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Research Article

The Effect of Project-based Collaborative Learning and Social Skills on Learning Outcomes in Biology Learning

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Abstract
This research aims to examine the effect of Project-based Collaborative Learning (PBCL) strategy on conceptual understanding and application of biology for students with different social skills. The research design used a quasi-experimental design of a non-equivalent control group. The population in this study was all 11th-grade students at Al-Abidin Surakarta high school. Seventy-five students were taken as the research subjects and divided into two groups, 38 students in the experimental class with PBCL implementation and 37 ones in the control class with Collaborative Learning (CL) strategically. Sampling technique using cluster random sampling. The instruments used a questionnaire of social skills developed by Tapia-Gutierrez & Delgado (2015) and a test instrument of multiple choice and essay for conceptual understanding and concept application. The data were analyzed using Multivariate Analysis Of Variance. Based on the results of the research, all significance values 0.00<0.05. The result shows that a significant difference in both strategies PBCL & CL towards either conceptual understanding or concept application exists. In addition, a significant difference in social skills towards either conceptual understanding or concept application appears. The interaction effect between those strategies and social skills towards conceptual understanding and concept application was found.

Keywords:
project-based collaborative learning, social skills, conceptual understanding, concept application

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Introduction

Conceptual understanding and concept application are part of the cognitive domain of learning results. It is stated in the cognitive domain of level two (C2) after remembering (C1), while the concept application is on level three (C3). It is a basic competence for reconstructing meanings based on prior knowledge (Lestari, Ristanto, & Miarsyah, 2019). In a learning process, it is important to implement that for it functions as a foundation in using knowledge (Hyder & Bhamani, 2017; Susilowati, Degeng, Setyosari, & Ulfa, 2019). It encompasses some cognitive processes, namely explaining, comparing, classifying, interpreting, summarizing, and inferring (Krathwohl, 2002). Besides, the ability of concept application is also necessary for students to use. Based on Bloom's taxonomy, concept application covers two processes of cognitive namely students doing and applying a procedure in a certain situation (Krathwohl, 2002). Hyder and Bhamani (2017) say that concept application is important to possess—especially for senior high school students. They are supposed to possess an ability to apply knowledge in reality (King & Henderson, 2018). For instance, in learning the blood circulatory system for biology, students must understand the concept of the blood circulatory system and then implement the acquired information in real life.

In learning biology, especially in senior high school, students often feel difficult to master biology. There are several reasons for making learning biology hard to learn (Diki, 2013). (Çimer, 2012) states that biology has much-complex material, objects directly invisible, intangible objects, and complex terms. Furthermore, biology material discussing body mechanics, physiology, and genetics, drive students in misconceptions (Karagöz & Çakir, 2011). According to Henno and Reiska (2008) and (Çimer, 2012), several biological materials are considered as a difficult one such as organ systems, circulatory systems, hormones, and cell division.

The difficulty in learning biology can influence students' achievement. This can make students feel less motivated and less interested in studying this subject (Diki, 2013). It can weaken the learning result of conceptual understanding and the application of biology concepts.

Another problem emerging from biology learning is the difficulty of applying acquired knowledge in real life. When students learn about new information, they do not understand what is being learned (Bahar, 2003). They only memorize the material, making them bored. Also, they are less skilled in applying the material in the context of real-life (Chavan & Patankar, 2018). This happens, as students barely comprehend the concept of the acquired knowledge so that it influences the ability to apply the concept in real life, which is poor.

