The 21st Century Capacity Development Strategy in the Subject of Motorcycle Chasis Maintenance at State Vocational High School (VHS)-1 of Gombong Kebumen

B A W Putra[1], M Samani[2], S Suparji[3], S Muslim[4], S Sunwinarti[5]
{bimaanggana90@gmail.com[1], msamani@unesa.ac.id[2] , suparji@unesa.ac.id[3],
supari.muslim@gmail.com[4], sunwinarti881@gmail.com[5] }

[1,2,4,5]Universitas Negeri Surabaya, Mechanical Engineering Education, Indonesia
[3]Universitas Negeri Surabaya, Civil Engineering Education, Indonesia
[2]Universitas Negeri Surabaya, Electrical Engineering Education, Indonesia

Abstract. This study aims to develop problem-based learning tools to develop the ability of vocational high school students in the context of facing the 21 st-century. The method used is the experimental method, with research instruments in the form of learning devices that include syllabus, learning implementation plans, modules, and thinking skills tests critical, creative, communication and collaboration. Data collection is done by tests and observations. Data analysis was carried out by analyzing the test of independent sample t-tests to distinguish 21st-century abilities between students of the experimental class and the control class and using test n-gain analysis and effect size to see the effectiveness of the treatment given to students' ability to deal with the 21st-century. shows that the device of problem-based learning models can improve students' abilities which include critical, creative, communication and collaboration skills in the context of facing the 21st-century.

Keywords: *Problem based learning, learning devices, 21st-century skills*

1 Introduction

One international study of cognitive abilities namely Trend in the Mathematics and Science Study (TIMMS) conducted by the International Association for the Evolution of Educational Achievement (IEA) found that in 2007 and 2011, more than 95% of Indonesian students were only able to achieve thinking skills in the middle level, while in Taiwan almost 50% of students are able to achieve the ability to think both levels and advance. In addition to this, based on the OECD Survey of Adult Skills held in Jakarta on April 1, 2014 to March 31, 2015, with the subjects of the study as many as 50,250 adults aged 16-65 years revealed that the adult population in Jakarta scored between 326-327 (from maximum score of 500) about numeracy skills that highlight respondents' activities in the form of collaboration and communication skills needed in the world of work. This score shows a level that is still low when compared to the adult population of other countries participating in the survey [1]. This happens because in the learning process in school students are generally less stimulated to improve higher-order thinking skills [2]. In addition to this, many educators are less used to using learning that demands high-level thinking skills [3]. Therefore, transformation is needed in terms of education, from learning by memorizing to thinking learning, or superficial learning to being profound or complex.

ICMASES 2019, August 03-04, Samarinda, Indonesia

DOI 10.4108/eai.3-8-2019.2290724

In the era of globalization, abilities that are more than just low-level thinking skills are increasingly needed. High-level thinking skills become a benchmark for students to face their lives later. High-level thinking skills (HOT'S) are often referred to as 21st-century abilities. The use of the term century skills 21 because this term is more often used in various parts of the world. Many educators define 21st-century skills as high-level thinking skills, deeper learning outcomes, and communication skills and collaboration skills. 21st century skills are divided into the following four categories: (1) ways of thinking: creativity and innovation, critical thinking, problem solving, decision making, and learning how to learn (or metacognition); (2) ways of working: communication and cooperation in groups; (3) tools for work: general knowledge and information communication technology literacy (ICT); (4) living as citizens: citizenship, life and career, and personal and social responsibilities, including cultural awareness and competence [4]. Wagner, suggested that students be provided with seven skills to survive in the 21st century as follows: (1) critical thinking and problem solving; (2) collaboration and leadership; (3) agility and adaptability; (4) initiative and entrepreneurship; (5) effective communication both oral and written; (6) access and analyze information; (7) curiosity and imagination. Some experts emphasize 21st-century skills on mastering technology, attitudes, and values. The ability to think high-level is a skill to process the mind to produce new ideas [5]. In line with this, Zimmerer explained that creativity is the ability to develop new ideas and to find new ways to see problems and opportunities 6] The ability to think creatively is a mental activity to make continuous connections, so that the correct combination is found [7]. While Craft, mentions that creativity is new ways of implementing knowledge and skills [8].

