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Research Article

AN EFFECT OF ONLINE PROJECT-BASED LEARNING (PjBL) ON STUDENTS' COLLABORATION SKILLS

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Abstract

This research was carried out to describe the influence of the implementation of Project-Based Learning (PjBL) on students' collaboration skills. This experimental method used a mental experiential design. The sample was divided into non-random or nonrandom-based research groups. The research was conducted at the Faculty of Teacher Training and Education of Universitas Muhammadiyah Surabaya on students who were taking the compulsory course of Indonesian in the first semester. The data collection techniques were carried out by using pretests, posttests, and observation sheet instruments to observe student collaboration skills. Analysis of the description included the average and standard deviation. Before the data was tested statistically, it is necessary to conduct prerequisite tests, namely normality and homogeneity tests. Furthermore, the MANOVA statistical analysis technique was carried out. From the discussion, it can be concluded that value F counts 27.028 with a significance of 0.000. Thus, there was an influence of the project-based learning model on the difficulty of collaborating with students. Therefore, it can be argued that Ho was rejected, which means that there is a significant influence on collaboration skills. Thus, the hypothesis was stated to be proven. The results of the data calculation were that there was an influence of the project-based learning model on the skill of collaborating students.

Keywords: Project-based learning, online learning, collaboration skills, cognitive style.

INTRODUCTION

At this time, knowledge and technology continued to advance very quickly. The development was marked by a revolution in the industrial world that entered the era of industrial revolution 4.0. These conditions and situations are complemented by the emergence of the concept of social society 5.0 (Koes-H and Putri, 2021; Mahajan *et al.,* 2021). The community is required to be able to harmonize economic progress and solve the problems that surround it in an integrated manner. The development of the virtual world and the physical state became something that was firmly attached. Like the side of a coin, the two cannot be separated and ignored. In its development, science, technology, and information have become an inseparable part of every human life, especially students as successors to future leadership (Suherman *et al.,* 2020; Yunita *et al.,* 2021). The use of various data is also unlimited. All of this happens along with the rapid development of interconnection networks or the internet. In addition, digital-based technology is developing massively. This industrial era indirectly contributes to the disruption of various human activities. No exception is the development of the world of science, technological progress, and the dynamization of higher education (Laal *et al.,* 2012; Laal and Laal, 2012). Therefore, the challenges faced in the industrial revolution 4.0 and society 5.0 today must be responded to quickly and appropriately as well. Stakeholders need to collaborate to find and determine strategies to deal with these conditions (Romero and Molina, 2011). Thus, the education process must continue to be revolutionized to shape the proficiency of the 21st century. With the proficiency of the century, citizens can be able to be competitive globally (Wang, 2015; Zhao *et al.,* 2015). Some educators realize the importance of learning that pays attention to the needs of students to be intelligent, critical, and creative. It is hoped that students can also be able to work together to solve problems faced in everyday life.

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However, the learning process of students today seems to be more focused on learning about things and learning how to be (Braver, 2012; Wang, 2015). Learning outcomes are certainly oriented towards achieving a high level of cognitive competence. If the achievement is only at a low cognitive level, the impact can be less good. The learners can tend to be individualistic. They are less able to tolerate and collaborate (Chu *et al.,* 2011; Steinberg, 2005). The values of togetherness feel difficult to build. The purpose of studying is also solely to seek high grades. In addition, they tend to attach importance to the personal ego (Basilotta Gómez-Pablos *et al.,* 2017; Hofmann *et al.,* 2012). This condition can usually last until they grow up. As a result, they can find it difficult to get along and cooperate with other people or the community in their environment. Although the cognitive dimension is high-rise, the skills of collaboration cannot be ignored. Competence in analyzing, synthesizing, evaluating, perfecting, and action must be an inseparable whole (Bennett and Gadlin, 2012; Chiong and Jovanovic, 2012). Mastery of the ability to think at a high level and collaborate will be a provision for students when they are in society. That's when they need provisions to mingle in society. Based on this, researchers emphasize the importance of increasing collaboration skills (Bennett and Gadlin, 2012; Kolko *et al.,* 2014). With the ability to collaborate effectively, students can improve their critical thinking skills. Collaboration is also expected to give birth to creativity to solve a problem. By collaborating skillfully, students are expected to be able to build cooperation to solve problems together for the common goal as well. Interactive learning is carried out by attaching importance to the two-way inter-action process, namely between lecturers and students (Lee *et al.,* 2015; Stern, 2009). Holistic learning is intended to encourage the establishment of a comprehensive and broad mindset. It contains a process of internalizing the value of excellence and local and national wisdom (Kwan and Wong, 2015). One of the learning models to improve student competence is project-based learning. This model is indeed not a new learning model. However, the project-based learning