Ability Understanding of concepts and application of concepts needs to be improved, especially in biology. This can be improved by implementing a Project-Based Collaborative Learning (PBCL) strategy. Project-based collaborative learning was developed at California State University, Los Angeles (CSULA) in 2009 to improve the study abilities of engineering faculty students (Avery et al, 2010). In learning using PBCL, collaborative learning is the basis of project work. This strategy involves the group's intellectual power in designing, solving problems, making decisions and producing products that are useful for life (Baser, Ozden, & Karaarslan, 2017). Project-based Collaborative Learning (PBCL) is a learning strategy integrating project-based learning with a collaborative learning strategy (J. Ellis & Hafner, 2017). Combining the PBL strategy with CL can produce positive results for students. Much research shows the results of learning activity using the PBCL strategy which can improve students' liveliness and learning results (Avery et al., 2010; Dong & Warter-Perez, 2009; Kapp & Kapp, 2016). PBCL has the potential to create a learning atmosphere required for the 21st century.

Project-based Collaborative Learning (PBCL) is a learning strategy integrating project-based learning with a collaborative learning strategy (Ellis & Hafner, 2017). The phase of this learning comprises a project-based learning phase that is done collaboratively in each phase (Donnelly & Fitzmaurice, 2012). According to Jeremi c et al. (2009), when a project-based learning strategy is implemented individually, students' ability in collaborating reduces so that the learning process becomes ineffective. Combining the PBL strategy with CL can produce positive results for students. Much research shows the results of learning activity using the PBCL strategy which can improve students' liveliness and learning results (Avery et al., 2010; Dong & Warter-Perez, 2009; Kapp & Kapp, 2016). PBCL has the potential to create a learning atmosphere required for the 21st century.

PBCL has learning phases, namely: (1) starting to determine the project, (2) designing the project, (3) creating a schedule, (4) finishing the project, (5) writing the report, and (6) evaluating the project (Baser et al., 2017). Based on those phases, students are requested to be active and to focus on finishing the project together. The direct involvement of students in building their knowledge, planning and making the project to be applied in real-life contexts can support them to increase their leaning results (King & Henderson, 2018).

To achieve better learning results, besides the learning strategy, teachers need to consider students' social skills. Every student has various social skills (Vidyapith, Vidyapith, & Delhi, 2016). It means that the learning process of each student is different making learning results required is also different (Feitosa, 2012). Social skills are people's skills in communicating and interacting with other people (Hutchins, Burke, Hatton, & Bowman-Perrott, 2016; Miller, Fenty, Scott, & Park, 2011) (Hutchins et al., 2016; Miller et al., 2011). Garrote (2017) concludes that students who have high social skills can improve their performance. Their high social skills can grow motivation to study, and they can study with optimum efforts and get better results.

Hutchins et al. (2016) and (Karimzadeh, 2015) declare that students who have high social skills are able to express themselves well. In addition, they will enjoy every learning process confidently and happily. In contrast, those who have low social skills will not be able to express themselves well, go through resistance in society, be doubtful, not be confident, feel unaccepted, and feel difficult to comprehend concepts, principles, & procedures. Concerning Garrote (2017) Norman & Combs-Richardson (2001) express that learning results of students who have high social skills are better than those who do not. This is because students who have high social skills are more diligent, active, and confident in learning.

There was some research in the past regarding learning strategy in biology. This study is conducted to find out the influence of PBCL strategy and social skills towards conceptual understanding and concept application in the biology learning process in senior high school.

Method

Research Design

The research design used a quasi-experimental design of a non-equivalent control group. The treatment unit used is the factorial of 2x2. By using the treatment unit of factorial 2x2, this allows the writer to investigate simultaneously the influence of the independent variable called as a factor towards the sample of the research. The first factor is the learning strategies that are Project-based Collaborative Learning (PBCL) strategy and Collaborative Learning (CL) strategy. The second one is social skills high social skills and low social skills. The detailed draft of the research can be seen in Table 1 below.

Table 1.

The Pattern of 2 x 2 Factorial Experiment

Social skills	Learning Strategy	
	PBCL	CL
High	Group 1	Group 3
Low	Group 2	Group 4

Participants

The population in this study was all 11th-grade students at Al-Abidin Surakarta high school. The population is 148 students spread in 4 classes. In this study only used 2 classes for the sample. The number of students involved is 75, with 37 students in the control group and 38 ones in the experimental group. Subject selection using cluster random sampling (Creswell, 2009).