Creative thinking is thinking consistently and continuously to produce something that is creative or original in accordance with the requirements [9]. A little different from the above view, Boyd explained that in addition to out of the box, to be creative can also be done by thinking inside the box [10]. So from some of the opinions above it can be concluded that creativity is the ability to think to produce something new, besides that it can also improve the existing thinking patterns to solve a problem. The definition or understanding of 21st-century skills mentioned above is delivered in different ways, but the emphasis is on complex or high-level thinking (creativity, metacognition), communication, collaboration, and more demanding teaching and learning than memorizing. In accordance with what was stated above, the 21st-century capability that must be mastered by students in this study is 4C, namely: (1) Critical Thinking; (2) Communication; (3) Collaboration; and (4) Creativity.

Many expert explanations define the ability to think critically. According to Paul & Elder, critical thinking is a way for someone to improve the quality of their thinking by using systemic techniques of thinking and producing intellectual thinking in ideas initiated [11]. Someone who thinks critically will be able to solve important problems well. Furthermore, according to Baron & Stemberg, critical thinking is a thought that is focused on deciding what is believed to be done [12]. Fisher, explains that critical thinking is a model of thinking about things that are substance or any problem, where the thinker increases the quality of his thinking by handling skillfully the structures inherent in thinking and applying intellectual standards to him [13]. So from the above quotation we can know that critical thinking can improve the quality of the thinker in solving a problem skillfully, detailed and meticulously and the results of these activities can explore thinking skills by applying or applying all the intellectual standard ideas that they have. According to Facione, an indicator in critical thinking skills is an activity carried out by students which include: (1) interpretation; (2) analysis; (3) evaluation; (4) inference; (5) explanation; and (6) self-regulation [14].

The second skill of the 21st century is creative thinking. Creative thinking is a thought process that has fluency characteristics, flexibility, and originality. Fluency is the ability to express ideas or ideas that are true, and as much as possible clearly. Flexibility is the ability to issue many ideas or ideas that are diverse and not monotonous by looking at it from various perspectives. Originality is the ability to issue unique and unusual ideas or ideas, for example, those that are different from those in a book or different from the opinions of others. Elaboration is the ability to explain the factors that influence and add detail to an idea or idea so that it is more valuable [15]. The component in creative thinking is the problem of sensitivity which is the ability to recognize the existence of a problem or ignore the fact that is not appropriate (misleading fact), and originality is the ability to build ideas in an unusual manner [7].

The third 21st-century skill is communication skills. According to Theodorson, communication is "the transmission of information, ideas, attitudes, or one person or another (or other) primarily through symbols" [16]. Communication is the exchange of verbal and non verbal messages between the sender and the recipient of the message to change behavior [17] It can be concluded that communication ability is the ability of a person to convey a message to the audience (recipient of the message) so that the communication that is carried out runs smoothly and provides benefits, both for the delivery party and for the recipient of the message. Communication skills are important because communication skills are the basis for achieving competitive advantage. If someone has quality communication skills, then he will have a good competitive advantage. According to *hutagalung*, indicators of communication skills are: (1) seeing the other person; (2) the sound is clear; (3) pleasant facial expressions; (4) good grammar; (5) talks are easy to understand, short and clear [18].

Furthermore, the fourth 21st skill is collaboration skills. According to Woolfolk, collaboration is a philosophy of how to relate to others (how to learn and work), which is a way to deal with other people by respecting differences, sharing power, and gathering knowledge from others [19]. Therefore, collaboration has more meaning than cooperation. Gray, illustrates that collaboration is a thought process, where the parties involved look at the different aspects of a problem, and find solutions to those differences and the limitations of their views on what can be done [20]. Collaboration is a complex process that requires sharing of knowledge planned intentionally, and being a responsibility. Collaborative practice emphasizes shared responsibility in learning management. Indicators of student collaboration capabilities adapted from the Interprofessional Resource Center are: (1) shared experience; (2) responsibility and accountability; (3) sharing information; (4) cooperation; (5) support for innovation; and (6) trust each other [21].

The 21st-century skills, as described above, need to be trained in vocational students. Vocational High Schools (SMKs) are mandated by law to prepare human resources who are ready to enter the workforce and become productive workforce. Vocational school graduates are ideally ready-to-use workers, can immediately work in the business or industry. The human resources (HR) in question must be in accordance with the competency standards of graduates who have been determined with criteria regarding the qualifications of graduates' abilities which include attitudes, knowledge, and skills. In addition, Vocational Schools also have the obligation to equip students with the ability to think logically, analytically, systematically, critically, and creatively, which requires students to be active (student-centered). Learning active learning can be done through learning by doing. Active learning helps students to develop knowledge flexibly, effective problem-solving abilities, directed learning (self-directed) in order to improve collaboration skills and effective intellectual motivation [22]. Active learning also emphasizes learning through problem-solving [23].

