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Effect of Problem-Based Learning Model with Concept Map on Biology Learning Outcomes and Collaboration Skills

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ABSTRACT

This study aimed to determine the effect of the Problem-Based Learning model with a Concept map on students' biology learning outcomes. This research is a quasi-experimental study with a pretest-posttest control group design. The population used in this study were students of class XI IPA at the SMA Budi Luhur Samarinda. The research sample was taken using the cluster random sampling technique. Data collection techniques of the research used observation and tests. Based on the results of data analysis, the -test with the PBL model on learning outcomes is 0.000 <0.05 it can be interpreted there is an influence of the PBL model with concept maps on biology learning outcomes. The results of the effectiveness of the N-Gain pretest and posttest of the PBL model on student learning outcomes in the control class were 0.47 with a medium category and the experimental class was 0.78 with a high category.. The results of the data analysis presented that students' collaboration increased to the high category (≥ 85.3%) with details of 85.7% indicators of collaborative attitude and character, 84.7% indicators of active collaborating behaviour, and 87.5% indicators of collaboration skills. Based on the t-test with the PBL model for collaboration skills is 0.000 <0.05 it can be interpreted there is an influence of the PBL model with concept maps on collaboration skills. These results arise because of the active role of students in the problem-based learning process so that it is possible for students to gain a more realistic learning experience and improve student learning outcomes as well as student collaboration skills, especially in Biology lessons.

Keywords: Problem-Based Learning, Learning Outcomes, Collaboration Skills, Concept Map.

Introduction

Education is a system that must be implemented in an integrated manner with other existing systems in order to achieve the goals set to improve the quality of human life in all aspects of life (Nabila, 2021). In the dynamic landscape of education, traditional teaching methods continually evolve to meet the demands of a rapidly changing world. Problem-Based Learning (PBL) has emerged as a powerful pedagogical approach that goes beyond rote memorization, encouraging students to engage in the learning process actively. This model is designed to cultivate academic knowledge and essential skills such as collaboration, critical thinking, and problem-solving (Wirabumi, 2020).

Based on initial observations made by researchers at SMA Budi Luhur Samarinda. Biology learning is only applied by teachers in the classroom using traditional learning models. So teachers tend only to explain and students only learn theory and memorize facts without any interactive learning media or opportunities to develop problem-solving skills. The learning model used is still ineffective. This leads to low learning outcomes and students' creative thinking skills not being optimally developed. In addition, the biology learning process pays more attention to and emphasizes cognitive aspects rather than affective aspects. As a result, students' cooperation skills are still relatively low; this is due to the ineffective learning model applied, so students' enthusiasm for participating in learning is still low. During the learning process, student activities in the group have not worked well and haven't been maximized in performing collaboration skills. Students still have difficulty in completing group assignments on time for their part, have not been active in conveying ideas or ideas when discussing, there is no desire to find learning resources related to the assigned tasks, have difficulty drawing conclusions from an activity decision, and have a low confidence to make presentations in front of the class. Traditional learning models do not adequately prepare students for the demands of the modern world, which require skills such as problem-solving, creativity, and communication.

Problem-based learning is an approach that gives students new knowledge to solve a problem, so this approach is a participatory learning approach that can help teachers create a fun learning environment because it starts with important and relevant problems for students. This also allows students to gain a more realistic learning experience (Syamsidah & Suryani, 2018). Problem-based learning (PBL) is a learning model that can help students improve the skills needed in the current era of globalization. This learning model presents a real problem for students at the beginning of learning, then it is resolved through investigation and applied using a problem-solving approach (Hotimah, 2020).

The Syntax of Problem-Based Learning is described as follows: orienting students to problems, organizing learning activities, guiding independent and group investigations, developing and presenting work, and analyzing and evaluating the problem-solving process (Zainal, 2022). In PBL syntax, in the early stages, a problem is presented to students. Students are divided into several groups for problem-solving discussions guided by the teacher. During problem investigation, students will be encouraged to seek information. Students may search for resources on the internet or make direct observations. Furthermore, the discussion results are made in the form of a report, video, or poster and then presented in front of other groups. Afterward, proceed to the analysis and evaluation stage assisted by the teacher. At the analysis stage, all students can contribute by expressing their ideas. Combining PBL with concept maps creates a more structured, contextual, and visual approach to learning, enriching students' learning experiences and facilitating deeper understanding.

