

The Effectiveness of Science Project Learning based on Entrepreneurship Model to Improve Elementary Students' Collaborative Skills

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The Effectiveness of Science Project Learning based on Entrepreneurship Model to Improve Elementary Students' Collaborative Skills

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Abstract. Collaborative skills are among four essential life skills that students need to master in the 21st century. The fifth-grader of elementary school students' low collaborative skills encourages the researcher to develop a science project learning model with an entrepreneurship model to improve these skills. The purpose of this research is to determine the effectiveness of the learning model by implementing quasi-experiment, with one group pre-test and post-test design. Data analysis methods used were t-test, N-Gain analysis, and one-way analysis of variance (One Way Anova) to determine if there was an improvement after learning. The results of the analysis using the t-test showed a significant increase in pre- and post-test ($p < 0.05$), with post-test values better than pre-test (negative t). The results of the N-Gain analysis showed the average increase in student scores in the high category (≥ 0.70), and the results of the analysis of the one-track variance showed no difference in each group ($p > 0.05$). In general, the findings indicate that the learning model is effective in improving the collaborative skills of elementary school students.

Keywords: collaborative skills, elementary education, entrepreneurship, project learning, science subject

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INTRODUCTION ~ Almost all the aspects of life keeps changing and do not stop; it goes faster (Skiba, 2012) instead. Those who lacked the skills should be ready to be replaced by a machine (Shum, Kodama, & Shibata, 2020). To survive in the future, students, especially elementary students, should be equipped with various essential skills, namely Creativity & Innovation, Critical Thinking & Problem Solving, Collaborative, and Communication (4C) (Trilling & Fadel, 2010). At the level of elementary education, those skills are not necessarily required in the high level; it started by incorporating the aspects into everyday learning. One of the 4C skills, namely collaboration, is interaction and a personal lifestyle in which individuals are responsible for their actions, including learning and respecting their peers' abilities and contributions (Song, 2018). The difference between cooperation and collaboration is that cooperation is an interaction structure that is designed to facilitate a specific final product or goal through people working together in groups. Nowadays, collaborative skills have become crucial, since they can accelerate group work. Various students with varied backgrounds and skills are working together to achieve one big goal by doing what they are talented at.

Collaborative learning is done through students' interactive involvement in activities while at the same time, engaging them in social learning experiences. Research by Cho and Quint (Cho & Lim, 2017; Quint & Condliffe, 2018) states that such an approach positively affects learning outcomes. One of the learning models that can be used to improve collaborative skills is Project-Based Learning (PjBL) (Trilling, 2010). One of the policies in implementing elementary curricula in Indonesia, K-13, is a change in the learning paradigm from teacher-centered to student-centered (Yonanda, Yuliaty, & Saputra, 2019). To achieve student-centered learning, teachers are expected to apply a scientific approach in learning activities, namely, observe, ask questions, gather information, reason/associate, and communicate. Four learning models that use this scientific approach are: Discovery and Inquiry Learning, Problem Solving, Problem-Based Learning, and Project-Based Learning.

Project-based learning has become the primary strategy used by most of the best education systems in the world. Authentic learning that addresses 21st century skills is what Project-Based Learning (PjBL) offers (Rubrica, 2018). According to Quint & Condliffe (2018), there is a rapid increase in the use of the PjBL teaching method in science classrooms. The benefit for students is that they can actively participate in project-based learning in class, where they are asked to work collaboratively to solve problems, and then discuss and reflect on what they have learned (Gu, Chen, Zhu, & Lin, 2015).

Collaborative project-based learning is recognized as a component of several higher education courses, as it appears to motivate students and keep them active in the learning process. Collaborative PjBL is required so that tutors can intervene and guide students flexibly: by encouraging them to develop independent solutions and keeping their efforts and activities targeted for learning goals. On the other hand, students need to develop essential skills in finding and analyzing information and communication and time management.

Industry Revolution 5.0, which is on its way happening to the world, requires humans to continue to change before being changed (Schwab, 2017). Much different from before, this 5.0 Industrial Revolution has a broader scale of complexity and scope. Various new digital technologies that continue to shift humans' role in their profession massively cannot be denied that they will continue to develop. With the increase in the number of school graduates, Indonesia's unemployment rate will also increase if school graduates do not have skills in the field of entrepreneurship.

