

The Effect of Blended Learning with a Collaborative Problem Solving Approach on Students' Cognitive Learning Outcomes and Collaboration Skills in Science Learning

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Dena Alseptina Bonitasya¹, Arif Widiyatmoko^{1*}, Kao Sovansopha²

¹Science Education Program, Faculty of Mathematics and Natural Sciences,
Universitas Negeri Semarang, Semarang, Indonesia

²Ministry of Education, Youth and Sports, Phnom Penh, Cambodia

Corresponding Author: *arif.widiyatmoko@mail.unnes.ac.id

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Abstract

This research aims to determine the effect of blended learning with a collaborative problem-solving approach on students' cognitive learning outcomes and collaboration skills in science learning. This research is a quasi-experimental method using posttest-only control group design with a cluster random sampling technique. Data were obtained from the posttest scores and observation sheets. Using t-test calculation analysis, the results showed that there was a significant effect on the cognitive learning outcomes of experimental class students in the form of a significant increase after learning using blended learning with a collaborative problem-solving approach ($t_{count} = 3.908$ with a significance level of 5% $dk = 62$). The results of the experimental class collaboration skill observations show one indicator is in the "very good category", and four indicators are in the "good category", while in the control class there is only one indicator that is in the "good category" and four indicators are in the "bad category". The results show that there is a significant effect of blended learning with a collaborative problem-solving approach on students' collaboration skills.

Keywords: Blended Learning, Collaborative Problem Solving, Cognitive Learning Outcomes, Collaboration Skill

INTRODUCTION

The Program for International Student Assessment (PISA) survey in 2018 showed that Indonesia in the field of science was ranked 74th out of 79 countries (Hewi & Shaleh, 2020), this is not much different from the survey from Trends in Mathematics and Science Study (TIMSS) in 2015, which showed that Indonesia was ranked 45th out of 48 countries (Nizam, 2016). The survey results are due to the fact that students' learning scores, especially in the science field are still low, because the learning process is teacher centered (Bustami et al., 2018; Muna, 2017), especially during online learning, the learning process is teacher-centered (Anggianita et al., 2020). The virtual face-to-face learning process makes students passive (Ma'rufa & Mustofa, 2021; Rusly et al., 2021). Students are also slow in responding, answering questions, and in completing assigned tasks (Noviansyah & Mujiono, 2021; Page et al., 2020). The passiveness of the students in online learning, has an impact on their low cognitive learning outcomes (Pasaribu & Lubis, 2021; Wibowo, 2016). Thus, it is necessary to do a treatment to make students active and affect their cognitive learning outcomes.

Learning that requires active students is in accordance with Indonesian

curriculum or known as curriculum 2013 (Ledoh et al., 2021; Nastiti et al., 2018). Curriculum 2013 also applies network learning by utilizing technology or ICT (Yonafri & Gani, 2021). This is supported by the covid-19 pandemic which has made the Indonesian Ministry of Education and Culture issue a policy regarding teaching and learning activities carried out online by utilizing technology (Purwanto et al., 2020; Saputra, J., & Priskawati, 2020). The Indonesian Ministry of Education and Culture's policy makes the learning process into online learning. Online learning has been widely used by various educational institutions, so that learning is not limited by time and space and can be done anytime and anywhere (Taufik et al., 2021). Online learning that is carried out is face-to-face learning that is carried out virtually by utilizing technology (virtual synchronous) but needs to be interspersed with learning without virtual face-to-face (virtual asynchronous) so that learning is student-centered.

Learning by utilizing technology is not only indispensable in the 21st century, but also must develop 21st century skills (Chalkiadaki, 2018; Kivunja, 2014). One of important skill in the 21st century is collaboration skills. The results of the National Association of Colleges survey states that collaboration skills are in the

top position and are needed for human progress (Banar, 2015). The application of collaboration skills in learning also has an effect on increasing students' mastery of concepts, so that the learning outcomes obtained will be of higher quality (Hidayati, et al., 2020; Muiz, et al., 2016).