A concept map is a schema that shows the relationships between one concept and the others. Concept maps are learning strategies that are compatible with meaningful learning. Concept maps are created by writing concepts in boxes or circles and showing the relationships between these concepts using labeled lines (Redhana et al., 2021). Concept maps are a new teaching style that allows students to connect all the information in their minds and

has been widely recommended in science education because it allows students to memorize and learn the information better both visually and verbally (Woldeamanuel et al., 2020).

Collaboration skills are a group learning process in which each member contributes their information, experience, ideas, attitudes, opinions, abilities and skills to jointly increase the mutual understanding of all members (Nurwahidah et al., 2021). The indicators of mathematical collaboration ability, according to Sufajar & Qosyim (2022), are attitude and character indicators; there are sub-indicators observed, they are attitude and character of collaboration, active collaborative behavior, and collaborative skills. In the attitude and character indicators, there are sub-indicators observed, such as students playing an active role in discussing with their groups, students looking for sources of problems on student worksheets, students conveying ideas in solving problems, students accepting the opinions of their members when discussing solving problems, students complete the tasks that are their part in a timely and responsible manner. In the active cooperation behavior indicator, some sub-indicators are observed, such as students are willing to enter the group that has been determined, students discussing the division of tasks to solve problems on their worksheets, and students asking for tasks or material that they are not understood and help other group members. In addition to indicators of collaboration skills, there are sub-indicators observed, such as students making conclusions in student worksheets and then presenting the results of their work in front of the class.

Student learning outcomes can be improved by encouraging student activeness in learning through the learning model applied in the classroom. So, researchers are interested in conducting research by applying the PBL model accompanied by a concept map. This study aimed to see the effect of problem-based learning models with concept maps on student learning outcomes and student collaboration skills.

Methods

This research is a quasi-experimental study with a pretest-posttest control group design. The research design used a pretest-posttest control group design, where the experimental group used the Problem-Based Learning (PBL) model, while the second class used the Student Team Achievement Division (STAD) model. In this study, the independent variable is the PBL model with concept maps. The dependent variable is learning outcomes and collaborative skills. The population of this study was students of class XI IPA Budi Luhur Samarinda High School using a cluster random sampling technique.

Data collection techniques were carried out by observation and tests consisting of a pretest, which was carried out before the implementation of learning. The pretest aimed to measure students' initial abilities in learning biology, and the posttest was carried out after the implementation of learning to determine students' understanding of concepts. The test questions used in this study are description questions. The data taken is the result of observations of student collaboration skills in classroom learning, then analyzed based on indicators of student collaboration skills. Experts have tested the instrument for validity. The instrument grid from the collaboration ability observation sheet can be seen in the following Table 1.

Table 1. Collaboration Skills Indicators

Indicator	Sub- Indicators Skills Collaboration
Attitude and Character Collaboration	a. Students play an active role in discussing with their groups b. Students look for sources of problems on student worksheets c. Students convey ideas in solving problems d. Students accept the opinions of their members when discussing solving problems

Indicator	Sub- Indicators Skills Collaboration
	e. Students complete the tasks they are responsible for in a timely and responsible manner.
Active Collaboration Behavior	a. a. Students are willing to join the assigned group b. b. Students discuss the division of tasks to resolve the problems on student worksheets c. Students asking assignments or material that they have not understood and helping group members
Collaboration Skills	a. Students make conclusions in worksheets b. Student presenting the results of their work in front of the class

Source: (Sufajar & Qosyim, 2022)

The quantitative data were collected through the students' collaborative skills in each course. According to Sufajar & Qosyim, (2022), the formula for the score of the data can be seen as follows:

$$NP = \frac{R}{S} \times 100\%$$

Description:
NP = Percentage value
R = Raw score obtained by students
S = Maximum score

The percentage of the result was categorized into several levels as Table 2.

Table 2. Assessment and Collaboration Capability Categories

Percentage of Collaborative Aspect Achievement (%)	Categorization
81-100	Very Collaborative
61-80	Collaborative
41-60	Simply Collaborative
21-40	Less Collaborative
0-20	Very less Collaborative

Source: (Wati dkk., 2022).

