT-based Problem Based Learning (PBL) as the experimental class and PjBL as the control group. The results of the n-gain data analysis are presented in Table 3.

Table 3. N-Gain Results for the IT-based PBL Group and PjBL Group

Descriptives				
	Class		Statistic	Std. Error
Percentage of N-Gain	IT-Based PBL	Mean	67.0429	2.85778
		Minimum	28.00	
		Maximum	100.00	
	PjBL	Mean	17.7543	1.52814
		Minimum	0.00	
		Maximum	33.33	

Table 3 shows that the gain based on the pre-test and post-test scores for the experiment group (the IT-based PBL class) is higher than the control group (the PjBL class). The experiment group experienced an n-gain of 67.0429, while the control group had an n-gain of 17.7543.

3.4. Statistical Tests

3.4.1. Normality Test

Kolmogorov-Smirnov was used to test the normality of the data in this study. The pre-test and post-test frequency distribution normality test in the experimental class and control class was carried out with a significant level (α) of 0.05 and degree of freedom (DF) of 3, with the following conditions:

a) If the significance value < 0.05, the data is not normally distributed

b) If the significance value > 0.05, the data is normally distributed.

The results are presented in Table 4.

Table 4. Results of the Normality Test

		Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Class	Statistic	df	Sig.	Statistic	df	Sig.
Post-test	PjBL	0.088	40	0.200*	0.969	40	0.338
	IT-based PBL	0.135	40	0.064	0.959	40	0.150
Pre-test	PjBL	0.135	40	0.063	0.957	40	0.131
	IT-based PBL	0.131	40	0.080	0.953	40	0.095

a. Lilliefors Significance Correction

*. This is a lower bound of true significance.

Table 4 shows that the significance value for the experimental group is 0.063 and for the control group is 0.080 before treatment (pre-test). The values are bigger than 0.05, so it can be said that the data is normally distributed. After treatment (post-test), the significance value for the experimental group is 0.200 and for the control group is 0.064 or bigger than 0.05, so it can be said that the data is normally distributed.

3.4.2 Homogeneity Test

The normality test shows that the two data in each class were normally distributed, then a homogeneity test had to be done to find out whether the data obtained from the two groups had a homogeneous variance or not. The homogeneity test was carried out using the Levene statistical test with the following requirements:

a) If the significance value < 0.05, the data is not homogeneous.

b) If the significance value > 0.05, the data is homogeneous.

The results of the pre-test and post-test homogeneity tests of the two groups are presented in Table 5.

Table 5. Results of the Homogeneity Test

Test of Homogeneity of Variances				
	Levene Statistic	df1	df2	Sig.
Pre-test	0.244	1	78	0.623
Pos-test	0.919	1	78	0.341

Table 5 shows that student motivation before being given treatment has a significance value of 0.623, which is bigger than 0.05, so the data is homogeneous. After being given the treatment, the significance value is 0.341, which is bigger than 0.05, so the data is homogeneous.

3.4. Pre-Test

Results of the pre-test using the independent sample t-test are presented in Table 6.

Table 6

		t-test for Equality of Means		
		Sig. (2-tailed)	Mean Difference	Std. Error Difference
Pre-Test	Equal variances assumed	0.604	0.875	1.681
	Equal variances not assumed	0.604	0.875	1.681

Table 6 shows the significance value (2-tailed) for student motivation before being given the treatment is 0.604 or bigger than 0.05. This value is not significant, meaning no difference in student motivation before being given treatment.

3.5 Hypothesis Testing

3.5.1 Post-Test Hypothesis Testing

The test for the difference between the two post-test means was carried out to test the hypothesis to reveal whether differences in the post-test between the experimental class and the control class existed. The decision is made based on the following criteria:

a) If the significance value < 0.05, there is a difference.

b) If the significance value > 0.05, there is no difference.

Table 7. Results of Post-Test Hypothesis Testing

		t-test for Equality of Means		
		Sig. (2-tailed)	Mean Difference	Std. Error Difference
Post-test	Equal variances assumed	0.000	-12.100	1.176
	Equal variances not assumed	0.000	-12.100	1.176

Table 7 shows the significance value (2-tailed) for student motivation after receiving the treatment is 0.000 or smaller than 0.05. This value is significant, meaning there are differences in student motivation after being given treatment.

3.5.2 Gain Hypothesis Testing

The test for the difference between the two means of the N-Gain data was carried out to test the hypothesis of whether there was a difference in the increase (gain) of learning in the experimental class and the control class.

Table 8. Results of Gain Hypothesis Testing

		t-test for Equality of Means		
		Sig. (2-tailed)	Mean Difference	Std. Error Difference
N-Gain percentage	Equal variances assumed	0.000	-49.28856	3.24069
	Equal variances not assumed	0.000	-49.28856	3.24069

The significance value (2-tailed) is 0.000 or smaller than 0.05, which means the value is significant. It can be concluded that there is a difference in the increase (gain) of student motivation between the experimental class

and the control class. It can be seen from the average gain value between the experimental class that was higher than the control class.

4.Discussion

The means of the two groups for the pre-test were not significantly different, which means that the two groups had no difference in learning motivation. It could be seen from the significance value, which was 0.0604 or bigger than 0.05.