Based on the observation results at one of junior high schools in Semarang, Indonesia and interviews with science teachers showed that there are some obstacles in doing science learning during online learning, which includes the lack of time duration in explaining the learning material, learning process is still teacher centered where the teacher explains more and not student centered. The results of online learning is students being less trained to develop the ability to analyze, argue and have an impact on the low cognitive learning outcomes. It is proven when a daily assessment is held, 19 out of 32 students still get scores below the minimum completeness criteria, whereas, the student-centered learning process must applied in teaching in the 21st century learning (Ichsan et al., 2020). Online learning at one of junior high schools in Semarang, Indonesia, also makes there is no variation in group learning, so it does not train students' collaboration skills. Students are only given information that is known to the

teacher and from the source book used. During virtual face-to-face learning, there are still many students who are not present in virtual face-to-face learning due to signal constraints.

One of the efforts to improve students' collaboration skills in science learning is to apply blended learning with Collaborative Problem Solving (CPS) approach. Blended learning can be interpreted as a combination of between synchronous (face-to-face or online) and asynchronous modes (Heilporn et al., 2021). The use of blended learning is effectively used for science learning during the covid-19 pandemic (Anoba & Cahapaya, 2020). The blended learning process can be a student-oriented learning solution and affect cognitive learning outcomes, but collaborative learning activities between students are very minimal (Susanti & Prameswari, 2020). Thus, the learning process need an approach that can foster students' collaboration skills. Learning that can foster students' collaboration skills is contextual and collaborative learning. Collaborative learning makes students actively participate in groups (Mawad, 2020; Supena et al., 2021), so that students can process the information obtained and provide a conclusion. One of the learning approaches that can foster students' collaborative skills is the

Collaborative Problem Solving (CPS) approach.

The implementation of learning with the collaborative problem-solving approach must be accompanied by material that has problem-based characteristics. One of the junior high school science materials that can be implemented in blended learning with the CPS approach is vibration, waves, and sound. According to Rengganis (2015), in the concept of vibration, waves, and sound, it can be done by applying problem-based learning because in the concept there are problems in the form of physical phenomena in everyday life. The application of learning using blended learning with the CPS approach is expected to make students understand these phenomena and find causes and find solutions by discussing face-to-face or online.

METHOD

This research was conducted at at one of junior high schools in Semarang, Indonesia in the even semester of the 2020/2021 academic year. The research population was students of class VIII A, B, C, F, G, H. The research sample used class VIII G as the experimental class and class VIII H as the control class. The sample selection used cluster random sampling technique. The method used in this research is an experiment with a

quasi-experimental method using posttest-only control group design with a cluster random sampling technique. Students were divided into two classes, namely the experimental class and the control class. The control class was treated using direct instruction learning, while the experimental class was treated using blended learning with a collaborative problem-solving approach.

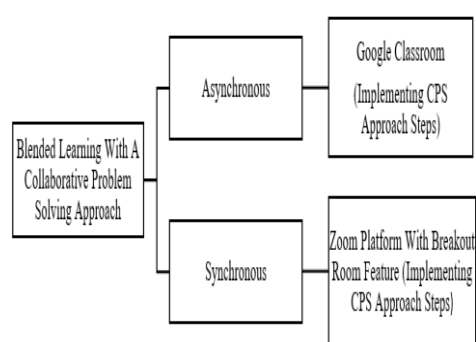


Figure 1. Blended learning with CPS approach

RESULT AND DISCUSSION

This research was carried out with the aim of analyzing the effect of blended learning with the CPS approach on students' cognitive learning outcomes and collaboration skills in science learning. This section presents the results of the study.

The results of the homogeneity test of the initial data of the daily assessment values of students in class VIII A, B, C, F, G, H during online learning obtained the results of χ^2 arithmetic of 0.332, while the value of χ^2 table of 11.07, so that the population variance is the same.

Samples of the experimental class and control class were taken from a homogeneous population using cluster random sampling technique. The next analysis is the analysis of cognitive learning outcomes, normality and homogeneity of the data. Cognitive learning outcomes data are normally

distributed and homogeneous, so the final data analysis used is a parametric test in the form of a t-test. The t-test was conducted to test the hypothesis of the difference in the average posttest value data for the experimental class and the control class.