The normalized gain test (N-Gain) was carried out to determine the increase in students' cognitive learning outcomes after being given treatment. The formula is as follows:

$$\text{N-Gains} = \frac{\text{Skor postest} - \text{skor pretest}}{\text{skor maksimal} - \text{skor pretest}}$$

Terms of interpretation of the above formula in Table 3.

Table 3. Criteria for the N-Gain test

Gain Normalization Coefficient	Classification
$g > 0.7$	High
$0.3 \leq g \leq 0.7$	Moderate
$g < 0.3$	Low

Source : (Ramdhani et al., 2020)

Before analyzing the research data, an assumption test was carried out, which included (a) a normality test, which is carried out to determine whether the data obtained is normally

distributed or not. For data analysis, this research used SPSS. (b) Homogeneity Test (Test F), the purpose of the homogeneity test is to find out whether the pair of classes to be tested for difference has homogeneous or heterogeneous variance, which is further used in SPSS analysis as a basis in determining the type to be used for hypothesis testing. With the condition: If F count < 0.05, it means homogeneous; if F count > 0.05, it means it is not homogeneous; if F count < 0.05, then Ho is accepted, meaning the population is said to be homogeneous and if F count > 0.05, then Ho is rejected, meaning the population is said to be inhomogeneous. The data analysis techniques used in this research are the two-sample t-test and the independent sample t-test. The t-test is used to determine the significance of the effect of the independent variable, the Problem-Based Learning model, on the dependent variable(cognitive learning outcomes and collaboration skills) of class XI students at SMA Budi Luhur Samarinda. This hypothesis testing uses the help of an application program, IBM SPSS Statistics 25.

Results and Discussion

1. The Effect of Problem-Based Learning Models Assisted by Concept Maps on Student Learning Outcomes

The results of this study indicate that learning using the Problem-Based Learning (PBL) model has a real influence on student learning outcomes. Students who study with this learning model have an average increase in learning outcomes higher than students who study with the Student Team Achievement Division (STAD) learning model. This improvement in learning outcomes can be seen from the learning outcomes of experimental class students before treatment (pretest) of 39.68 and after treatment (posttest) 81.88 while the control class before treatment (pretest) 38.78 and after treatment (posttest) is 68.38 so that through these data it shows that student learning outcomes in PBL class are higher than students who study with the Student Team Achievement Division (STAD) learning model.

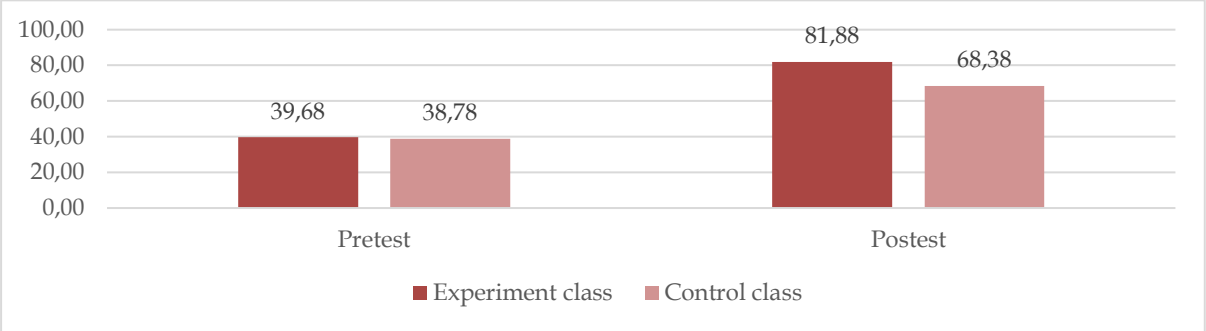

Figure 1. Comparison of the Average Learning Outcomes of Experimental and Control Class

Based on Figure 1. shows that student learning outcomes in Biology subjects using the Problem-Based Learning model are higher than learning outcomes in Biology subjects using the Student Team Achievement Division (STAD) learning model. The results of the calculation of pretest and posttest data for experimental classes and control classes before being given different treatments can be seen in Table 4.