Data Collection

Pre-test data collection in PBCL and CL learning classes was applied to 75 eleven grade high school students. As many as 38 students in the experimental class (PBCL learning class) and 37 students in the control class (CL learning class). Clustering techniques are used to control deficiencies in sorting or selecting samples (Setyosari, 2016). This pre-test data is used to get the initial abilities of students. Post-test data were obtained after treating the two classes with different strategies. During the learning process, social skills data were collected from the experimental and control classes.

Research Procedure

In this research, there are two learning strategies, namely PBCL and CL. PBCL and CL are used in the experiment class, and the control class sequentially. The students are divided into two groups based on the learning strategy used and social skills. The study examines the influence of the use of PBCL and CL in biology. The learning process focuses on eleventh graders' material in semester two like the blood circulatory system and motion system. It is four weeks with eight meetings for the writer to conduct this study. The detailed activities of PBCL and CL strategy can be seen in Table 2.

Table 2.

The Basic Activity of PBCL and CL Strategy Adapted from Baser, Ozden, & Karaarslan (2017)

Project-based Collaborative Learning (PBCL)	**Collaborative Learning (CL)**
The teacher divides students into several groups.	The teacher divides students into several groups.
The teacher stimulates students regarding a task.	The teacher tells students about a task.
The students working in groups determine a project, create a schedule, arrange the need of learning source, and do the project.	The students working in groups identify, investigate, and analyze the task to solve problems.
The students present the result of the project in front of the class and other students are supposed to observe and respond to them. The teacher evaluates the result of the project.	After agreeing with the result of the solved problems, the students present their discussion in front of the class and other students are supposed to observe and respond.
Conclusion	Conclusion

In the experimental class, the teacher uses a learning strategy based on collaborative learning (PBCL). Students create projects in groups according to the topic taught, namely the circulatory system. During the development of the circulatory system project, students are free to determine the appropriate tools, materials, and learning resources. The process of making the project for four weeks, according to the schedule. After the project is finished, each group must present in front of the class, and the other groups give responses. This study concludes by giving an evaluation to each group.

In the control class, the teacher uses Collaborative learning. The teacher gives assignments in the form of student worksheets to each group of students. Students discuss to solve problems and analyze problems related to the topic of the circulatory system. After the problem is solved, students deliver the results in front of the class. At the end of the lesson, the teacher gives an evaluation.

Research Instrument

There are two kinds of research instruments, namely: (1) social skills questionnaire, (2) result test of conceptual understanding of biology and concept application of biology. Students' social skills are measured using a social skills questionnaire. The measurement of conceptual understanding and concept application of biology is conducted by using a test of conceptual understanding of biology and concept application developed by the researcher. Those tests are given in the form of essay and multiple choice.

Social Skills Scale (SSS); The first instrument is a social skills questionnaire used in this study is the result of adaptation developed by Gutierrez & Delgabo (2015). Experts also validated the items in the social skills test. The rubric uses scale levels 1-4. The consists of 39 questions regarding five dimensions, namely solidarity and empathy skill, communication skill, collaboration skill, conflict resolution skill, and self-affirmation skill. The researcher adopts 24 items to measure the dimension of those skills. This social skills instrument was initially used in a university in Chile (Tapia-Gutierrez & Delgado, 2015). The researcher adapts the instrument though there are some differences in terms of a context. The reliability test shows 0.864. This proves that the instrument can be applied. Besides, construct validity is also examined. The result shows those factors are valid.

Student Achievement; The tests cover the conceptual understanding test and concept application test. It is developed by the researcher and validated by the experts of education. The forms of them are multiple-choice and essay. Operational verbs used are conceptual understanding (C2) and concept application (C3) based on Bloom's taxonomy (Krathwohl, 2002). There are 50 items in the test. The test uses scale 0-100. The reliability of Cronbach's alpha test with Statistical Package for the Social Sciences (SPSS) 23.0 for Windows shows that conceptual understanding is 0.934 with 25 questions and concept application is 0.926 to 25 questions. Subsequently, the valid social skills instrument and result test can be used for data collection. This is done twice in the shape of the pretest and posttest for each learning strategy.