model has some strengths (Alloway and Elsworth, 2012; Kettanun, 2015). Based on the statement above, the implementation of project-based learning can be used to improve the quality of students' competencies. The implementation of project-based learning in the learning process has many benefits (Kok *et al.,* 2021; Van de Weijer-Bergsma and Van der Ven, 2021). When working on a project, students are expected to be skilled in planning, organizing, negotiating, and taking responsibility for their duties. Thus, this learning model provides opportunities for students to think high following developments in the real community (Grønlien *et al.,* 2021; Liu *et al.,* 2016). The application of project-based learning is expected to be able to facilitate students to be directly involved in higher-order thinking activities. That competence can be very meaningful when they enter the real world in their lives. With project-based learning, students will be involved in discovery based on the tasks they do. Students can also collaborate to solve problems together. They can also receive feedback on solving the problem at hand (Lavrijsen *et al.,* 2021; Stolte *et al.,* 2019). This is in accordance with the purpose of project-based learning, which is to direct students to actively conduct research, investigation, and understand a problem contextually and in-depth so that the study and psychomotor aspects can be assessed. For example, mechanical responses, complex responses, adaptations, and originations in the high category (Kazemi *et al.,* 2012; Ogawa *et al.,* 2020). Project-based learning can also be applied to develop reflective thinking skills. This way of thinking is carried out thoughtfully and rationally to overcome a problem (Mulyadi *et al.,* 2021; Sart, 2014). In addition, the project-based learning model can strengthen a person's skills to solve a problem. All of that can divide students into the world of work. Regarding scientific learning, learning outcomes are carried out by prioritizing a scientific approach (Loes and Pascarella, 2017; Ríos *et al.,* 2010). Thus, an academic environment can be created that prioritizes rationality. Learning takes place based on the value system and rules in mastering the knowledge of knowing. The learning process also always upholds the values of science. For contextual learning, it means that learning outcomes are adjusted to the demands of students' ability to solve problems (Gavin, 2011; Loes and Pascarella, 2017; Ríos *et al.,* 2010; Tascı, 2015).

The problems presented are thematic, in the sense that they are real problems through a transdisciplinary approach. To be effective, the achievement of learning is more directed at the internalization of the material. Learning can be successful if it is also carried out collaboratively. That is the learning process relates to the active interaction of each individual. The goal is to generate an increase in the competence of students' attitudes, knowledge, and skills (Chen *et al.,* 2018; Le *et al.,* 2018). Finally, learning must be student-centered. In this case, the learning process is directed to develop their inventiveness, strengths, personality, and needs. Students are also directed to develop independence in seeking and finding knowledge. As it is known that the type of learning of each person is different. Everyone thinks differently (Häkkinen *et al.,* 2017; Scarbrough *et al.,* 2014). Some prefer to study in groups, there is pula who like to learn independently. Everyone certainly chooses and sets the most preferred way when processing and managing information obtained from their environment (Ayas and Zeniuk, 2001; White *et al.,* 2020). The identification of project-based learning based on the learning management system is certainly very helpful in the learning process. Knowledge related to collaborative and cognitive skills is needed for learning. The formulation of the material, objectives, methods and learning strategies must refer to the cognitive style that the student has. Based on the understanding of these cognitive ability factors, it is hoped that students can achieve learning materials (Diana *et al.,* 2021; Kokotsaki *et al.,* 2016).