Table 4. Description of Pretest Posttest Values of Both Sample Classes

Statistical Results Data	*Pretest*		*Posttest*	
	Experimental	**Control**	**Experimental**	**Control**
N	32	32	32	32
Minimum Value	25	25	71.4	50
Maximum Value	53.5	53.5	96.4	85.7

Statistical Results Data	*Pretest*		*Posttest*	
	Experimental	Control	Experimental	Control
Average	39.6	38.7	81.8	68.3
Standard Deviation	8.8	8.4	7.5	9.1

Based on Table 4. it can be seen that the average score of student's knowledge in the experimental class is higher than the control class. Likewise, the standard deviation and variance values in the experimental class are higher than the control class. To find out whether the application of the PBL model assisted by concept maps has an effect on learning outcomes and collaboration skills, can be seen by conducting hypothesis testing. However, before testing the hypothesis, the normality test and homogeneity test were first carried out.

Table 5. Normality Test Results of Pretest and Posttest Results

Class		Sig.	Criteria	Conclusion
Experiment	*Pretest*	0.740	Sig > 0,05	Normal
	Posttest	0.165		
Control	*Pretest*	0.120		Normal
	Posttest	0.110		

Based on Table 5, above the results of the normality test, it is known that the pretest and post-test data of the experimental class and control class have a sig value. > 0,05. So, the pretest and posttest data from the experimental and control classes are normally distributed.

Table 6. Homogeneity Test Results of Posttest Results

Homogeneity Test	df1	df2	Sig.	Criteria	Conclusion
Levene's Test	1	62	0,297	Sig > 0,05	Homogeneous

Based on Table 6, above Levene's method homogeneity test data based on the mean has a sig value. (0.297> 0.05), this means that the variance data in the experimental class and control class is homogeneous, which shows that the data obtained has the same variance.

Based on the results of the prerequisite test, the normality test and the homogeneity test, it was found that the pretest-posttest data obtained in the experimental class and control class were normally distributed and had relatively the same variance (homogeneous). Based on these data, the requirements for conducting the t-test have been met.

Table 7. Hypothesis Test Results of Learning Outcomes

Hypothesis Test	T	Df	Sig. (2-tailed)	Conclusion
Independent Sample t-test	6,439	62	0,000	Ha accepted

Based on table 7. Above, the significance value is 0.000 <0.05, thus Ho is rejected, and Ha is accepted. This shows that there are differences in student posttest results between the control and experimental classes. This means that the hypothesis test conducted on the two classes shows that using the problem-based learning model assisted by concept maps has an effect on the learning outcomes of grade XI students in Biology class at Budi Luhur Samarinda High School.

The Normal Gain (N-Gain) test was conducted to determine the increase in pretest and post-test scores in experimental and control classes given different treatments. The N-Gain data for the experimental and control classes can be seen in Table 8.

Table 8. N-Gain Test Results Data on Learning Outcomes

Data	Experimental Class	Control Class
Highest	0.94	0.14
Lowest	0.50	0.78
N-Gain score	0.78	0.47
Category	High	Moderate

Table 8 shows an increase in students' biology learning outcomes, both in the experimental and control classes. This can be seen from the average N-Gain score of the experimental class of 0.78, which is included in the high category, and the average N-Gain score of the control class is 0.47, which is included in the medium category. So, it can be concluded that the average N-Gain score in the experimental class is higher than the average N-Gain score in the control class.

The difference in the results obtained between the experimental class and the control class occurred because the Problem-Based Learning model had been developed in the experimental class. Where students are actively involved in the learning process. Students are guided to solve real problems in groups, so students can interpret theory and memorize it and are trained to solve problems in the surrounding environment. According to Nurlindayani et al., (2021) in learning activities, the teacher not only delivers material, but students also take an active role in learning such as discussing, doing assignments and finding material sources via the Internet. This learning experience can help students increase their knowledge and improve good learning outcomes. As stated by Syamsidah & Suryani, (2018) the PBL learning model has the characteristics of solving problems related to problems in real life so as to enable students to gain a more realistic learning experience. The same thing was stated by Anggraini et al., (2020) that in PBL learning, students are required to respond, remember, solve problems, analyze and make decisions in groups. This could increase students' mental activity. When students' mental activity increases, thinking activity also increases which in turn can improve students' cognitive abilities so that it affects the increase in cognitive learning outcomes.