Entrepreneurship-based learning for students aged 11 years is the right time (Hassi, 2016). His research was designed to identify appropriate and relevant goals that need to be pursued through entrepreneurship activities targeting elementary school children. He assessed the effectiveness of early entrepreneurship education. The research findings found that children aged 11-12 years are at a sufficient period to develop self-efficiency, the non-cognitive skills

needed to become entrepreneurs (Polat, 2018). So, this 5th grade students are perceived to be the right time for combining an entrepreneurship approach with a project learning model (Ghazi, Ullah, & Jan, 2016).

The results of preliminary research at an elementary school in Surabaya, Indonesia, through observations in fifth-grade science class showed that (1) students still lacked collaboration in solving the problems given by the researcher as indicated by the results of the pre-test collaborative skills with a mean value below 75 and the score for each indicator between 1-2 (maximum score of 4); (2) in the learning material for the water cycle on the theme of environment, it did not use learning media; so (3) the given project had not been oriented towards a specific new skill. These problems have an impact on student activities in class, including: (1) students who actively expressed opinions were only a few; (2) there was a lack of social activities in the form of interactions and contributions in class, so that students were not accustomed to collaborating in a project. One of the problems that must be resolved immediately is the students' ability to collaborate.

In recent years, there has been growing recognition of vital links between project-learning and entrepreneurship approach (Harms, 2015; Sabahi & Parast, 2020; Seikkula-Leino, Ruskovaara, Ikavalko, Mattila, & Rytkola, 2010; Shepherd, Haynie, & Patzelt, 2013). However, those studies have not combined science project learning with entrepreneurship. Most of them are the social topic. It is interesting knowing that some survey data suggest that more young people, in both developed and developing countries, increasingly view entrepreneurship as the right choice for a career option in this era (Guthrie, 2014). Hence, this research seeks to find out if science project learning can be a good combination with the entrepreneurship approach to play a significant role in fostering the collaborative skills of elementary students. Based on the aforementioned background and previous research, this research aimed to solve problems in group learning activities/work on assignments in groups to improve student collaborative skills while fostering an entrepreneurial spirit.

METHOD

This research employs quasi-experimental model for science learning conducted to 5th-grader of elementary school. A quasi-experimental model aims at predicting the conditions achieved by pure experimental research, without controlling or manipulating all the relevant variables (Ramdan, Hanifah, & Isrokatun, 2019). Also, this type of research is frequently used to evaluate educational programs when a random assessment is not possible (Putri, Rahayu, Muqodas, & Wahyudy, 2020). The subjects were 30 fifth grade students from three different classes of an elementary school in Surabaya, Indonesia.

¹ According to Astutik & Prahani (2018) and Fuad, Alfin, Fauzan, Astutik, & Prahani (2019), the effectiveness of the learning model is determined based on: 1) Significant increase in the score between the pre-test and post-test of the students' collaborative skills, (2) The n-gain average is determined at least on the medium improvement criterion, (3) The consistency of the average n-gain score of the students' collaborative skills, and (4) Student's response is at least positive enough.

Research Procedure

This research design used was one group pre-test and post-test design (Fraenkel & Wallen, 2012), which was implemented to 30 students of 5th-grade elementary school.

O1 X O2

O1: Pre-test score, O2: Post-test score, X: Science Project Learning based on Entrepreneurship Model.

¹ Before the research, firstly, the researcher set up teaching instruments that covered these components: The natural science learning instruments are syllabus, learning implementation plan, student activity sheet, textbook, collaboration evaluation sheet, and student's response questionnaire (valid and reliable). The validity of those teaching instruments from science project learning model was then assessed by the biology and elementary education experts in terms of the content and construct. For the teaching instruments to be implemented, the learning instruments had to meet the valid and reliable requirements. To find out students' collaborative skills, this study begins with giving a pre-test of collaborative skills (O1) through several collaborative skills questions with indicators proposed by Hermawan et al., (2017). After that, they were using science project learning based on the entrepreneurship model. After all the learning process completed, all students are given a collaborative skills' post-test with the same material and problems as the pre-test questions.

Research Analysis

Collaborative skills of elementary students are analyzed based on the assessment conducted before and after applying science project learning based on entrepreneurship approach to 5th-grade of environmental science subjects. ¹ Pre-test, post-test, and n-gain of collaborative skills were analyzed using inferential statistics with the help of IBM SPSS software 25. The N-gain was determined using the equation: $n\text{-gain} = \frac{\text{post-test score} - \text{pre-test score}}{\text{maximum score} - \text{pre-test score}}$, with criteria: (1) if $n\text{-gain} \geq .7$ (high), (2) if $.3 < n\text{-gain} < .7$ (medium), and (3) if $n\text{-gain} \leq .3$ (low). The inferential statistical test with the science project learning model used ANOVA test.