MATERIALS AND METHODS

Design

This research belonged to the experimental type. Treatment of one or more variables was required simultaneously. The sample was divided into non-random or nonrandomized research groups. This experimental research had a controlled group. However, the group is not always fully useful for tackling external variables that affect the realization of a study. Based on the experimental research design of a nonequivalent control group design, it can be interpreted that the main impact (main effect) and interaction impact (interaction effect) are all variables.

Participants

Research variables were a concept that describes a group of objects that had different values. For example, intelligence, abilities, skills, intelligence, values, attitudes, creativity, and so on. The value of the group of objects was then studied and drawn to a conclusion. This research had one free variable (X1), one moderator variable (X2), and one bound variable (Y1). This experimental research was conducted at the Universitas Muhammadiyah Surabaya on students of the Faculty of Teacher Training and Education who were taking the compulsory course of Indonesian in the first semester. Several ways were done to collect research data. Such data are obtained by such steps: 1) The test method, which included pretest and posttest. Pretests were carried out to determine students' understanding before learning and find out the homogeneity of sample purity and normal distribution. Post-test was carried out after learning to know the difference in student understanding between experimentation and control. 2) The method of the questionnaire, is to see the instrument on each respondent. From the results of the questionnaire, data on the classification of students' cognitive styles were obtained, namely students categorized as field-dependent cognitive styles (FD) and students categorized as field-independent cognitive styles (FI).

Data Collection

A test can be called high validity if it has carried out the sizer function or provided results according to the purpose of using the test then in the validity test. The validity test was applied to all research samples with a real level of 0.05 using product moment correlation. A data was called valid if it can measure something that should be measured and can present the data of a variable that is studied precisely from each questionnaire. The result of the r calculation is then compared with the r table of product moment. When the result of the r count is greater than the r of the table, it can be stated that the data is already valid. The next step is the reliability test, which is a test to determine the level of accuracy, stability, and consistency of the research data collection tool in showing the symptoms of a group of individuals even though the time of use of the tool those data collectors were different. The reliability of the

instrument was carried out through the application of the SPSS program with the Cronbach alpha coefficient measuring instrument. If Cronbach's alpha coefficient ≥ 0.60, it meant that the instrument was reliable. On the contrary, if Cronbach's alpha coefficient ≤ 0.60, it means that the instrument is unreliable. Reliability tests need to be carried out to determine the level of reliability of the instrument as a research measuring tool. If the instrument had been declared reliable, the results of the study can be declared to have met scientific standards of science.

Data Analysis

The collected data were analyzed descriptively with the help of the SPSS Version 21 application. Analysis of the description included the average and standard deviation. Description of data related to pretest and posttest data by the dimension of free variables using project-based learning. Research data in the form of the value of student collaboration skills. Before the data was tested statistically, it was necessary to carry out prerequisite tests, namely normality and homogeneity tests. The normality test was used to describe the search data that was already normally distributed. Normality was carried out using the Kolmogorov-Smirnov normality test. Meanwhile, the homogeneity test can be assumed to be homogeneous if the probability (p) of the calculation result was greater than 0.05.
The research data analyzed was in the form of the value of the collaboration skills instrument. The data analysis technique used to describe the influence of project-based learning on student collaboration skills was the Multivariate Analysis of Variance (MANOVA) statistical analysis technique. This statistical analysis technique was also used to explain intervariable interactions. The criteria for decision-making exist and the absence of a free variable runs against a bound variable based on a significance level of 5% or =0.05.

RESULTS AND DISCUSSION

As an approach to learning, project-based learning was expected to provide opportunities for students to explore knowledge while developing their potential to solve problems and conduct investigations. In its implementation, the project-based learning model can also be used online or offline. With this post-pandemic Covid-19 condition, learning is carried out online. Some learnings also were used classically at the Universitas Muhammadiyah Surabaya. For this learning was applied to the control class. The use of e-learning by lecturers at every meeting helps the activities of overseas learners so that learning can be carried out without being hindered by distance and time. The display for e-learning at the Universitas Muhammadiyah Surabaya can be seen in the following picture:

Figure 1. E-learning Display of UMSurabaya

A pretest was carried out before treatment and aimed to find out the initial picture of the research sample. Pretests were used to determine the initial abilities of research respondents. A descriptive analysis of *the* pretest showed the results that the students' collaborating skills can be seen in the following table:

Table 1. Descriptive Analysis of Pretest Results Data of collaborating skills

	Class	N	Mean	Std. Deviation	Std. Error Mean
Pretest of collaborating skills	Experiment	66	72.23	5.482	.675
	Control	64	71.09	4.587	.573

Based on the data in the table, data from the pretest results of collaborating skills for the group of students who applied project-based learning was 72.23 and the standard deviation was 5,482. The data on the average pretest results cannot be used as a basis for interpreting the results of the research. The purpose of proving whether the experimental classes differ significantly or not was to carry out a statistical analysis of the t-test of two independent samples. Before conducting the t-test, the next step was to test the normality of the data and test the homogeneity of the data as a requirement for the analysis of the t-test.

A normal distribution test was performed to measure the normality of the data distribution. It was intended that the data can be processed using parametric statistics. His usual calculations used chi-square. However, since this test had some drawbacks, the calculation uses Kolmogorov-Smirnov (KS). Chi-square compared the theoretic distribution and empirical distributions (observations) by categories, while KS was based on cumulative frequency. Thus, what was compared is the cumulative frequency of the theoretic distribution with the cumulative frequency of the empirical distribution. The results of the normality test with the Kolmogorov-Smirnov test obtained a significant figure of 0.625. This was greater than 0.05 so that both groups of pretest data had a normal distribution.

Uji's mean with Levane's Test shows a significant number of 0.28 > 0.05, the pretest data was declared homogeneous. After the pretest data were normally distributed and had a homogeneous variant, a t-test analysis of two independent samples was carried out on the pretest data. From this, it can be said that the data is normally distributed. D = 0.066 (p>0.05). Furthermore, some people there were those who make the reference significance is Z. and usually they write Z=0.751 (p>0.05). The results of the t-test analysis can be explained Table 2.

Hasil analysis of pretest test-t independent samples test showed the number 0.24 (sig > 0.05). This showed that the initial collaboration skills in the experimental class and the control class did not have significant differences. Thus, Between the groups showed no difference or had the same ability the skills to collaborate. It was the abilities of the two groups are the same. The results showed the interpretation of the research data that has been obtained. The first l score was a tabulation of data that included data on collaboration skills. A descriptive analysis of the results of such studies was presented in the table as follows:

Table 2. Pretest Independent Samples Test Analysis Results

	Levene's Test for Equality of Variances			t-test for Equality of Means						
	F		Itself.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
Pretest of collaboration skills	Equal variances assumed	1.150	285	1.277	128	204	1.134	.888	-.623	2.890
	Equal variances not assumed			1.280	125.331	.203	1.134	.886	-.619	2.886

Tabel 3. Descriptive Analysis of Collaboration Skills Results

	Project Based Learning	Cognitive style	Mean	Std. Deviation	N
collaboration skills	Google Classroom	Field Independent	72.23	5.482	66
		Total	72.23	5.482	66
	LMS	Field Dependent	71.09	4.587	64
		Total	71.09	4.587	64
	Total	Field Independent	72.23	5.482	66
		Field Dependent	71.09	4.587	64
		Total	71.67	5.074	130

Table 4. Homogeneity Test Results of Collaboration Skills

Levene's Test of Equality of Error Variances				
	F	df1	df2	Itself.
Collaboration Skills	1.150	1	128	.285
Tests the null hypothesis that the error variance of the dependent variable was equal across groups.				