The problem-based learning model, assisted by concept maps, is useful for minimizing misconceptions in students when solving problems, and it makes it easier to remember the subject matter in the material being studied. Concept maps assist students in understanding the relationship between concepts and their explanations more easily and may be used to open up students' knowledge and curiosity. So, the PBL learning model assisted by the concept map has a real influence on student learning outcomes. Increasing student learning outcomes can certainly occur with the influence of the learning model used. As stated by Yanti, (2019) in his research, learning the PBL model with concept map media has a significant influence on student achievement in cognitive and affective aspects. This is the same as stated by Tri Wulansari et al., (2019) through learning using the Problem-Based Learning (PBL) model it becomes a meaningful experience because it allows students to master a concept, solve a problem and provides opportunities for critical thinking, communicating and creative, by cognitive, creative and affective aspects as well as students' communication skills increase.

2. The Effect of Problem-Based Learning Model Assisted by Concept Maps on Collaboration Skills

Based on the data analysis that has been done, it is known that the Problem-Based Learning model assisted by concept maps has an effect on improving students' collaboration skills. The average value of student collaboration skills, which includes collaboration attitudes and characters, active collaboration behavior, and collaboration skills in the experimental class, is 85.33% greater than the control class, which is 71.42%.

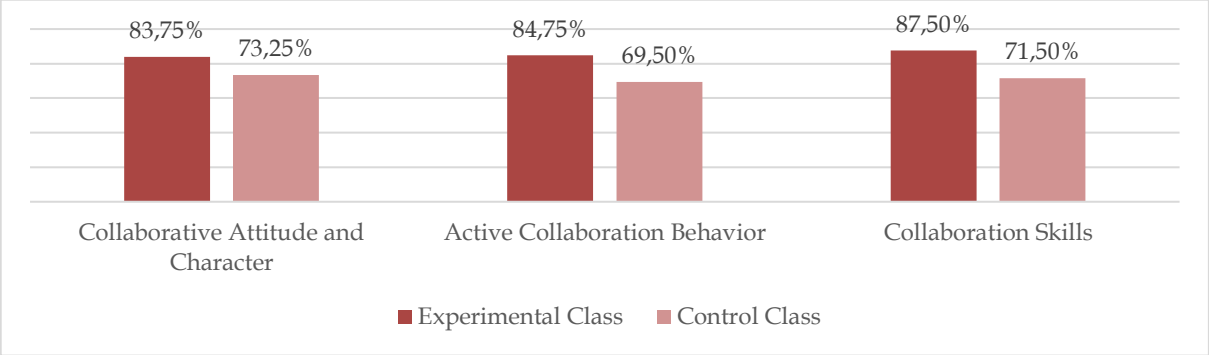

Figure 2. Percentage Value of Collaboration Skills Per-Indicator

Based on Figure 2. shows that the average score of students in the experimental class has better collaboration skills than the control class in terms of the attitude and character of collaboration, active collaboration behavior, and collaboration skills. The results of observations in the experimental class on the attitude and character indicators of collaboration obtained an average value of 83.75%, which is included in the very collaborative category. In the active collaborating behavior indicator, an average value of 84.75% is obtained, which is included in the very collaborative category. The behavioral indicator of collaborating skills, an average value of 87.50%, is obtained and included in the very collaborative category. The results of observations in the control class on the attitude and character indicators of collaboration obtained an average value of 73.25%, which is included in the collaborative category. In the active collaborating behavior indicator, an average value of 69.50% is obtained, which is included in the collaborative category. On the behavioral indicator of collaborating skills, an average value of 71.50% is obtained, which is included in the collaborative category.

Data analysis was carried out based on the results of observation sheet data on both samples, which began with a normality test. Normality test to ensure the sample comes from a normally distributed population. Then proceed to conduct a homogeneity test to determine whether some population variants are the same or not. If the results of the prerequisite test, i.e. the normality test and homogeneity test, show that the data is normally distributed and has relatively the same variance (homogeneous). Based on these data, the requirements for conducting the t-test have been met. The normality test of the observation results of collaboration skills can be seen in Table 9.

Table 9. Normality Test Results of Collaboration Skills Observation Results

Class	Sig.	Criteria	Conclusion
Experiment	0.122	Sig > 0,05	Data is normally distributed
Control	0.100		Data is normally distributed

Based on Table 9, the normality test results of students' collaboration skills show that the experimental and control classes have a sig value > 0,05. So, it shows that the data on students' collaboration skills from the experimental and control classes are normally distributed.