Data Analysis

The analysis used in this study is the multivariate analysis of variance (MANOVA). There are six hypotheses taken in this study. The first three are (1) there is a significant difference of conceptual understanding of biology between students taught with PBCL and the ones taught with CL, (2) there is a notable difference of concept application of biology between learning process using PBCL & CL, and (3) there is a significant difference of conceptual understanding of biology between students with high social skills and the ones with low social high skills. Further, the rest is (4) there is a notable difference of concept application of biology between students with high social skills and the ones with low social skills, (5) there is an interaction between learning strategies (PBCL & CL) and social skills (high & low) towards conceptual understanding of biology, and (6) there is an interaction between learning strategies (PBCL & CL) and social skills (high & low) towards concept application of biology.

Before doing the hypotheses examination, the researcher does normality and homogeneity tests. Data normality test uses the Kolmogorov-Smirnov test, while the homogeneity test uses Levene's test with a significance level of 5% (α = 0,05). All statistical analysis is carried out using SPSS 23.0 for Windows.

Results

The statistical description of conceptual understanding, skill and concept application of biology between the groups of learning strategies (PBCL & CL) and social skills (high & low) are shown in Table 3 below.

The research results show that the learning result of conceptual understanding and concept application by implementing PBCL and CL strategy and social skill level (high and low) is different. It is shown in Table 3 that the learning result of students' conceptual understanding with PBCL (M = 81.973; SD = 8.390) is higher than with CL (M = 74.783; SD = 6.347). The learning result of the conceptual understanding of biology with PBCL is higher than with CL. Afterward, the leaning result of the students' concept application with PBCL (M=81.157; SD= 8.168) is higher than with CL (M= 74.189; SD=5.863).

The results show that the learning result of conceptual understanding and concept application with PBCL & CL strategy and social skill level (high & low) are different. It is displayed in Table 3 that the learning result of conceptual understanding of students who learn using the PBCL strategy (M = 81.973; SD = 8.390) is higher than using CL (M = 74.783; SD = 6.347). The result of the learning of conceptual understanding using PBCL is higher than CL. Furthermore, the learning result of concept application of the students learning using PBCL (M=81.157; SD= 8.168) is higher than using CL (M= 74.189; SD=5.863). The learning result of the concept application of biology with PBCL is higher than CL.

Table 3.
Statistical Descriptive from the Results

Learning result	Learning strategy	Social skill	Mean	Std. Deviation	N

Conceptual Understanding	CL	Low	73.562	6.480	16
		High	75.714	6.238	21
		Total	74.783	6.347	37
	PBCL	Low	74.705	5.587	17
		High	87.857	4.901	21
		Total	81.973	8.390	38
Concept Application	CL	Low	73.187	6.002	16
		High	74.952	5.783	21
		Total	74.189	5.863	37
	PBCL	Low	74.176	5.908	17
		High	86.809	4.534	21
		Total	81.157	8.168	38
	Total	Low	73.697	5.881	33
		High	80.881	7.896	42
		Total	77.720	7.898	75