Innovative learning is learning that is more student-centered. That is, learning that provides more opportunities for students to construct knowledge independently (self-directed). Given the main purpose of learning to develop critical thinking skills and creativity, the learning model must be designed to encourage students to analyze some critical things and then encourage students to generate ideas. The various innovative learning models in question include problem-based learning models, project-based, collaborative, cooperative, with various approaches used, such as scientific and contextual approaches. Learning is also very possible to apply various learning strategies.

Related to this, to develop the ability of 21st-century abilities, teachers no longer use conventional learning models where teacher-centered learning (teacher-centered). Students are given more opportunities to develop abilities in their own way (student-centered), through critical, creative, communicative and collaborative thinking used in problem-solving efforts. Based on this, the learning model which is considered capable of developing critical, creative, communication and collaborative thinking skills is a problem-based learning model.

Problem-based learning is a method of teaching in the way students are faced with a problem that must be solved based on data or accurate information to get a conclusion [24]. In line with this, Arends states that problem-based learning is a learning approach, where students work on problems authentic with the intention to compile their own knowledge [25] Problem-based learning is one of the learning approaches used to stimulate high-level thinking students in situations that are oriented to real-world problems, including how to learn.

Problem-based learning is a teaching method by the way students are faced with a problem that must be solved based on accurate data or information so that they get a conclusion. [24]. In line with this, Arends states that problem-based learning is a learning approach, where students work authentically with the intention to compile their own knowledge [25]. Problem-based learning is one of the learning approaches used to stimulate high-level thinking students in situations that are oriented to real-world problems, including how to learn.

The problem-based learning model (PBM) in addition to having a theoretical foundation as the basis of its development, the purpose of implementation, management of learning, also has a syntax or steps in the process of implementing learning. PBM syntax includes 5 steps that must be applied in the learning process, namely: (1) student orientation in the problem; (2) organizing students for learning; (3) guiding in investigations; (4) develop and present the work; and (5) analyze and evaluate the problem solving process. Research in terms of developing a problem-based learning tool is carried out to increase the ability to think creatively for vocational high school students. This research was conducted with the aim of analyzing whether the application of problem-based learning models can improve the ability of creative thinking for students and the implementation of teachers in implementing problem-based learning models. Another purpose of this study is to describe the success of a problem-based learning model in order to improve the ability to think creatively and analyze student responses to the components of learning developed.

2 Method

This study aims to develop a problem-based learning tool in order to improve the ability of 21st-century Vocational students while applying it. The research instruments included assessment sheets for critical, creative, communicative and collaborative thinking skills, learning implementation plans (LIP), syllabus, and learning modules. This research was conducted at Gombong Kebumen State Vocational School 1, in Motorcycle Engineering Expertise Competence (MEEC) about brake system learning material. Data collection

techniques are carried out by observation, tests, and documentation. Data analysis techniques were carried out with descriptive and inferential statistics.

2.1 Data analysis

Data analysis techniques are based on the results of the 21st-century ability test. Test questions contain indicators of the ability of the 21st century, which are then analyzed descriptively and inferentially. Descriptive analysis is carried out on each 21st-century capability that includes the ability to think critically, creatively, communicatively, and collaboratively based on the posttest scores obtained by students, using the following formula:

$$\text{Skill} = \sum \frac{\text{skor jawaban benar}}{\text{skor keseluruhan}} \text{ x } 100 \qquad (1)$$

The use of inferential statistics is used to test the proposed hypothesis by comparing the capabilities of the 21st century, between the experimental class and the control class. The test was carried out through a two-party t-test with the help of SPSS 23. Before the t-test was carried out, the assumption was tested for the data obtained, namely the normality test, and the homogeneity test. Normality test was carried out using the one-sample Kolmogorov-Smirnov method with the help of SPSS 23 software with the level of sig. 0.05, while the similarity test of variance between the two groups was carried out with the help of SPSS 23 software with the level of sig. 0.05. The homogeneity test of students in the experimental class and control class was carried out through a Levene test.