RESULTS

Extensive trials conducted in classes 5A, 5B, and 5C with 30 students in each class. The trial was conducted by providing the learning process of three meetings to know the learning devices' practicality and effectiveness. The implementation of learning on trial was extensive, the author as a teacher and five people as observers. Each observer was tasked to observe and assess the implementation of the lesson plan and student activities during the learning process. The learning process was descriptively qualitatively analyzed, while the learning results were analyzed in quantitative description.

The analysis of collaborative skills results was carried out based on data obtained from the collaborative skills test of fifth grade students and analyzed using t-test and N-Gain. The t-test was used to calculate the significance improved in collaborative skills, while N-Gain was to determine the degree of improvement in collaborative skills.

A paired t-test requires the data to be normally distributed. The normality test was carried out using the IBM SPSS 25 application with the Shapiro-Wilk formula. Based on the normality test results using the IBM SPSS 25 the results of the sig value. The pre-test value of class 5A was 0.452 and the post-test value was 0.261. Meanwhile, the pre-test .sig value of class 5B was 0.201 and the post-test score was 0.125. Finally, the normality test of class 5C showed that the .sig pre-test was 0.448 and the .sig post-test was 0.125. The result of sig.> 0.05 shows that the pre-test and post-test data for classes 5A, 5B, and 5C were normally distributed. Hence, the t-test analysis could be carried out to see whether there was a significant increase in collaborative skills. The results of the paired t-test are presented in the Table 1 below.

Table 1. Paired T-test Result

	Paired Differences							
	Mean	Std. Dev	Std. Error Mean	95% Confidence Interval of the Difference		t	Df	P
				Lower	Upper			
PRE.A – POST.A	-41.26000	13.23876	4.18646	-50.73044	31.78956	-9.856	9	.000
PRE.B – POST.B	-40.63000	11.87837	3.75627	49.12727	32.13273	10.817	9	.000
PRE.C – POST.C	-38.13000	9.99367	3.16028	45.27904	30.98096	12.065	9	.000

The t-test results obtained from the pre-test and post-test data for each of the 10 students in the classes 5A, 5B, and 5C showed that the P value was 0.000. Because the P value <0.05, it

³ can be seen that there was a significant difference between the pre-test and post-test scores.

The degree of influence of learning effectiveness can be analyzed using the N-Gain formula. N-Gain or the degree of improvement in several indicators of collaborative skills of students in class 5A is presented in Table 2 below.

Table 2. N-gain Score of Collaborative Skills of 5A Students

Number	Indicators	Pre-test	Post-test	N-Gain	Category
1.	Be actively involved in group discussions (contribution aspect)	40	87.5	0.8	High
2.	Give friends the opportunity to express opinions / ideas (aspects of working effectively in diversity of members)	45	82.5	0.7	High
3.	Share tasks with each other to achieve learning goals (contribution aspect)	40	87.5	0.8	High
4.	Give ideas to solve problems (problem solving aspects)	45	80	0.6	High

Based on Table 2, it can be inferred that although the N-Gain on each indicator varies with a range between 0.6 - 0.8. The category of improvement of collaborative skills for each indicator was the same, namely the high category.

As for the degree of improvement (N-Gain) several indicators of collaborative skills of class 5B students is presented in Table 3 below.

Table 3. N-gain Score of Collaborative Skills of 5B Students

Number	Indicators	Pre-test	Post-test	N-Gain	Category
1.	Be actively involved in group discussions (contribution aspect)	40	80	0.7	High
2.	Give friends the opportunity to express opinions / ideas (aspects of working effectively in diversity of members)	42.5	82.5	0.7	High
3.	Share tasks with each other to achieve learning goals (contribution aspect)	40	80	0.7	High

	aspect)				
4.	Give ideas to solve problems (problem solving aspects)	47.5	90	0.8	High

In class 5B the degree of improvement of several indicators varies, with a range between 0.7 - 0.8 but all are in the high category, while for N-Gain class 5C is presented in Table 4. The data in Table 4 shows that the class 5C also had N-Gain variations with a range between 0.6 - 0.8 with the high category.