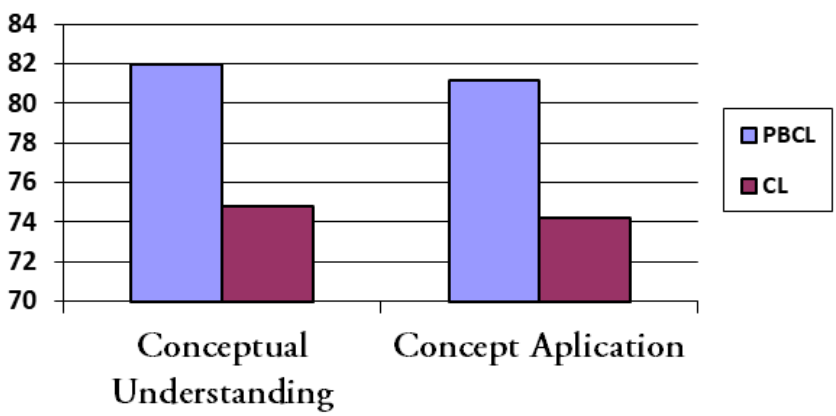

Figure 1
Graph of Summary Statistics Descriptive

Figure 1 explains the summary of the average conceptual understanding and application of concepts in the PBCL class is higher than CL-class.

On Table 3, it shows that conceptual understanding with students' high social skills in the learning process using PBCL (M=87.857; SD = 4.901) is higher than with students' low social skills (M = 74.705; SD = 5.587). The conceptual understanding of students with high social skills in the implementation of the PBCL strategy is higher than without high social skills.

The learning result of concept application (see table 3) of students with high social skills in the learning process using the PBCL strategy (M=86.809; SD=4.534) is higher than students with low social skills (M=74.176; SD=5.908). Regarding the result of PBCL strategic implementation of the concept application, students with high social skills to get a higher result than students with low social skills to get.

Before conducting a hypothesis test using MANOVA analysis, the researcher takes normality and homogeneity tests. The resume of those tests can be seen in Table 4 and Table 5.

According to table 4, the result of Lilliefors Significance Correction test from Kolmogorov-Smirnov shows a significant value that is more than 0.05. It can be concluded that the data of conceptual understanding of biology and concept application of biology of students where PBCL and CL learning strategies are implemented are normally distributed. Having conducted the normality test, the researcher takes the homogeneity test with Levene's test. The result can be seen below.

Table 4.
The Test of Data Normality

Tests of Normality				
Dependent Variable	Learning Strategy	Kolmogorov-Smirnov[a]		
		Statistic	df	Sig.
Conceptual Understanding	CL	0.125	37	0.152
	PBCL	0.107	38	0.200*
Concept Application	CL	0.105	37	0.200*
	PBCL	0.113	38	0.200*

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

Table 5.
The Test of Homogeneity

Levene's Test of Equality of Error Variances				
Dependent Variable	F	df1	df2	Sig.
Conceptual Understanding	0.509	3	71	0.677
Concept Application	1.056	3	71	0.373

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.
a. Design: Intercept + Learning Strategy + Social Skills + Learning Strategy * Social Skills

Based on Table 5, Levene's test significance value of the variable of conceptual understanding is 0.677, which is bigger than 0.05, while the significance value of the variable of concept application is 0.373 which is bigger than 0.05 as well. Both variables have a significant value of more than 0.05, which can be deduced than those data are homogenous.

Regarding those two tests, the data can be further analyzed using MANOVA analysis. The result of the analysis of conceptual understanding and concept application based on learning strategy and social skills was shown in Table 6.

Table 6 tells that the students' conceptual understanding of biology, where the PBCL strategy was implemented shows F=24.232 and the significance value of 0.000<0.05. This indicates that there is a notable difference in conceptual understanding of biology between students learning through PBCL and those learning through CL. The learning result of the conceptual understanding of biology in the PBCL class (see Table 3) is 81.972 while in CLS class is 74.783. Therefore, it can be stated that the score of conceptual understanding after implementing PBCL is higher than CL. The score of F of conceptual understanding between students who have different social skills is 32.147 with a significance value of 0.000<0.05. This means a significant difference in conceptual understanding between students who have high and low social skills existed. Table 6 shows that interaction between learning strategies (PBCL & CL) and social skills (high & low) towards conceptual understanding shows the value of F=16.608 with the significance value of 0.000<0.05. This means that there is an interaction between learning strategies and different social skills.