Hypothesis testing is done to find out whether there are differences in abilities between students who learn by using learning tools based on problems and students who learn using the MPL learning device. Capability testing is done using the independent sample t-test. Tests were conducted to determine whether there were differences in the average score of the experimental class with the control class. The N-Gain test was conducted to determine the effectiveness of the learning model in order to improve students 'abilities, using SPSS version 23. Effect Size Test was conducted to determine the amount of donation given in order to improve students' abilities, using the cohen formula d below this.

3 Result and Discussion

The results of this study consisted of four groups, namely the results of data processing about learning outcomes, creative thinking skills, implementation of learning, and student responses.

3.1 Critical Thinking Skill

Hypothesis testing is done by comparing the average score of the posttest results in critical thinking skills from the experimental class and the control class. The average score of critical thinking skills from the experimental class and control class as shown in Table 1 below.

The aspect of critical thinking	Mean of students' score	
	Experiment group	Control group
Interpretation	74,17	74,44
Analysis	83,61	79,72
Evaluation	82,22	76,81
Inference	83,33	78,68
Explanation	83,19	77,22
Self regulation	77,92	73,75
Critical Thinking	81,57	76,77

Table 1. Students' Achievement on Critical Thinking

Based on Table 1, the graph of the average score of critical thinking skills of the experimental class students and the control class is shown in Figure 1 below.

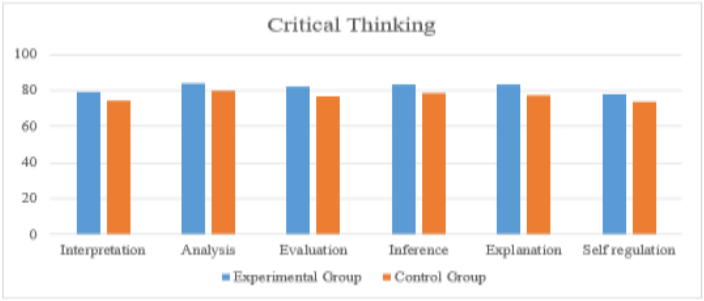

Figure 1. Student Achievement on Critical Thinking

To see the difference in the average score about critical thinking skills from the experimental class and the control class, the independent sample t-test was used, the results of which are shown in Table 2 below.

Independent Samples Test				
		t-test for Equality of Means		
		T	df	Sig. (2-tailed)
Critical Thinking	Equal variances assumed	2,350	70	0,022
	Equal variances not assumed	2,350	69,750	0,022

Table 2. Statitic test on Critical Thinking

From Table 2, it can be seen that the level of sig. at 0.022 <0.05, so it can be concluded that the average score of critical thinking skills for students who study using PBL (81.57) is significantly higher than students who learn using Direct Instruction (DI) (76.77). Next are the n-gain test and effect size test to see the effectiveness and magnitude of the PBL effect on critical thinking skills. Based on the results of n-gain testing the results are 0.037 <0.05, which means that PBL is effective for improving critical thinking skills. The results of the size effect

test obtained a result of 0.55 which indicates that PBL's size effect on critical thinking skills is in the moderate category.

The results of this study are in accordance with Fisher's opinion about critical thinking which states that critical thinking is a model of thinking about things that are substance or any problem in which students improve the quality of their thinking by skillfully handling the structures inherent in thinking and applying intellectual standards to him [13]. In line with this, according to the theory of cognitive development delivered by Rath, that cognitive development is a learning process that is needed in increasing understanding of the material influenced by the development of mental processes used in thinking and concepts used in learning. One of the factors that can influence the development of critical thinking skills is the interaction between teachers and students. To develop critical thinking skills students need an academic atmosphere that provides freedom and security for students to analyze and express their opinions in learning activities [26]. The explanation is in accordance with the application of problem-based learning models, where the role of the teacher in the learning process is only as a facilitator, then the students solve the problem independently.

In addition to this, the results of this study are in line with the research conducted by Nazir entitled "Problem-Based Learning in Students' Critical Thinking Skills in Malaysia: A Literature Review" which concluded that the learning approach using problem-based learning had a positive impact on producing professional competence. Furthermore problem-based learning offers a solution to the problems faced in education, where in the implementation of problem-based learning has an impact on critical thinking skills [27].

