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Mathematics Communication Skill of Students on *Project Blended Learning* (PB2L) with *Moodle*

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Abstrak

This research aims to analyse effectiveness of *Project Based Blended Learning* (PB2L) to mathematics communication skill of students and to describe the skill on PB2L learning with *moodle.* This *mixed method* research with *sequential explanatory design* took XMIPA of SMA N Garawangi, Kuningan, in academic year 2018/2019 as the population. The subjects consisted of 33 XMIPA4 students. The techniques of collecting data were test, observation, documentation, and interview. Based on the findings, the mathematics communication skill on PB2L with *moodle* was effective. Students with poor mathematics communication skill consisted of 2 persons, the moderate students consisted of 24 persons, while the high category students consisted of 7 persons.

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INTRODUCTION

In this 21st globalization era, the features are science and technology advancement and internet access of communication system. This digital technology development has brought disruptions on various human activities in educational world in which requires to anticipate the fast development of technology in 4.0 industrial revolution era. The changes greatly influence human characters to skills will quickly change based on the needs. One of preparations to face 4.0 industrial revolution is by designing curriculum. Learning on 2013 curriculum improves creativity of students through 6M (observing, asking, trying, reasoning, creating, and communicating) through assessment process such as cognitive, affective, and psychomotor aspects. According to Rosyada (in Haryati, 2017), four sustainable components in accordance to 21st Century Partnership Learning Framework" are "4Cs", Communication, collaboration, critical thinking dan creativity. They are demanded variables by every institution and professional.

Rule of National Education Ministry, No. 22, states that through learning mathematics, students are expected to communicate their notions, symbols, tables, diagrams, or other media to explain problems or situations. Mathematics skill of Indonesian learners are still in Low International Level Benchmark in Trends In International Mathematics and Science Study (TIMSS). TIMSS' assessment in 2015 (Muliis et al, 2016) showed that the average score of each assessment: cognitive 395, application 397, reasoning, 397, made Indonesia in 44th position of 49 countries. It is similar with Putra's research (2015) stating that poor mathematics communication was caused by misappropriation to not put students as the subjects to find the knowledge but it was the teacher whom became the center of learning. It was in line with observation done at X IPA of SMA N Garawangi. The mathematics communication skill of the students were poor. It could be seen from the preliminary study that proved their poor skill while facing problems. They were not expressing the solution accurately and had difficulties to communicate their mathematics notions or ideas, understanding and argument to their teacher, peers, group, and whole class. It could be seen on Figure 1.

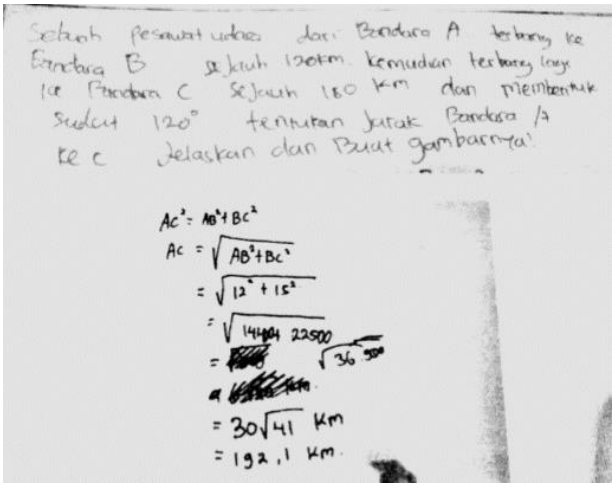

Figure 1. Question and a Student's Answer

Based on the figure, it can be seen that during solving the question, the students had not been able to change contextual problem into mathematics model. They could not communicate mathematics ideas into mathematics model. Based on the test, it was obtained the average score of such problem with 63.25, from 30 test takers. The score was under the minimum passing grade, 75. It showed that mathematics communication skill became serious problems.

Good mathematics communication skill would be better in expressing ideas or notions in front of their friend or teacher. Besides that, the statement of NCTM (Rizqi, 2016), one of standard capability to master by students is expressing mathematics idea coherently and clearly to teacher, student, and other participant by using accurate mathematics language in various mathematics expressions. Communication is a method to share notions and clarify understanding. Mathematics communication is ability to express mathematics ideas or notions both written and figures. Then, the indicators of mathematics communication skill in this research, according to Sumarmo in Tinungki (2015) were (1) expressing again an essay or paragraph into their own language, (2) explaining and illustrating ideas, situations, and mathematics relationship into figures, graphs, and mathematics models, (3) reading by understanding a certain mathematics representation, (4) stating and connecting daily events into mathematics ideas or language, and (5) creating conjecture, arranging argument, formulating definition, and generalizing.