Table 6 shows that the score of F of concept application of students who receive a learning process through the PBCL strategy is 24.828 with a significance value of 0.000<0.05. This signifies that there is a significant difference of concept application among students who are taught through PBCL and CL. Concept application of biology between students with diverse social skills shows F=31.189 with a significance value of 0.000<0.05. This indicates that there is a significant difference of concept application of students having high and low social skills. Interaction between learning strategies and social skills towards concept application is also discovered in this study. It shows F=17.771 with a significance value of 0.000<0.05. This signifies that there is an interaction between learning strategies and distinct social skills towards students' concept application.

Table 6.

The Result of the Significance Test of Multivariate

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	Conceptual Understanding	2636.023[a]	3	878.674	26.121	0.000
	Concept Application	2438.021[b]	3	812.674	26.479	0.000
Intercept	Conceptual Understanding	449036.471	1	449036.471	13348.938	0.000
	Concept Application	441254.571	1	441254.571	14377.080	0.000
Learning Strategy	Conceptual Understanding	815.122	1	815.122	24.232	0.000
	Concept Application	762.012	1	762.012	24.828	0.000
Social Skill	Conceptual Understanding	1081.370	1	1081.370	32.147	0.000
	Concept Application	957.236	1	957.236	31.189	0.000
Learning Strategy * Social Skill	Conceptual Understanding	558.679	1	558.679	16.608	0.000
	Concept Application	545.421	1	545.421	17.771	0.000
Error	Conceptual Understanding	2388.324	71	33.638		
	Concept Application	2179.099	71	30.692		
Total	Conceptual Understanding	466330.000	75			
	Concept Application	457647.000	75			
Corrected Total	Conceptual Understanding	5024.347	74			
	Concept Application	4617.120	74			

a. R Squared = .525 (Adjusted R Squared = .505)

b. R Squared = .528 (Adjusted R Squared = .508)

Discussion

The influence of learning strategies of Project-based Collaborative Learning (PBCL) and Collaborative Learning (CL) towards conceptual understanding

The first finding in this study shows that there is a significant difference between students who are taught through PBCL and CL towards a conceptual understanding of biology. The students in the PBCL class have higher scores of conceptual understanding than those who are in the CL-class. According to Table 6, it is explained that conceptual understanding shows F=24.23 with a significance value of 0.000<0.05. This matter implies that there is a difference between students who get treatment of PBCL strategy and CL strategy regarding conceptual understanding. Accordingly, the conclusion is that the hypothesis is accepted. Table 3, shows that the learning result of conceptual understanding in the PBCL class has a mean of 81.973—higher than CL-class, which is 74.783. This implies that the use of the PBCL strategy is better than the CL strategy. In line with Holmes & Hwang (2016) statement, saying that the PBCL strategy for a learning process is recommended so that students can actively involve in exploring, problem-solving, solution finding, project making that can be applied in real life. This differs from the CL learning strategy where students are more into discussions without making any projects so that the learning process seems to be abstract and hard to understand (Redes, 2016).

The students' conceptual understanding of biology proves a better result when it deals with the PBCL strategy. One of many things that contributes to improving conceptual understanding is the phases of the PBCL learning strategy that function well. Baser et al. (2017) state that the phases such as designing project activity that involves students to work individually or in groups can make them apply the conceptual knowledge they have learned. A project-working activity like problem identification, literature review, problem-solving, creation, product design, producing activity, or product evaluation can encourage students' creativity as well as motivation until affecting their learning result (Kai et al., 2017).

The good learning result of conceptual understanding related to the PBCL strategy is due it is suitable for students in senior high school who can do abstract and concrete thinking. Hence, students can adhere to the learning process well. The significant impact of the PBCL strategy towards the learning result shows that the integration between project-based learning and collaborative learning affects strongly to students in improving their academic achievement and thinking skills (Dong & Warter-Perez, 2009).