3.2 Creative Thinking Skill

Hypothesis testing is done by comparing the posttest average score about creative thinking skills from the experimental class and the control class. Average score data about creative thinking skills from the experimental class and control class as shown in Table 3 below.

The aspect of creative thinking	Mean of students' score	
	Experiment group	Control group
Fluency	84,44	77,08
Flexibilty	82,50	76,67
Originality	80,28	74,17
Elabotion	82,64	76,94
Creative Thinking	82,47	76,22

Table 3. Students' Achievement on Creative Thinking

Graph of the average score of creative thinking ability of the experimental class students and the control class as shown in Figure 2 below.

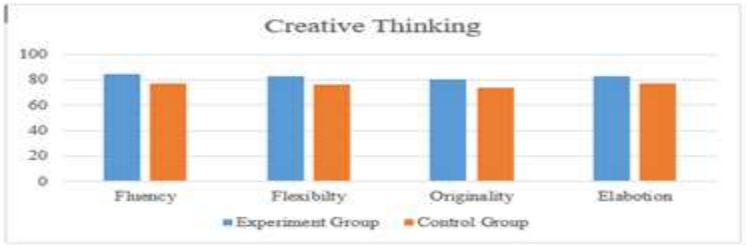

Figure 2. Stundent Achievement on Creative Thinking

To see the difference in the average score about creative thinking skills from the experimental class and the control class, the independent sample t-test was used, the results of which are shown in Table 4 below.

Independent Samples Test				
		t-test for Equality of Means		
		T	df	Sig. (2-tailed)
Creative Thinking	Equal variances assumed	2,082	70	0,041
	Equal variances not assumed	2,082	65,148	0,041

Table 4. Statitic test on Creative Thinking

From Table 4 it can be seen that the value of the sig level. amounting to 0.041 <0.05, so it can be concluded that the average score of creative thinking skills for students who study using PBL (82.47) is significantly higher than students who study using DI (76.22). Next is the n-gain test and the effect size test to see the effectiveness and magnitude of the PBL effect on the ability to think creatively. Based on the results of n-gain testing, the results are 0.033 <0.05, which means that PBL is effective in increasing the ability to think creatively. The results of the size effect test obtained a result of 0.51 which indicates that PBL's size effect on creative thinking skills is in the moderate category.

The results of this study are in accordance with the social aspects of learning presented by Vygotsky, who stated that learning that promotes social interaction with others will spur the development and development of new ideas in overcoming and enriching students' intellectual development. The statement is in accordance with the syntax of the learning model based on the problem where in addition to students oriented in the problem, students are also divided into small groups so that they find new ideas [28].

Furthermore, according to Rawlinson, someone who thinks creatively must go through the following stages: (1) the preparation stage, the stage to obtain facts about the problem to be solved; (2) the stage of business, the stage where individuals apply divergent thinking methods (spread); (3) the incubation stage, the stage where the individual will leave the problem and put it into the subconscious, while his consciousness thinks of other things; (4) the stage of understanding, the stage of obtaining insight or commonly called the erlipnis stage, where the characteristic of this stage is the existence of a beam of illumination that suddenly awakens people will find answers; and (5) the evaluation phase, at this stage, the resulting ideas are carefully examined and critically separate ideas that are less useful, inappropriate or too expensive if implemented [29].

The results obtained in this study are relevant to the research conducted by Cetinkaya, entitled "The Effect of Gifted Student's Creative Problem Solving Program on Creative Thinking" which concluded that students who study using problem based learning have higher creativity than the control class. Learning based on problem solving that is applied, proved effective in improving students' creativity abilities. Steps in developing student creativity, namely: (1) asking questions according to the level of students; (2) use various group studies, which allow them to express themselves on certain topics [30]. Other research that is in line is the research conducted by Talat, about "The Effect of PBL and 21st Century Skills on Students' Creativity and Competitiveness in Private Schools" which concluded that PBL supports 21st century skills along with personal and social development. Students are encouraged to undergo a process of inquiry to respond to complex problems. Students learn

the main academic content and practice 21st-century skills (such as collaboration, communication, and critical thinking) with the PBL approach. This study provides theoretical and quantitative evidence about how the PBL approach has gone beyond the traditional education system [31].

3.3 Communication Skill

Hypothesis testing is done by comparing the posttest average score about communication skills from the experimental class and the control class. Average score data about communication skills from the experimental class and the control class as shown in Table 5 below.