Table 1. Results of Analysis of Final Data Normality Test

Experiment Class	χ^2_{count}	6.854
	χ^2_{table}	11.07
	Description	Normal Distribution
Control Class	χ^2_{count}	7.141
	χ^2_{table}	11.07
	Description	Normal Distribution

Table 2. Results of Final Data Homogeneity Test

Class	Varians	F _{count}	F _{table}	Criteria
Eexperiment	203.931	1.263	1.822	Homogen
Control	257.636			

Table 3. Results of the Average Difference Test

Class	t _{count}	t _{table}	Description
Eexperiment	3.908	1.669	Significantly
Control			Different

Table 3 showed the t-test calculation, the t-count value is 3.908 with t-table 1.669 with a significance level of 5% dk = 62. These results indicated that there is a significant effect on cognitive learning outcomes between the experimental class and the control class after the treatment of blended learning with a collaborative problem solving approach is given to the experimental class.

The Effect of Blended Learning with Collaborative Problem Solving Approach on Students' Cognitive Learning Outcomes in Science Learning

The cognitive learning outcomes of the experimental class were better than the control class because the learning steps applied to the two classes were different. The experimental class has a place to communicate and discuss at any time outside of virtual synchronous meetings accompanied by researchers as

teachers, besides learning that is carried out collaboratively in problem solving in accordance with the collaborative problem solving approach makes experimental class students who still have difficulty understanding the material and difficulties in finding individual solutions to the problems given in the article and students' worksheet can discuss and ask questions in the group discussion forum provided during asynchronous learning using the LMS google classroom, and also during synchronous learning using the zoom meeting platform.

The asynchronous learning process in the experimental class through the LMS google classroom and synchronous learning carried out on the zoom meeting platform is getting better, students are more actively discussing in solving problems in the students' worksheet, so that learning becomes student-centered and improves cognitive learning outcomes. Blended learning had a good effect on learning activities, making students interactive and student-centered (Dakhi et al., 2020; Rahim, 2019).

The blended learning learning process that triggers students activity and supported by learning steps using the CPS approach, makes students able to develop higher-order thinking skills,

because they are required to solve their own problems. The higher-order thinking process makes students have a complete understanding of the material provided and improves their cognitive learning outcomes (Rintayati et al., 2020).

Learning with the CPS approach implemented in blended learning is carried out synchronously and asynchronously, requiring students to actively seek problem solving individually and then discussed together in groups to get mutually agreed solutions, so that the CPS approach also triggers student activity and increases cognitive learning outcomes. This is because teacher-centered learning and students only listen to the teacher explain the material, turning into student-centered learning and improve students' understanding of the concepts of the material being taught, if understanding of the concept increases, student learning outcomes will also improve (Rodiah et al., 2020). This is also in accordance with Humaira's research (2015) which stayed that the CPS learning process encourages students to express opinions and find solutions to problems, and if CPS learning is carried out well, it will have a good effect on cognitive abilities.

Based on these results, it can be concluded that blended learning with the CPS approach has a significant effect on

students' cognitive learning outcomes and makes the science learning process student centered.

Effect of Blended Learning with Collaborative Problem Solving Approach on Students' Collaboration Skills in Science Learning

Collaboration skills observations were carried out with the aim of knowing the effect of blended learning with CPS approach on students' collaboration skills. Collaboration skills were measured using an observation sheet consisting of five collaboration skill indicators and twenty aspects that were observed. The collaboration skill indicators used in this study are (1) contributing actively; (2) work productively; (3) showing flexibility; (4) showing an attitude of responsibility; and (5) showing respect. The process of observing students' collaboration skills was carried out three times during the learning process, observers joined in asynchronous learning (google classroom) and joined synchronous learning (zoom) to observe students' collaboration skills during the learning process.

The results of the collaboration skill observations of students are as follows:

1. Contribute actively

The first indicator on the collaboration skill observation sheet is actively contributing. There are 4 aspects observed in the indicators contributing actively, namely (1) contributing in expressing the results of thoughts; (2) contribute in discussing the thoughts of each individual; (3) contribute in unifying the results of the discussion; and (4) contribute to finding solutions to problems. The percentage results for three meetings in the experimental class showed a significant increase, the experimental class obtained an average percentage result of 71.73% with a good category, while in the control class the average percentage result of the active contribution of students was 51.56 % with less category. The difference in the percentage results of the two classes is quite significant, it shows that there is an influence on the collaboration skill indicators of students in terms of actively contributing after being given the treatment of blended learning with the CPS approach.