The influence of learning strategies of Project-based Collaborative Learning (PBCL) and Collaborative Learning (CL) towards concept application

The second finding shows that there is a notable difference between students who are treated using PBCL strategy and those using CL towards concept application. In Table 3, the mean of concept application in the PBCL class is 81.157 whilst in CL-class is 74.189. This signifies that the use of PBCL is better than CL use. Based on MANOVA, Table 6 shows that the F score of concept application is

24.82 with a significance value of 0.000 lower than α=0.05. It indicates that a significant influence of PBCL and CL strategies on the concept application emerges. Consequently, the conclusion is that the hypothesis saying, there is a difference of concept application between the use of CL and PBCL strategies are accepted. The finding was in line with some researchers conducted in the past. According to (Ellis & Hafner, 2017), the implementation of the learning model of PBCL can increase the aspects of students' skill and performance—meaning that the learning result increases too. In the learning process through PBCL, in this study, it is found that there are several skills, which students consider as proper, namely the skill of working collaboratively and applying materials related to the digestive system and motion system in daily life. That is what makes the PBCL learning process better than CL.

By considering the aforementioned fact, it is reasonable that the learning result of concept application in the class where PBCL is implemented is higher than the class where CL is implemented. Related to that, Donnelly & Fitzmaurice (2012) argue that students can integrate cognitive skills into the next level as application, analysis, and creating domains by the implementation of the PBCL strategy. The implementation, in this research, is aligned with the previous research (Avery et al., 2010; David, 2018; Shadiev, Hwang, & Huang, 2015), explaining that the learning result can be improved through the implementation of Project-based Collaborative Learning (PBCL) strategy.

The influence of social skills (high and low) towards conceptual understanding

Table 6 shows that the F value of conceptual understanding based on social skills is 32.14 with a significance value of 0.000 lower than α=0.05. This denotes that there is a significant difference between students who have high social skills and low social skills towards a conceptual understanding of biology. The third finding in this research shows that students with high social skills have a better conceptual understanding than those who are with low social skills. Table 3 can be the proof showing the students in the PBCL class with high social skills have higher scores of conceptual understanding, 87.875, than those with low social skills, 74.705. As well as in CL-class, the students with high social skills have a higher conceptual understanding number, 75.714, than those with low social skills, 73.562.

The result of the research is in line with the research of Dom & Yba (2016) concluding that the students' learning results in the experiment class, who have high social skills, are higher than the control class. Reciprocally, Lee, Huh, & Reigeluth (2015) state that social skills affect significantly learning results. In this study, it is also similar to the finding of Garrote's research (2017) saying that high social skills can improve students' confidence and independence in studying. Higher social skills can turn students highly motivated so they can fully learn and achieve better results.

The influence of social skills (high and low) towards concept application

In Table 6, the conceptual application of biology, based on social skills, shows an F score of 31.189 with a significance value of 0.000 lower than α=0.05. It implies that there is a significant difference of concept application among students with high social skills and those without. Students with high social skills have a better concept application of biology. The fourth finding in this study in accordance with the data in Table 3 above, where the students with high social skills in PBCL class have higher scores of concept application, 86.809, than without high social skills, 74.176. As well as students in CL-class, those with high social skills have better scores of concept application, 74.925, than those without, 73.187. This shows that social skills may determine the success of learning concept applications of biology.

Hutchins et al. (2016) argue that students with high social skills have a high level of confidence in learning that they can express themselves well. Otherwise, those with low social skills go through resistance in society, feel doubtful, feel unaccepted, do not express themselves in a good way, and feel difficult to comprehend concepts, principles, & procedures. The result of the research is also strengthened Norman & Combs-Richardson (2001) and Garrote (2017) saying, that the learning result of students with high social skills is significantly different from those with low social skills. The observable result of the research in the class tells that students with high social skills are more diligent and communicate well with others. Those affect their learning results. Students with good social skills are skilled in solving problems, have good self-control, are more popular, and are actively involved in class discussions (Karateke, 2017). Those are what make students with high social skilled better.