It indicated a need of learning to develop mathematics communication skill of the students. *Project Based Blended Learning* (PB2L) is a learning model supported by learning strategy in improving mathematics communication skill of students. It integrates various form of media or learning based on IT into project based learning. It has purpose to create a final product from its learning activity. The learning combination is in line with the concept of 21st century. PB2L is a combination of PjBL and BL integrating various form of media or ICT into learning activity. It emphasizes production of a product as final stage of learning activity (Putri, 2018). It is asserted by Simeonov (2017) stating that general guidance of project based learning and blended learning is to allow students to be active in constructing knowledge and developing other important skills, such as communication, collaboration, and critical thinking by using contextual reality.

PB2L can be an effective learning model to achieve better students' involvements by altering the focus into students. Thus, it creates student – centered learning so it teaches students to be more detail and responsible plus giving understanding in assessment process and following expected guidance to achieve learning objectives.

Information technology development in educational world strongly influence learning model. Singh (Putri, 2018:153) "*proposes that blended learning combines various learning media or learning tools such as real time virtual/collaboration software, face-to-face, web-based lecture, electronic performances support system (EPPS) which is integrated in the job task environment and knowledge management system designed to complement each other".* The use of *e-learning* could provide new nuances in educational world and could develop students to think and widen time allotment and limitation in learning face to face in class.

Moodle is an application with various supportive features of *Learning Management System* (LMS) and is appropriate to current learning needs. It is developed by a teacher and Australian – information technology analyst, named Martin Dogiamas. Aljarrah (Ahmad, 2018) stated that LMS allows students to communicate and interact to their teachers for cooperative purposes with new ways and fun..

Based on the explanations, the objectives of this research were (1) to analyse effectiveness of *Project Based Blended Learning* (PB2L) to mathematics communication skill of the students; (2) to describe mathematics communication skill of the students on PB2L with *moodle.*

The stages of BL based project of PB2L with *moodle* can be seen on Table 1.

Table 1. Stages of PB2L

Stages	Face to Face	E-Learning	Remark
Determining basic question and finding out information.	Investigating project theme based on real life.	Determining project theme	Question
Designing the project plan and elaborating the information (acquisition of information)	Students and teacher collaborate in planning the project	Planning project solution	Project plan
Scheduling	Creating project completion timeline	Scheduling jadwal (project completion timeline)	Uploading the schedule and the group distribution
Facilitating and monitoring	Developing project through media (learning video)	Monitoring the project development	Uploading project activity
Testing the result and reconstructing the knowledge (Synthesizing of knowledge)	Measuring the standard achievement and evaluating students' developments and giving understanding and creating further learning plan, done by the teacher	Justifying the explorative result and acquiring the material.	Uploading the project result and evaluating.
Evaluating	Presenting	Project result	Presenting

METHOD

This *mixed method* research with *sequential explanatory design* combined quantitative and qualitative research respectively. This article was written to find out effectiveness of a treatment so the method used in this research was quantitative. The quantitative design was *quasi experimental* research with *nonequivalent control group design.* The paradigm of quantitative research can be seen on Table 2.

Table 2. Nonequivalent Control Group Design Research Design

Groups	*Pre test*	Treatment	*Post test*
Experiment	O_1	X	O_2
Control	O_3	-	O_4

(Source : Sugiyono, 2016)

by,

O_1, O_3 = *pre-test* initial mathematics communication skill

X = implementation of PB2L

O_2 = *post-test* of mathematics communication skill after intervention

O_4 = *post-test* of mathematics communication skill without the intervention

The research used two groups: experimental and control groups. Each group was given pretest then the experimental group was given treatment by using PB2L with *moodle* while control group was given PjBL. This research was conducted at SMA Negeri Garawangi.

All students were X IPA students. The sample consisted of 67 students divided into two groups. The experimental group consisted of 33 students while the control group consisted of 34 students. The techniques of collecting data were initial skill test and mathematics communication skill test. The techniques of analyzing data were initial data analysis test and hypothesis test. The initial data analysis test covered normality and homogeneity tests. The hypothesis test consisted of t-test, Z proportional test, average of variance test, and variance of proposition test.

FINDINGS AND DISCUSSION

The initial data analysis was done by normality test on daily test result to see whether the sample was taken from normally distributed population. The normality test showed that significant score 0.97 > 0.05. Based on the result, on level $\alpha = 5\%$ then it could be concluded that the sample was from normal distribution population. Then, to find out whether the sample had same variants, homogeneity test was done. The test showed that the significant score 0.44 > 0.45. It showed that the sample was homogeneous.

The data analysis of initial mathematics skill test was done to measure the actual minimum passing grade score (BLA). The BLA of mathematics communication skill of experimental group was 60 while control group was 58. Before doing hypothesis test, normality and homogeneity tests were done first on score of mathematics communication skill of both groups.