Aspect of communication	Mean of students' score	
	Experiment group	Control group
View others	85,88	79,63
Voice was clear	82,41	76,62
Nice expression	85,88	77,31
Good grammar	81,25	78,70
Easy to understand	81,94	81,41
Communication	83,47	78,94

Table 5. Students' Achievement on Communication Skill

Graph of the average score of communication skills of the experimental class students and the control class as shown in Figure 3 below.

Figure 3. Student Achievement in Communication Skill

To see the difference in the average score about communication skills of the experimental class and the control class, the independent sample t-test was used, the results of which are shown in Table 6 below.

Table 6. Statistics test on Communication Skill

Independent Samples Test				
		t-test for Equality of Means		
		T	Df	Sig. (2-tailed)
Communication Skill	Equal variances assumed	2,747	70	0,008
	Equal variances not assumed	2,747	69,158	0,008

From Table 6 it can be seen that the level of sig. amounting to 0.088

<0.05, so it can be concluded that the average score of communication skills for students learning using PBL (83.47) is significantly higher than students who study using DI (78.22). Next, are the then-gain test and effect size test to see the effectiveness and magnitude of the contribution of PBL effects on communication skills. Based on the results of n-gain testing, the results are 0.029 <0.05, which means that PBL is effective for improving communication skills. The results of the size effect test get a result of 0.64 which indicates that PBL's size effect on communication skills is in the moderate category.

The results of this study are in accordance with the opinion of Boss & Krauss, which states that through the learning process that emphasizes problem-solving (project) makes students get additional benefits beyond the expected, one of the students can build communication skills. Such learning can train and improve communication skills because in the learning process there is a stage of presenting work results, so students will get used to presenting through presentations and will understand how to treat the other person [32] According to Effendy, communication skills in the form of discussion in the teaching and learning process take place very effectively, both between the teacher and the students as well as among the students themselves because the mechanism allows students to be accustomed to express opinions in an argumentative manner. Competent communicators must have the following conditions: (1) understand what must be done in various communication events; (2) develop behavior that can produce the right message; and (3) care about the importance of communication actions and processes [33].

Research that is in line with this research is research conducted by Awang, entitled "Improving A Communication Skill Through The Learning Approach Towards The Environment Of Engineering Classroom", which concludes that through this approach, students acquire communication skills in generating ideas. The role of the learning approach is used to improve the ability of communication skills among students. This research is used to measure the influence of communication skills on students 'academic achievement and to measure students' responses to learning approaches "Improving A Communication Skill Through The Learning Approach Towards The Environment Of Engineering Classroom". The results of the study indicate that this learning approach significantly influences students' abilities in significant communication skills [34].

3.4 Collaboration Skill

Hypothesis testing is done by comparing the posttest average score about the collaborative ability of the experimental class and the control class. The average score data about the collaborative ability of the experimental class and the control class as shown in Table 7 below.

Aspect of collaboration	Mean of students' score	
	Experiment group	Control group
Shared Experience	86,81	78,47
Responsibility and Accountability	81,25	74,07
Sharing Information	84,03	78,47
Co-operation	84,03	78,94
Support for Innovation	83,10	78,01
Mutual trust and respect	84,26	77,78
Collaboration	83,91	77,62

Table 7. Students' Achievement on Collaboration Skill

The graph of the average score of the collaborative ability of the experimental class students and the control class as shown in Figure 4 below.

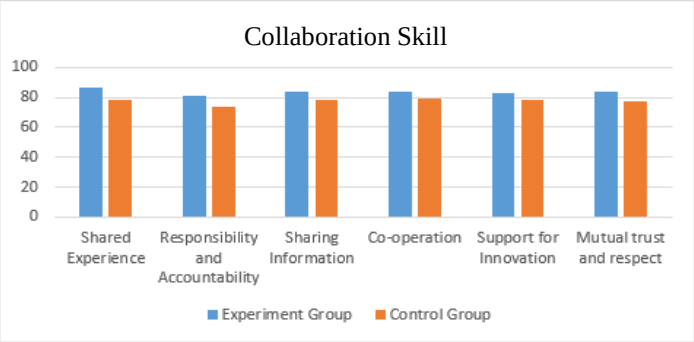

Figure 4. Student Achievement on Collaboration Skill

To see the difference in average scores about the ability to collaborate from the experimental class and the control class, the independent sample t-test test was used, the results of which are shown in Table 8 below.