Table 10. Homogeneity Test Results of Observation Results of Collaboration Skills

Homogeneity Test	df1	df2	Sig.	Criteria	Conclusion
Levene's Test	1	62	0,542	Sig > 0,05	Homogeneous

Based on table 10. above the homogeneity test data of Levene's method based on the mean has a sig value. (0.542 > 0.05) then, the observation data of collaboration skills in experimental and control classes are homogeneous; this shows that the data obtained has the same variant

or homogeneous. Based on the results of student collaboration skills data that are normally distributed and have relatively the same variance, the conditions for conducting t-tests have been met.

Table 11. Results of Hypothesis Test for Collaboration Skills

Hypothesis Test	T	Df	Sig. (2-tailed)	Conclusion
Independent Sample t-test	6,439	62	0,000	Ha accepted

Based on Table 11, a significance value of 0.000 <0.05 is obtained, thus Ho is rejected, and Ha is accepted. This shows that there is a difference in students' collaboration skills between the control and experimental classes. This means that the hypothesis test conducted on both classes shows that there is an effect of using the Problem-Based Learning model assisted by concept maps on the collaboration skills of grade XI students in biology subjects at SMA Budi Luhur Samarinda.

It shows that applying the Problem-Based Learning model assisted by concept maps is used to stimulate students to be actively involved in solving problems and encourage students' collaboration skills when discussing in their groups. Students must be active in solving the problems provided since this learning model is student-centred, the aim is to carry out an in-depth investigation of a problem. The teacher is only limited to guiding students in finding the right answers to the problems. Other students in a group must be more active in interacting and collaborating to solve the problems given. The same thing was stated by Yusri, (2018) the problem-based learning model is a learning activity that begins with presenting a problem, making students active in carrying out collaborative skills to be able to solve problems.

Problem-based learning is shaping and building students' way of thinking in dealing with problems through group cooperation, training students to express ideas, opinions, or questions, and the desire to understand concepts deeply. In applying the Problem-Based Learning model, there is interaction in teaching and learning that can build ideas, argumentation skills, and the ability to collaborate and solve problems. Students get this ability through discussion activities then students communicate the results of the discussion with presentations in front of the class.

Learning in the experimental class used the problem-based learning model, which is in accordance with its syntax. PBL syntax consists of orienting students to the problem, organizing students to study, guiding group investigations, developing and presenting work, and analyzing & evaluating the problem-solving process. The first step of the Problem-Based Learning model is problem orientation to students. In this step, students are presented with problems related to the human reproductive system. Students are responsible for mastering the material and are required to be able to collaborate to solve the problems. Learning using PBL models emphasizes cooperation and good collaboration skills between each student in solving problems to achieve common goals. This is in line with Wahyu Hartina & Permana, (2022) who revealed that through the Problem-based learning (PBL) model students are taught to collaborate with others in solving problems so that students are required to play an active role in cooperating in groups, sharing tasks, arguing in groups to solve problems.

The same thing was stated by Wahyu Hartina & Permana, (2022) who revealed that through the Problem-based learning (PBL) model students were taught to collaborate with others in solving problems, so students were required to play an active role in collaborating in groups, dividing tasks, arguing in groups to solve problems. This is in line with the statement expressed by Dewi et al., (2020) which said that collaboration is very important and effective for the continuity of learning because it can improve student learning outcomes and help students solve problems together.

The application of Problem-based learning models assisted by concept maps has an effect on improving collaboration skills; this is because PBL encourages students to be actively

involved in learning and makes learning student-centered. With student-centered learning, students can interact with the teacher and their group mates to work together to solve the problems presented by the teacher, thus making the classroom atmosphere active and effective. Therefore, student-centered learning can help students to develop learning abilities such as collaboration skills. This is as stated by (2022). Problem-based learning has characteristics such as student-centered so that it encourages students to be active and responsible in acquiring knowledge in learning. Similar to what was stated by Nurwahidah et al., (2021) the advantages of learning with the ultimate goal of collaboration are training in an effective division of labor, improving character, student responsibility, combining information from various sources of knowledge, and perspectives, experience and cohesiveness. Based on the facts that occur in problem-based learning activities, it can be concluded that students can learn collaboration skills by providing a learner-centered and collaborative learning environment.