Table 4. N-gain Score of Collaborative Skills of 5B Students

Number	Indicators	Pre-test	Post-test	N-Gain	Category
1.	Be actively involved in group discussions (contribution aspect)	45	80	0.6	High
2.	Give friends the opportunity to express opinions / ideas (aspects of working effectively in diversity of members)	47.5	87.5	0.8	High
3.	Share tasks with each other to achieve learning goals (contribution aspect)	47.5	85	0.7	High
4.	Give ideas to solve problems (problem solving aspects)	50	87.5	0.8	High

After the N-Gain analysis was carried out, the ³ pre-test and post-test data of all students were ² tested using one-way analysis of variance (one-way Anova) using the IBM SPSS 25 application ³ to find out whether there was a difference in the average in the pre-test and post-test results done in classes 5A, 5B, and 5C. One-way analysis of variance data is presented in Table 5.

Table 5. One-way analysis of Variance Result

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	24187.813	5	4837.563	44.648	.000
Within Groups	5850.786	54	108.348		
Total	30038.599	59			

From Table 5 above, it can be inferred that the .sig value was 0,000, which means ³ that there was a difference in the average pre-test and post-test scores for fifth grade students because (.sig) <0.05. In this process, students adapted to science project learning with an entrepreneurship approach in several learning meetings until their learning interests emerge and can improve their collaborative skills. According to Bruner (in Takaya, 2008), knowledge will be a compilation obtained from independent efforts obtained and seeking knowledge that supports it. In Bruner's theory, the teacher helps as a facilitator and guides to students in developing their knowledge independently.

Results of Collaborative Skills Self-Assessment Sheet

The analysis of the results of collaborative skills was obtained from the questionnaire, which amounted to 16 questions that refer to the indicators of collaborative skills. The results of the answers to the student questionnaires for classes 5A, 5B, and 5C are presented in Table 6.

Table 6. Students Questionnaires' Answer

Aspects	5A		5B		5C	
	Average Percentage (%)		Average Percentage (%)		Average Percentage (%)	
	Yes	No	Yes	No	Yes	No
Contribution	92.5	7.5	87.5	12.5	85	15
Problem Solving	85	15	77.5	22.5	80	20
Working Effectively in Diversity of Members	92.5	7.5	87.5	12.5	92.5	7.5
Managing Projects	92.5	7.5	95	5	85	15

Results of Collaborative Skills Observation

Student collaborative skills in this study include four aspects, namely: contribution, problem solving, working effectively in diversity of members, and managing projects. Each aspect has indicators as presented in Table 6. Collaborative skills are observed by observers during learning. The results of the collaborative skills of students in classes 5A, 5B, and 5C at the first, second, and third meetings during the trial are illustrated in Figure 1.

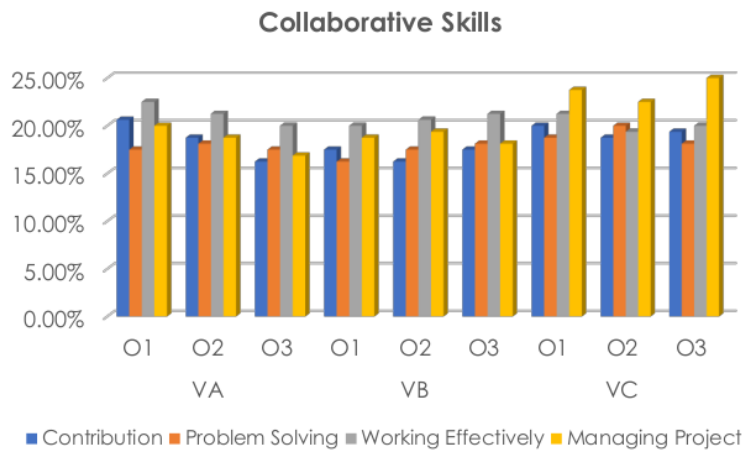


Figure 1. Observation in Students' Collaborative Skills

In class 5B, the percentage of collaborative skills that most often appeared was the aspect of working effectively in the diversity of members, while in class 5C the most frequently occurring collaborative skills were the aspect of managing projects. So based on Figure 1, it can be concluded that the most dominant skills during the application of science project learning with entrepreneurship-oriented were working effectively in diversity of group members and managing projects.

DISCUSSION

The effectiveness of learning model can be analyzed from the assessment of collaborative skills on test results, student activities, and student responses.