The post-test significance value for the experimental group was 0.000 or smaller than 0.05 and -12.100 for the control group; there was a difference in learning motivation between students in the two groups. The significance value for gain was 0.000 or smaller than 0.05, which means there was a difference in gains between the experimental and control group.

The IT-based PBL and PjBL resulted in different student motivation. Results showed that for both models, IT-based PBL and PjBL, students with high motivation gained better average scores than students with moderate and low motivation. Students with moderate motivation achieved better than students with low motivation.

The findings supported Halawah (2006), stating that "motivation is an important key for effective and successful learning". Motivation determines persistence in learning (Uno, 2010). Highly motivated students tend to spend more time and effort to master the subjects. The present study also proved that highly motivated students achieved better than their peers with moderate and low motivation.

A study by Nursyamsyu (2013) confirmed that highly motivated students tended to achieve better than those with moderate or low motivation in the class taught using PBL and the jigsaw model. IT-based PBL and PjBL can assist students in developing their thinking skills and learning motivation.

Motivation is a driving force for students' attitudes and behavior in making progress and achievement in learning. Students who have high motivation have a desire to succeed from within themselves. Students will work hard in any situation, either competing with others or working alone.

IT-based PBL challenges students to develop their critical thinking and provides satisfaction for students when finding new knowledge. It also increases motivation and helps students transfer knowledge to solve real-world problems and develop new knowledge. The method also makes students responsible for their learning by encouraging students to evaluate their own progress, both the process and the result of their learning. IT-based PBL is directed towards helping students understand concepts to solve real-world problems that they will face in their daily lives.

Sumarni (2011) also revealed that highly motivated students tended to achieve better than those with moderate or low motivation in PBL. Setiyawan (2013) asserted that motivation was a significant mediating variable that strengthened the effect of teaching and educational infrastructure on the accounting subject for Class 12 of Social Science Major in public senior high schools in Ponorogo.

The present study confirmed different learning outcomes for students with varying levels of motivation. The findings showed the existence of interaction between learning models and student motivation to improve student achievement or learning outcomes. Learning models affect learning outcomes, motivation affects learning outcomes, and both learning models and motivation simultaneously affect learning outcomes.

Thus, learning outcomes are affected by learning models or motivation and the interaction of the two. Innovative learning models can be an effective tool if students also have the passion and drive to participate in all learning processes, so teachers must always motivate their students. Trianto (2007) stated that motivation and modeling methods affected student learning achievement. Sumarni (2011) revealed an interaction between learning models (PBL and conventional) and student learning motivation.

Findings showed that both IT-based PBL and PjBL could improve student motivation. Students can develop their critical thinking abilities when learning using the suitable methods that support such processes. IT-based PBL and PjBL open up rooms for students to use their prior knowledge and look for new knowledge. The two models also allow students to use and connect their previous and new knowledge to solve the real-world problems at hand.

The IT-based PBL effectively improves university student motivation because the method gives students chances to interact with their peers and emphasizes students' active participation and motivation (Siarni Dianti, 2015).

The IT-based PBL group showed a higher N-gain than their peers in the PjBL group, although scores from both groups fell in the "mediocre" category. It happened because IT-based PBL allowed students to integrate their knowledge and skills simultaneously within the real-world context. In other words, what students do in the classroom follows real-world problems—they do not merely learn theories. Thus, learning using It-based PBL is authentic.

Based on our observations, different motivation between the two groups was caused by using in-class learning and independent study (outside classroom) in the IT-based PBL method. Learning in the classroom was dominated by discussion on the problems to solve. Students reviewed the literature using technology, such as the internet. It ran well based on our observations. Students intensively asked questions to their lecturers, who acted as facilitators.

Learning outside the classroom was done independently by students. They solved problems responsibly and developed their critical thinking. It could be seen during their presentations, although not all students could solve the problems. Students also discovered other problems related to the one given by the lecturers—they also tried to solve the emerging problems. Consequently, they had to use their critical thinking to find some alternatives to all problems they had. The skill would be beneficial for them later in their life.

The main obstacle in implementing IT-based PBL and PjBl was time allotment. The models required students' active participation from the beginning to the end of the teaching and learning process. Teachers or lecturers also need to use various styles in presenting the lessons suitable with the materials or topics learned—the use of multiple styles is also important to avoid boredom.

Regardless of the obstacles, IT-based PBL and PjBL effectively help improve learning outcomes, interpersonal skills, and critical thinking skills. Thus, it is suggested that the models are used as an alternative learning model to enhance motivation.

5.Conclusions and Recommendations

5.1 Conclusions

Based on the findings and discussion, the following conclusions are presented:

1. The experimental group learned using IT-based PBL and the control group learned using PjBL showed different motivation after the treatment was given (post-test).

2. The experimental group learned using IT-based PBL and the control group learned using PjBL showed a different gain in motivation after the treatment was given (post-test).

5.2 Recommendations

1. Teachers or lecturers have to pay attention to time allotment, availability of learning facilities, and learning material suitability when applying IT-based PBL and PjBL.

2. Teachers or lecturers may use IT-based PBL and PjBl on entrepreneurship subjects or other subjects as variations in the teaching and learning processes. The two models help to make learning more meaningful and challenging for students to avoid boredom in learning.

3. Teachers or lecturers play an essential role as facilitators in implementing IT-based PBL and PjBl so they need to be creative and have good skills in classroom management. Teachers or lecturers must guide students throughout the learning process, so they have to plan the lesson well

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