The increase in the aspect of working productively occurs because the learning process carried out with variations of blended learning with the CPS approach makes students enthusiastic and active in learning, this also supports the research of Mustapa et al. (2015) and Mulyadi et al. (2020)

which stated that blended learning provides opportunities for students to express themselves and makes students must be involved in their duties. Students actively contribute in expressing their opinions based on the problems presented in the articles and students' worksheet and discussing them to get solutions collaboratively with their groups according to the implementation of the CPS approach. The results of this study also support the research of Meylinda & Yuliyahya (2018) which says that collaborative learning in problem solving will increase students' self-confidence, so that students will be more daring to contribute in the process of exchanging ideas.

2. Work productively

The second collaboration skill indicator is working productively. There are 4 aspects observed in the indicators of working productively, namely: (1) actively conducting discussions in groups; (2) complete group tasks effectively and efficiently; (3) focus on group discussions to find solutions; (4) smooth communication in the group. The average percentage of working productively in the experimental class for three observations was 66.91% with the less category, while in the control class, the average percentage of working productively for three observations was

59.89% with the less category. but the experimental class has a higher value and the difference is very significant. This shows that there is an influence on the collaboration skill indicators of students in terms of working productively after being given the treatment of blended learning with the CPS approach.

The increase in aspects of working productively on students' collaboration skills was due to the fact that during the three-meeting learning process, students were more enthusiastic in conducting discussions either through asynchronous learning through Google Classroom, or during synchronous learning through the Zoom platform, this was because students were given more freedom in their respective groups in the asynchronous learning process, because the teacher only acts as a facilitator and giver of instructions without interfering in the discussion process, where students are grouped according to the small groups in asynchronous learning to continue the learning process according to the steps of the CPS approach. The learner-centered learning process also makes students practice communication skills in groups according to aspects of the indicators of working productively, this happens because students are given the freedom to regulate the course of the discussion process carried out in small

groups in a blended manner, so that students tend to be more fluent in communicating because they are in small groups that are more easily conditioned. Blended learning also supports a learning process that prioritizes discussion, sharing ideas and being able to achieve fluent communication skills, both orally and in writing (Hasanah et al., 2020; Tawil, 2018).

3. Showing flexibility

The third collaboration skill indicator is showing flexibility. In this indicator there are 4 aspects that are observed, namely: (1) receiving criticism and suggestions; (2) negotiate differences of opinion; (3) always compromise; (4) accept every assignment given. The average results of the collaboration skill indicator showed flexibility for three observations in the experimental class of 73.71% with a good category, while the average percentage of flexibility of control class students obtained results of 60.68% with less category, this shows that there is an effect in the form of positive changes in the collaboration skill indicators of students in terms of showing flexibility after being given treatment, this shows that there is an influence on the collaboration skill indicators of students in terms of showing flexibility after being

given the treatment of blended learning with the CPS approach.

The increase in the percentage result was due to blended learning with the CPS approach freeing students to organize discussions in small groups, both in synchronous and asynchronous discussion forums, but still giving obligations to each individual, making students independent in carrying out the learning process. Blended learning is able to train independent learners in learning (Bahri et al., 2021; Harahap et al., 2019). The learning process carried out collaboratively in problem solving also makes students more enthusiastic in accepting the assignments given, because the answers to the questions presented in the students' worksheet are thought out together in one group according to the identify the interest learning step in the CPS approach. This is in line with the research of Anggreni et al. (2019) and Salam & Farooq (2020), which says that collaborative learning in problem solving can be done by sharing. Students become ready and accept all assignments given, because if they are done and discussed in groups, it will relieve students. Learning carried out in groups also makes students accept each other's criticism and suggestions, this is because in one small group there are several students who have different abilities, so there are various

opinions that must be agreed upon in order to answer questions on the students' worksheet.