Results of Collaborative Skills

The collaborative skills test developed by the researcher consists of four description questions, each of which represents an indicator of collaborative skills and learning indicators. Based on the paired t-test analysis, it has been known that there was a difference between the results of the pretest and posttest before and after learning using entrepreneurship-oriented project-based learning. Based on the results of the t-test, it turned out that project-based learning could significantly improve student collaborative skills. Data regarding the significance (.sig) of increasing collaborative skills were also in accordance with the results of the N-Gain calculation. The difference in the results before and after learning is presented in Tables 2, 3, and 4 showing N-Gain for each indicator of collaborative skills. Based on the data, it can be inferred that the N-Gain of each indicator of collaborative skills of students in class 5A was in the high category, in class 5B was in the high category, and in class 5C the N-Gain value of

each indicator was also in the high category. In general, collaborative skills have experienced a high increase.

In addition to the improvement of each indicator, there was an increase in collaborative skills for each student. The N-Gain data for the collaborative skills of students in classes 5A, 5B, and 5C were then compared using a one-way analysis of variance formula (one-way ANOVA). Based on Table 5, the results of the analysis show that the sig value was 0.000 which indicates that there is a difference in the average result of increasing collaborative skills in the 5A, 5B, and 5C because $.sig \geq 0.05$. Thus, in terms of increasing collaborative skills, in general, science project learning with entrepreneurship approach can be said to be effective. This is in accordance with Song (2018) that project-based learning can improve students' collaborative skills.

In their book, Trilling & Fadel (2010) reveal that based on research, project-based learning was an effective learning model for practicing 21st Century skills, especially collaborative skills because in project-based learning students can learn more deeply when they apply knowledge from learning in the classroom and implement it in the real-world problems. This theory is in accordance with Paschalis' research (Paschalis, 2017), stating that project-based learning was very suitable to improve students' collaborative skills. Collaborative project learning that can trigger students to be active in the learning process (Murawski, 2010).

Collaborative skills are the interaction of two or more professionals who work together to achieve goals. Not all learning processes will be compatible with the application of collaborative learning methods because not all activities can be carried out collaboratively, depending on the goals to be achieved. Collaborative learning is developed to improve or complement and support other learning models. Therefore, project-based learning is suitable for improving collaborative skills because every step in its activities requires collaborative between students in groups.

The results of increased collaborative skills are related to student activity and were. Students were very active when doing project-based learning and they are also enthusiastic in doing experimental activities carried out in groups. Student responses in learning obtained from questionnaires at the end of the lesson also showed positive results.

Results of Self-Assessment Collaborative Skills (Student Response)

Table 6 presents the results of student responses on their ability to perform collaborative skills. In the aspect of contribution, there were 92.5% students of class 5A, 87.5% students of class 5B, 85% students of class 5C had done collaboration. In the problem-solving aspect, 85% students of class 5A, 77.5% students of class 5B, and 80% students of class 5C had performed problem-solving activities. In the aspect of working effectively in the diversity of members, 92.5%

students of classes 5A and 5C, and 87.5% students of class 5B had done this aspect. Whereas, in the aspect project management, 92.5% students of class 5A, 95% students of class 5B, and 85% students of class 5C had performed project management activity.

Observation Results of Collaborative Skills (Student Activities)

The observation results of the class 5A and 5B collaborative skills at the first, second, and third meetings showed that working effectively in diversity of members was the most frequently emerging skill. Whereas, in class 5C, the most common aspect was managing projects. From the observations it can be concluded that the most salient aspects were working effectively in diversity of members and managing projects.

21st century skills including collaborative skills in science classes can be trained during learning using project-based learning. This is consistent with research conducted by Rubrica (2018) who has proven the effectiveness of project-based learning as a more effective method of teaching.

CONCLUSION

Based on the aforementioned research findings, data analysis, and discussion associated with the problem formulation and research objectives, it can be concluded that the science project learning model meets the eligibility criteria, namely valid, practical, and effective. The learning model met the requirements for effectiveness, in terms of (1) enhancement of student collaborative skills was high; (2) well performance of collaborative skills well; (3) students' positive responses .

The proposed recommendation for the teacher is to understand and prepare the materials appropriately before implementing the science project learning model. In addition, the students must be accustomed to carrying out an investigative activity in science material, so that they are more confident in solving problems collaboratively by doing contribution, working effectively, and managing projects.

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