Independent Samples Test				
		t-test for Equality of Means		
		T	Df	Sig. (2-tailed)
Collaboration Skill	Equal variances assumed	3,722	70	0,000
	Equal variances not assumed	3,722	69,375	0,000

Table 8. Statistic test on Collaboration Skill

From Table 8 it can be seen that the level of sig. amounting to 0.088 <0.05, so it can be concluded that the average score of collaborative ability for students who studied using PBL (83.91) was significantly higher than students who studied using DI (78.62). Next are the n-gain test and effect size test to see the effectiveness and magnitude of the PBL effect on the ability to collaborate. Based on the results of n-gain testing, the results are 0.029 <0.05, which means that PBL is effective for improving communication skills. The results of the size effect test get a result of 0.87 which indicates that PBL's size effect on communication skills is high. The results of this study are in accordance with Orey's opinion, which states that learning models that orient students towards a problem (project) can improve students' collaboration skills. According to Orey, five advantages of the learning model are one of which is to increase collaboration [35] Problem-based learning models can enhance collaboration skills because in the syntax there are stages of investigation individually or in groups, where in this stage students learn to be active investigators and can use appropriate methods for the problems they face, students also need to learn about what and how right ethics of inquiry. At the stage of investigation a problem is expected to occur.

Whereas according to Barkley, there are several advantages of learning that emphasize collaboration skills, including (1) higher learning achievement; (2) deeper understanding; (3)

developing leadership skills; (4) increasing positive attitudes; (5) increase self-esteem; (6) learning inclusive; (7) feel belonging to each other; and (8) developing future skills [36].

4 Conclusion

the average score of critical thinking skills for students who study using PBL (81.57), is significantly higher than students who study using DI (76.77), and PBL is effective for improving critical thinking skills; (2) the average score of creative thinking ability for students who study using PBL (82.47), is significantly higher than students who study using DI (76.22), and that PBL is effective for improving the ability to think creatively; (3) the average score of communication skills for students who studied using PBL (83.47), significantly higher than students who studied using DI (78.22), and that PBL was effective for improving communication skills; (4) that the average score of collaborative ability for students who study using PBL (83.91) is significantly higher than students who study using DI (78.62), and that PBL is effective for improving communication skills.

5 Suggestion

Based on the results of the research that has been obtained, a suggestion is given to the parties related to this study, that in order to obtain optimal results, the development of learning devices with problem-based learning models (PBL), needs to be adjusted to the level of ability of the students concerned.

References

[1] OECD, "Skills Matter: Further Results From The Survey Of Adults Skills Jakarta (Indonesia)." 2016.

[2] L. Nurlela, "Developing Creative Thinking Skills in Learning at Higher-Educational Institution of Teacher," in *Proceedings of the 3rd UPI International Conference on Technical and Vocational Education and Training*, 2015, p. 114.

[3] M. & S. Samani, "Teaching-Learning Strategy For Developing Critical Thinking And Creativity For Engineering Student Teachers," in *TVET International Conference at Bremen University-Germany*, 2015.

[4] A. R. Saavedra and V. D. Opfer, "Learning 21st-Century Skills Requires 21st-Century Teaching," *Phi Delta Kappan*, vol. 94, no. 2, pp. 8–13, Oct. 2012.

[5] T. Wagner, *The Global Achievement Gap: Why Even Best Schools Don't Teach the New Survival Skills Our Children Need-and What We Can Do About It*. Basic Books Group: New York, 2008.

[6] Zimmerer and T. W, *Kewirausahaan dan manajemen usaha kecil*. Jakarta: Salemba Empat, 2009.

[7] J. R. Evans, *Creative Thinking*. Ohio: South-Western Publishing Co, 1991.

[8] C. A and J. B, *Creativity in Education: Current perspective on policy and practice*. London: Cassel Ltd, 2001.

[9] L. Nurlaela and E. I, *Strategi Belajar Berpikir Kreatif*. Yogyakarta: Ombak, 2015.

[10] D. Boyd and J. Goldenberg, *Inside the Box: Why the Best Business Innovation are in Front of You*. London: Profile Book Ltd, 2013.