Interaction between learning strategies (PBCL & CL) and social skills (high and low) towards conceptual understanding

The fifth finding shows that there is a significant difference in conceptual understanding of biology between students with social skills (high and low) in PBCL class and students with the same skills (high and low) in CL-class. It is shown in Table 6 that the result of MANOVA test related to F score is 16.608 with a significance value of 0.000 lower than α=0.05. It signifies that there is an interaction between students in PBCL class as well as CL-class and social skills (high and low) towards a conceptual understanding of biology. The interaction significance between each learning strategy and social skills (high and low) towards the learning result of conceptual understanding in this study, in fact, is in line with research Kapp' (2016). He concludes the students who learn through project-based learning combined with collaborative learning can understand better and the learning process runs effectively that they are satisfied with the learning process as well as their learning results end up to increase. This milestone proves that the implementation of the PBCL strategy needs deep interactions as social skills relate to an individual's interaction skill with surrounding (Miller et al., 2011).

The interpretation of the learning result is that in the implementation of learning strategy, both PBCL and CL have a significant impact on improving the students' conceptual understanding, which also depends on their social skills—high and low. In the PBCL process, students will communicate and interact more with the surroundings as well as work in teams in doing their projects or task. This will make students more confident and get motivated that they can achieve a better learning result, especially conceptual understanding.

Interaction between learning strategies (PBCL & CL) and social skills (high and low) towards concept application

The sixth finding tells that the F score of interaction between each learning strategy and social skills (high and low) towards concept application is 17.772 (see Table 6) with the significance value of 0.000 lower than $\alpha=0.05$. The result of MANOVA is that there is an interaction impact of students who are taught using both learning strategies and social skills (high and low) towards concept application of biology. The result is in line with Varanelli et al. (2001) who argue that project-based learning and collaborative one can create learning atmosphere, which is active, more independent, and more systematic in project making as well as more communication with other fellow students that it gets the students better learning results.

The result proves the interaction of the PBCL strategy and social skills towards the learning result of concept application of biology. Individual characteristic with high social skills has advantages such as being able to work collaboratively, having a good social sensitivity, having better self-control, and being able to express opinions with others making the concept application better (Hutchins et al., 2016).

Conclusion

After finishing the study, the researcher has six staff to conclude: firstly, a difference of conceptual understanding between the students who learn biology through PBCL and CL. The students in the PBCL class have a higher conceptual understanding than those in CL-class. The reasons are (1) they experience something directly from the learning process; (2) teamwork process and their responsibility make them more independent, and (3) they can express a biology concept with their own words based on their own experience. Secondly, there is a difference of concept application among the students learning through PBCL and CL. Those who are in PBCL class have higher scores of concept application than those who are in CL class. The reason is that they can implement the biology concept directly in real life. Third, there is a difference between students with high social skills and without high social skills towards concept application. Those with high social skills obtain higher conceptual knowledge. This is due the students with high social skills are able to easily communicate and interact better than those students with low social skills. Fourth, there is a difference between the students with high and low social skills towards concept application. They who have high social skills have a better concept application of biology. This thing is caused by their high social skills, which drive them to increase their learning performance. Students will be more confident in applying the concept in their life. Fifth, there is an interaction between each learning strategy (PBCL & CL) and social skills (high & low) towards students' conceptual understanding of biology. The interaction pattern shows that the strategies and social skills, strengthen their conceptual understanding. Sixth, there is an interaction between each learning strategy (PBCL & CL) and social skills (high & low) towards the concept application of biology. Based on those findings, PBCL implementation and high social skills, strengthen students' concept application in learning biology. Project-based collaborative learning can create learning that is efficient, independent and active (Avery et al, 2010). This is what makes PBCL suitable for high school students.

For future research, it should be conducted not only in senior high schools but also in all levels of schools. In addition, the focus of the research should be expanded on other skills aside from learning results.

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