Tabel 5. MANOVA Test Result Between Subject Effects

Tests of Between-Subjects Effects							
Source	Dependent Variable	Type III Sum of Squares	Df	Mean Square	F	Itself.	Partial Eta Squared
Corrected Model	Collaboration skills	41.749[a]	1	41.749	1.630	.000	.013
Intercept	Collaboration skills	667421.749	1	667421.749	26053.444	.000	.995
Project Based Learning	Collaboration skills	5378.257	2	179451.000	17.000	.000	.783
Gaya Kognitif	Collaboration skills	3816.268	1	3210.000	92.356	.000	.372
Project Based Learning * cognitive skill	Collaboration skills	6356.468	1	216.000	125.000	.000	.074
Error	Collaboration skills	3279.028	128	25.617			
Total	Collaboration skills	671063.000	130				
Corrected Total	Collaboration skills	3320.777	129				
a. R Squared = .675 (Adjusted R Squared = .603)							
b. R Squared = .724 (Adjusted R Squared = .629)							

Based on the data in the table, it can be seen that the students' collaboration skills with the cognitive style of field independent showed that the experimental class (i.e., the Google Classroom-based project-based learning model) is 72.23. The score was higher than the value in the control class (project-based learning model based LMS), which was 71.09. The results of the data normality test from Kolmogorov-S Smirnov found that the significance value of collaboration skills was 0.625. Since the significance value was more than 0.05, it can be concluded that the data were normally distributed.

The test of homogeneity was carried out to find similarities or differences in variants of research data groups. It meant that homogeneity was a set of data that was examined to have similar characteristics. The group of students of field independent in cognitive style and field dependent in cognitive style was carried out using Levane's Test with a significance level of 0.05. The hypothesis tested was the null hypothesis (Ho) which stated that the variance in each group was the same. Acceptance or rejection was based on: (1) if the significance of probability obtained > 0.05, the variance of each sample was the same (homogeneous). Acceptance or rejection was based on if the significance of probability was obtained > 0.05, and the variance of each sample was homogeneous. If the significance or probability value obtained was <0.05, the variance of each sample was not the same (inhomogeneous). The complete calculation results can be seen in the following Table 4.

The variance homogeneity test table above showed that Based on the Mean from the data of skills, the Levane test was obtained by 0.285 insignificance. Since the significance level of > 0.05, it can be drawn that the data from the collaboration data was homogeneous. The MANOVA test required that the matrix of variants or covarions of dependent variables must be the same. Homogeneity tests of the variant matrix were observed based on the results of the box test. The counting results showed a > number of 0.05. That was, the matrix of dependent variables had the same. Therefore, MANOVA analysis can be followed up. After the implementation of the normality and homogeneity test and the data had been declared normally distributed and had homogeneous variants, the next step was to test the research hypothesis The MANOVA test was presented in the table as follows Table 5. Based on table 7 the data with the MANOVA Multivariate test and the test of between-subject effects, hypothesis analysis in this research. The results of data calculations to test the influence of the project-based learning model on the collaboration skills with students pada compulsory course of Indonesian in Faculty of Teacher Training and Education showed the value of the learning model, namely Pillai's Trace 0.218, Wilks' Lambda 0.941, Hoteling's Trace 0.312 and Roy's Roots Largest 0.312. The value was equivalent to a calculated F value of 27.028 with a significance value of 0.000. Thus, there was an influence of the project-based learning model on the ability to collaborate with students in taking compulsory courses in Indonesian. From the above facts can be said that Ho was

rejected because there was a significant influence of collaboration skills between the experimental group and control. Thus, the hypothesis was stated to be proven.