[11] M. Mason, "Critical Thinking and Learning," in *Critical Thinking and Learning*, Oxford, UK: Blackwell Publishing Ltd., 2006, pp. 1–11.

[12] B. J. B and S. R. J, *Teaching thinking skills: theory and practice*. New York: W H

Freeman and Company, 1987.
[13] A. Fisher, *Critical thinking: an introduction*. Jakarta: Erlangga, 2009.
[14] P. A. Facione and N. C. Facione, "Critical Thinking for Life," *Inq. Crit. Think. Across Discip.*, vol. 28, no. 1, pp. 5–25, 2013.
[15] D. K. Filsaime, *Menguak Rahasia Berpikir Kritis dan Kreatif*. Jakarta: Prestasi Pustaka, 2008.
[16] G. A. Theodorson, *Modern Dictionary of Sociology*. New York: Ty Crowell Co, 1969.
[17] A. Muhammad, *Komunikasi organisasi*. Jakarta: Bumi Aksara, 2001.
[18] I. Hutagalung, *Pengembangan kepribadian (Tinjauan Praktis Menuju PribadiPositif*. Jakarta: Indeks, 2007.
[19] W. A and N. M. L, *Educational psychology for teachers englewood cliffs*. New Jersey: Prentice Hall, 1984.
[20] B. Gray, *Collaborating: finding common ground for multiparty problems*. San Francisco, California: Jossey-Bass, 1989.
[21] J. Eddins, L. Lindeke, and A. Sieckert, "Nurse-Physician Workplace Collaboration," *J. Assoc. Vasc. Access*, vol. 10, no. 4, pp. 169–170, Dec. 2005.
[22] B. R. Belland, B. F. French, and P. A. Ertmer, "Validity and Problem-Based Learning Research: A Review of Instruments Used to Assess Intended Learning Outcomes," *Interdiscip. J. Probl. Learn.*, vol. 3, no. 1, Mar. 2009.
[23] E. M. Hunt, P. Lockwood-Cooke, and J. Kelley, "Linked-Class Problem-Based Learning In Engineering: Method And Evaluation," *Am. J. Eng. Educ.*, vol. 1, no. 1, Jan. 2011.
[24] N. L and Buditjahjanto, "Implementasi teknologi informasi dan komunikasi dalam pembelajaran bidang vokasi," *J. Teknol. Pendidikan, Teor. dan Prakt.*, vol. 2, no. 2, 2013.
[25] R. I. Arends, *Classroom instructional and management*. New York: The McGrw-Hill Companies, 1997.
[26] R. L. E, *Teaching for thinking*. New York: Teacher College Columbia University, 1966.
[27] M. Nazir, "Problem-Based Learning On Students Critical Thinking Skills In Teaching Business Education In Malaysia: A Literature Review," *Amecrican J. Bus. Educ.*, vol. 3, no. 6, p. 19, 2010.
[28] L. S. Vygotsky, *Mind in Society*. Cambridge: Harvard University Press, 1978.
[29] R. J. G, *Berpikir kreatif dan brainstorming*. Erlangga: Jakarta, 1976.
[30] T. Amina and C. H. F, "The Effect of PBL and 21st Century Skills on Students' Creativity and Competitiveness in Private Schools," *Lahore J. Bus.*, vol. 2, no. 2, 2014.
[31] Ç. Çetinkaya, "The Effect of Gifted Students' Creative Problem Solving Program on Creative Thinking," *Procedia - Soc. Behav. Sci.*, vol. 116, no. 2, pp. 3722–3726, Feb. 2014.
[32] B. S and J. Krauss, *Thinking Through Project-Based Learning Guiding Deeper Inquiry*. United State: SAGE Publications, 2013.
[33] Effendy and U. Onong, *Ilmu, teori dan filsafat komunikasi*. Bandung: Citra Aditya Bakti, 2003.
[34] H. Awang and Z. Daud, "Improving a Communication Skill Through the Learning Approach Towards the Environment of Engineering Classroom," *Procedia - Soc. Behav. Sci.*, vol. 195, pp. 480–486, Jul. 2015.
[35] M. Orey, *Global Text: Emerging Perspectives on Learning, Teaching, and Technology*. Switzerland: Catherine Land, 2010.

[36] Barkley, *Collaborative learning techniques: Teknik-teknik Pembelajaran Kolaboratif*. Bandung: Nusa Media, 2012.