Concept maps show a meaningful relationship between one concept and another associated with words in a particular unit (Aritia & Suyanto, 2019). Learning by using concept maps has many benefits. Through the concept network described in the concept map, learning becomes meaningful because new knowledge or information with structured knowledge that students already have is connected so that it is easier for students to absorb (Khasanah, 2019). Concept maps are very well used by teachers to improve memory, strong understanding of concepts and increase student creativity through freedom of imagination. So that students become enthusiastic in the learning process in class (Kusumadewi & Kusmaryono, 2022). Concept map learning media helps students to organize, classify and recall what is the essence of learning. Concept maps can act as good and interesting media because concept maps can simplify complex subject matter can make it easier for students to receive and understand the subject matter (Sitorus & Simatupang, 2017).

Conclusion

After conducting research and continuing to analyze the data of the research results, it can be concluded that the application of the PBL model accompanied by a concept map has an effect on students' biology learning achievement. This is indicated by the high average quiz score and average post-test score in the class that applied the PBL model accompanied by a concept map, compared to the class that applied the STAD model without a concept map. In addition, based on the results of hypothesis testing, it is concluded that Ho is rejected and Ha is accepted.

The utilization of problem-based learning models in biology learning can develop students' collaboration skills. It causes students to interact with the teacher and their groupmates to work together to solve the problems presented by the teacher, thus making the classroom situation active and effective. Accordingly, student-centered learning can help students to develop learning abilities such as collaboration skills. This is characterized by the high average score of student collaboration skills observation form in classes that apply the PBL model with a concept map, compared to classes that apply the STAD model. In addition, based on the results of hypothesis testing, it is concluded that Ho is rejected and Ha is accepted.

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References

Anggraini, W. N., Purwanto, A., & Nugroho, A. A. (2020). Improvement of Cognitive Biology Learning Outcomes Through Problem-Based Learning in Class X Students of SMA

Negeri 1 Bulu Sukoharjo. *IJIS Edu : Indonesian Journal of Integrated Science Education*, *2*(1), 55. https://doi.org/10.29300/ijisedu.v2i1.2864

Aritia, E., & Suyanto, S. (2019). The Effect of Problem-based Learning Model and Concept Map Strategy for Problem Solving and Understanding of the Ecosystem Concept of High School Students. *Journal of Physics: Conference Series*, *1233*(1), 3. https://doi.org/10.1088/1742-6596/1233/1/012005

Dewi, A. P., Putri, A., Kurnia, D., Baskoro, A., Prayitno, A., Studi, P., & Biologi, P. (2020). Profil Keterampilan Kolaborasi Mahasiswa pada Rumpun Pendidikan MIPA. *Pedagogia*, *18*(1), 57–72. https://doi.org/10.17509/PDGIA.V18I1.22502

Hartina, A. W., & Permana, I. (2022). The Impact of Problem-Based Learning to Improve Collaboration Skills in Thematic Learning. *Journal of Education Action Research*, *6*(3). https://doi.org/10.23887/jear.v6i3

Hotimah, H. (2020). Penerapan Metode Pembelajaran Problem Based Learning dalam Meningkatkan Kemampuan Bercerita pada Siswa Sekolah Dasar. *Jurnal Edukasi*, *7*(2), 6. https://doi.org/10.19184/JUKASI.V7I3.21599

Khasanah, K. (2019). Peta Konsep sebagai Strategi Meningkatkan Hasil Belajar Siswa Sekolah Dasar. *Jurnal Edutrained : Jurnal Pendidikan Dan Pelatihan*, *3*(2), 152–164. https://doi.org/10.37730/EDUTRAINED.V3I2.8

Kusumadewi, R. F., & Kusmaryono, I. (2022). Concept maps as dynamic tools to increase students' understanding of knowledge and creative thinking. *Premiere Educandum : Jurnal Pendidikan Dasar Dan Pembelajaran*, *12*(1), 13. https://doi.org/10.25273/PE.V12I1.11745

Nabila, N. (2021). Tujuan Pendidikan Islam. *Jurnal Pendidikan Indonesia*, *2*(5), 867–875. https://doi.org/10.36418/japendi.v2i5.170

Nurlindayani, E., Setiono, S., & Suhendar, S. (2021). Profil Hasil Belajar Kognitif Siswa dengan Metode Blended Learning pada Materi Sistem Pernapasan Manusia. *BIODIK*, *7*(2), 56. https://doi.org/10.22437/BIO.V7I2.12813