4. Showing an attitude of responsibility

The fourth collaboration skill indicator is showing an attitude of responsibility. There are 4 aspects observed, namely: (1) being responsible for the assignments given in the group; (2) complete group assignments on time; (3) serious in discussion; and (4) obey the instructions given in the group. The average result of the collaboration skill indicator shows the responsible attitude of the experimental class and control class students. In the experimental class for three observations, the average result was 73.86% in the good category, while the average percentage result for the control class was 59.63% in the less category. The results of the average aspect showing responsibility for three meetings indicate that the experimental class has a higher average than the control class. The difference in the percentage results of the two classes is quite significant. This shows that there is an influence on the collaboration skill indicators of students in terms of showing an attitude of responsibility after giving the treatment of blended learning with the CPS approach.

The increase in the percentage of students' responsibility attitudes in the

experimental class was due to the learning process requiring students to complete their respective obligations, then when they entered the group forum according to the steps of the CPS approach, both during synchronous and asynchronous learning. The learning process requires students to complete their respective obligations, making students more responsible for the assignments given, so that the attitude of responsibility of students begins to form well and increases in each meeting. In addition, in blended learning, assignment collection is carried out in the LMS google classroom which is set to have a deadline, so that if it exceeds the specified time limit, it will be seen in google classroom that the collection of assignments has exceeded the collection time limit. Blended learning is also flexible, this is in accordance with research of Dahmash (2020) and Kholifah et al. (2020) on the advantages of blended learning, so that the flexibility of students in learning becomes better. The results of this study also support blended learning components, namely self-directed learning. Self-directed learning can make students discipline themselves (Allam et al., 2020; Chung et al., 2020; Saeid & Eslaminejad, 2016). The implementation of the CPS approach in blended learning also plays a role in

giving a positive influence on the responsible attitude of students, this is because there are learning steps that require students to be responsible for their respective assignments and be responsible for the group. The results of this study are also in line with Humaira's research (2015) which says that CPS learning requires each group member to find various opinions and thoughts, so that diversity will be produced. The demands in expressing opinions or thoughts make students more serious in understanding the discussion process so that they can complete their respective tasks.

5. Showing Appreciation

The last collaboration skill indicator is showing respect. In this indicator there are 4 aspects that are observed, namely: (1) respecting every opinion expressed by friends in the group; (2) respect when there are differences of opinion; (3) not forcing an opinion; (4) accept joint decisions in solving problems. The average result of the percentage of the experimental class for three observations was 81.51% in the very good category, while the average percentage of the control class on the attitude of responsibility of the students was 64.9% in the good category. The experimental class has a higher percentage of appreciative indicators

compared to the control class. This shows that there is an influence on the collaboration skill indicators of students in terms of showing respect after giving the treatment of blended learning with the CPS approach.

The results of the percentage of collaboration skill indicators in respect for the experimental class increased at each meeting due to the learning process carried out in blended learning with the CPS approach prioritizing discussion, interaction, arguing, and the process of seeking mutual agreement in each small group. Learners become familiar with a series of discussion processes to reach agreement. Students also exchange ideas and respect each other's opinions marked by not cutting the opinion of friends when talking in group forums, responding to each other's opinions offered by friends, these activities are very visible when discussions are held in small groups, the final results of the discussion are also mutually agreed without forcing each other, students also look professional when there are differences of opinion during the discussion process, so that the atmosphere of the discussion forum also remains comfortable and conducive. This is in accordance with Sudarmika et al (2020) and Fadli (2020), collaborative learning oriented in social interactions,

and learning processes that accommodate individual differences, and social of students. The existence of intense social interaction, making mutual respect for students also getting better.

In this research, the overall results show that the collaboration skills of the experimental class are increasing in each meeting, while the control class tends to fluctuate, if there is an increase, it is less significant. The average results of the experimental class collaboration skill observations show one indicator in the very good category, and four indicators in the good category, while in the control class there is only one indicator that is included in the good category, and four indicators in the poor category. Based on these results, it can be concluded that blended learning with the CPS approach has an effect on students' collaboration skills.

CONCLUSION

Based on the results of the analysis and discussion, in this study the conclusions were that the blended learning with the CPS Approach has a significant effect on students' cognitive learning outcomes in science learning and the lended Learning with the CPS Approach affects the collaboration skills of students.

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