DISCUSSION

Based on the results of the MANOVA Test Between Effects analysis that was known that the value of F count with a significance of 0.00. This meant that the project-based learning model affects students' collaboration skills. This fact is obtained based on the processing of data on pretest and posttest results. The results of the data showed significant differences between the experimental class and the control class. The average score for collaboration skills was 72.23, while the k grade control was 71.09. The second fallout value is 1.14. This provides clues that the application of the Google Classroom-based project-based learning model affects students' collaboration skills in the compulsory course of Indonesia Faculty of Teacher Training and Education, Universitas Muhammadiyah Surabaya, Surabaya, Indonesia. The application of the project-based learning model had a better influence on the ability to collaborate with students because this learning provided more effective and fun learning opportunities with learning materials from home (Chaijum and Hiranyachattada, 2020; Indiramma, 2014). The article was in the form of e-books, videos, or other sources that were still related to the teaching material. After videos, e-books, and other sources are sent in google classroom, students can study the material by looking for other sources that can support student references and can be used by group mates before the cauldron meeting took place. This can improve the ability to interact as well as participate in contributing aspirations. They fully support each other to jointly achieve their goals (Lim and Richardson, 2020; Xu *et al.,* 2021). The facts proved that collaboration skills were useful for increasing the effectiveness of workability and respecting each other's differences between groups. Collaboration also makes one practice to be flexible and willing to seek agreements to achieve common goals. Therefore, collaborative tasks become a shared burden. The collaboration also appreciates the contribution of each team member (Chiong and Jovanovic, 2012; Chu *et al.,* 2011). In the learning process, Google Classroom is a learning model that can be accessed online so that interaction between students and lecturers is like offline learning (Grønlien *et al.,* 2021; Kettanun, 2015). In addition, lecturers can monitor the progress of projects from students whether they have been sent or not, so that this can facilitate supervision in the learning process. the google classroom feature also provides Google Calendar services. It can remind students about the final deadline of their project progress (Kok *et al.,* 2021; Stolte *et al.,* 2019). The project-based learning model is one of the platforms that can help the student learning process and facilitate supervision from lecturers. The concept of this learning model was material, videos, and other sources sent through the platform. In addition, there was a reminder for students to deadline for the project. The supervision was also easy for lecturers to do (Kwan and Wong, 2015; Lavrijsen and Verschueren, 2020). This is following the research, it can be interpreted that project-based learning plays an important role in increasing collaboration in the research experiment class. This is following research that the effectiveness of project-based learning can significantly increase collaboration in both the experimental class and the control class (Mulyadi et al, 2021; Stolte et al, 2019).

Learning that provided opportunities for students to work individually and in groups, including project-based learning. In this learning, students' abilities were encouraged to produce work. The result, both individual and team can be contextual (Kokotsaki *et al.,* 2016; White *et al.,* 2020). In this case, educators need to try to apply an innovative learning model. One was a project-based learning model. Project-based learning included innovative learning because it prioritized contextual learning. Its various activities were also complex. Project-based learning requires students to work in ingroups to be able to conduct experiments, make reports, experiments, or other projects (Le *et al.,* 2018; Xu *et al.,* 2021).

In addition, project-based learning emphasized learning to solve a problem. It required students to learn various concepts and principles to complete their project assignments. The project encouraged the students to gain a significant level of the learning experience. In working on a project is given authority, alternatives, and flexible time. The student's answer was to complete the project appropriately (Mahajan *et al.,* 2021; Romero and Molina, 2011). The project-based learning model prioritizes developers and understanding of a concept. The students were required to conduct investigations into the problems faced and be able to create a product (Basilotta Gómez-Pablos *et al.,* 2017; Yunita *et al.,* 2021). The project-based learning model also focused more on solving various problems openly. In this case, students are required to absorb their respective cognitions to work on and produce a certain product (Diana *et al.,* 2021; Mahajan *et al.,* 2021). Referring to the above exposures, it can be said that project-based learning provides a valuable experience for students. The mechanism of a project, the allocation of time, human resources, equipment, and materials must be properly managed for the task to be completed (Braver, 2012; Suherman *et al.,* 2020; Wang, 2015). This was following the opinion of Chaijum and Hiranyachattada (2020) that project-based learning can also improve students' collaboration skills. Collaboration skills also contributed to shaping individual characteristics to get better results. It can also change the mindset and create better work as well (Alloway and Elsworth, 2012; Lavrijsen and Verschueren, 2020). The learning result became the object of class assessment in the form of new competencies obtained by students after undergoing a certain learning process (Kazemi *et al.,* 2012; Lim and Richardson, 2020).

Conclusion

From the results of the research that had been carried out, it can be concluded that the analysis of the MANOVA test between-subject effects with a calculated F value of 17.00 and a significance of 0.000 proved the influence of the project-based learning model on students' collaboration skills on the compulsory course of Indonesian in Faculty of Teacher Training and Education, Universitas Muhammadiyah Surabaya, Surabaya, Indonesia. Thus, the project-based learning (PJBL) model can improve students' collaboration skills at the Universitas Muhammadiyah Surabaya in a compulsory course of Indonesian.

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