Nurwahidah, Samsuri, T., Mirawati, B., & Indriati. (2021). Meningkatkan Keterampilan Kolaborasi Siswa Menggunakan Lembar Kerja Siswa Berbasis Saintifik. *Reflection Journal*, *1*(2), 71. https://doi.org/10.36312/RJ.V1I2.556

Ramdhani, E. P., Khoirunnisa, F., Asti, N., Siregar, N., Raja, M., Haji, A., & Riau, K. (2020). Efektifitas Modul Elektronik Terintegrasi Multiple Representation pada Materi Ikatan Kimia. *Journal of Research and Technology*, *6*(1), 164. https://journal.unusida.ac.id/index.php/jrt/article/view/152

Redhana, I. W., Widiastari, K., Samsudin, A., & Irwanto. (2021). Which is More Effective, A Mind Map or A Concept Map Learning Strategy? *Jurnal Cakrawala Pendidikan*, *40*(2), 521. https://doi.org/10.21831/cp.v40i2.33031

Sitorus, E., & Simatupang, S. (2017). Pengaruh Model Problem Based Learning (PBL) Berbasis Peta Konsep terhadap Hasil Belajar Siswa pada Materi Pokok Listrik Dinamis di Kelas X SMA Negeri 17 Medan T.A 2013/2014. *Jurnal Inpafi*, *2*(4), 131. https://jurnal.unimed.ac.id/2012/index.php/inpafi/article/view/2131

Sufajar, D., & Qosyim, A. (2022). Analisis Keterampilan Kolaborasi Siswa SMP pada Pembelajaran IPA di Masa Pandemi Covid-19. *Pensa: E-Jurnal Pendidikan Sains*, *10*(2), 255. https://ejournal.unesa.ac.id/index.php/pensa/article/view/45054

Syamsidah, & Suryani, H. (2018). *Problem-Based Learning (PBL)*. Deepublish Publisher.

Wati, M., Syamsuddin, A., & Rukli, R. (2022). Pengaruh Model Pembelajaran Problem Based Learning Berbantuan Media Mobile Learning Terhadap Kemampuan Kolaborasi Matematika Siswa Kelas IV SD. *Indonesian Journal of Educational Science (IJES)*, *5*(1), 56–64. https://doi.org/10.31605/IJES.V5I1.1834

Wirabumi, R. (2020). Metode Pembelajaran Ceramah. *Annual Conference on Islamic Education and Thought (ACIET)*, *1*(1), 105–113. http://pkm.uika-bogor.ac.id/index.php/aciet/article/view/660

Woldeamanuel, Y. W., Abate, N. T., & Berhane, D. E. (2020). Effectiveness of Concept Mapping-Based Teaching Methods on Grade Eight Students' Conceptual Understanding of Photosynthesis at Ewket Fana Primary School, Bahir Dar, Ethiopia. *Eurasia Journal of Mathematics, Science and Technology Education*, *16*(12), 2. https://doi.org/10.29333/EJMSTE/9276

Wulansari, B., Hanik, N. R., & Nugroho, A. A. (2019). Penerapan Model Problem Based Learning (PBL) disertai Mind Mapping untuk Meningkatkan Hasil Belajar pada Siswa Kelas X SMA Negeri 1 Tawangsari.. *Journal of Biology Learning*, *1*(1). https://doi.org/10.32585/.v1i1.250

Yanti, R. (2019). Pengaruh Model Pembelajaran Pbl (Problem Based Learning) Menggunakan Peta Konsep Terhadap Hasil Belajar Biologi Siswa Di SMAN 01 Lais Bengkulu Utara. UMB Library Repository. https://repo.umb.ac.id/items/show/1143

Yusri, A. Y. (2018). Pengaruh Model Pembelajaran Problem Based Learning terhadap Kemampuan Pemecahan Masalah Matematika Siswa Kelas VII Di SMP Negeri Pangkajene. *Mosharafa: Jurnal Pendidikan Matematika*, *7*(1), 51–62. https://journal.institutpendidikan.ac.id/index.php/mosharafa/article/view/mv7n1_6

Zainal, N. F. (2022). Problem Based Learning pada Pembelajaran Matematika di Sekolah Dasar/Madrasah Ibtidaiyah. *Jurnal Basicedu*, *6*(3), 3587–3588. https://doi.org/10.31004/BASICEDU.V6I3.2650