Based on the calculation of *post-test* normality result, the *output* showed that *Sig* score = 0.200. 0.200 > 0.05 meant that the final data (*posttest*) was from normal distributed population. Based on homogeneity calculation, the output showed *Sig* = 0.110. It was obtained that 0.110 > 0.05. It meant that the final data was from homogeneous population. The statistics of mathematics communication skill of the students is presented on Table 3.

Table 3. Scores of Mathematics Communication Skill

No	Aspects	Experimental Group	Control Group
1	Numbers of students	33	34
2	Averages	68	56
3	Maximum score	92	90
4	Minimum score	45	26
5	Variant	84	182
6	Standard Deviation	9	14

The table shows that mathematics communication skill of experimental group students was better than control group. It could be seen from mathematics communication skill for both groups. The average of mathematics communication skill of experimental group was 68 while the control group was 56. The hypothesis test could be seen on Table 4.

Table 4. Hypothesis Test Result Recapitulation

Hypothesis Test	Counted Score	Table Score
T-test	$t_{count} = 4{,}76$	$t_{table} = 1{,}692$
Z Proportional Test	$Z_{count} = 1{,}71$	$Z_{table} = 1{,}645$
Average of variance test	$t_{count} = 3{,}93$	$t_{table} = 1{,}645$
Proportional variance test	$Z_{count} = 4{,}85$	$Z_{table} = 1{,}645$

Based on the table, the first hypothesis test by using t-test showed $t_{count} > t_{table}$ with 4.76 > 1.692 It could be concluded that the average of mathematics communication skill had passed the minimum passing grade or passing the BLA. The second hypothesis test was done by using

Z proportional test. It could be seen from $Z_{count} > Z_{table}$ with score 1.71 > 1.645. It could be concluded that the proportional passing grade of the students taught by PB2L with *moodle* (experimental group) had achieved 75%. The third hypothesis was tested by average of variance. It showed that $t_{count} > t_{table}$ with score 3.93 > 1.67. It could be understood that the average skill of mathematics communication of the students taught by PB2L with *moodle* was better than the control group taught by PjBL. The fourth hypothesis test was done by using proportional test. It showed that $Z_{count} > Z_{table}$ with score 4.85 > 1.645. It meant that the proportion of the students' mathematics communication skill taught by PB2L with *moodle* was better than the control group taught by PjBL. Wahyudi (2018) also concluded that *blended learning* based project had better result than the previous model, *blended learning* based project. It was strengthened by Jadhay (2017) stating that *project based learning* was effective to minimize gap between education and *platform* addition which created students showing their ideas and skills. Therefore, learning with PB2L and *moodle* was better.

Qualitatively, the research was done to describe mathematics communication patterns of the students based on poor categorization. There were

two students. Based on the analysis, students with poor mathematics communication skill could not read mathematics representation but they could state and connect daily events into mathematics language although they could not conclude the final result of the solution correctly. They students also did not understand how to create conjectures, arguments, formulations of definitions, and generalization. Moderate mathematics communication skill students consisted of 24 persons. Based on the analysis, the students could express again a certain mathematics explanation by using their own language. They could explain and illustrate ideas, situations, and mathematics relation into figures, graphs, and structured mathematics model. The students could not read a mathematics representation accurately but they could state and connect daily events with their own language or mathematics ideas although they had mistakes in concluding on concluding the final calculation and they could create conjecture of argument arrangement, formulate definition, and generalize. However, those were not structured. High mathematics communication skilled students consisted of 7 persons. Based on the analysis, almost all students could do five indicators of mathematics communication skill properly although there were several students could not really understand by certain understanding or mathematics representation plus they had not been able to create conjectures, arrange argument, and generalize mathematically and accurately

The analysis of PB2L effectiveness to mathematics communication skill of the students could be obtained that $t_{count} > t_{table}$ with $4.72 > 1.692$. It could be concluded that the average score of mathematics communication skill had met or passed the BLA of experimental group, consisting of 29 students from 33 students. It meant the proportion of experimental group's passing grade reached 75%. It was due to PB2L allowed students to be more active and interactive during learning so they did not feel hesitate to share opinon or mathematics ideas.

This statement is supported by Prabawa (2017) stating that PjBL was effective and could be used as model alternative for teacher to develop students' skills. La Nani & Yaya (in Kumalaretna, 2017) added that result of their research showed PjBL was effective to improve mathematics communication skill statistics of the students Muazizah (2016) stated that *e-learning* by using *moodle* was effective toward learning outcomes.

Based on the analysis, it showed that mathematics communication skill of experimental group was better than control group. It could be seen from mathematics communication skill score of both groups. The average score of mathematics communication skill of experimental group was 68 while the control group was 56. The similar finding were also obtained from Sudianto (2019). He stated that *Project Based Learning* with LMS *moodle* was better than students' skills in conventional learning. Wahyudi (2018) also concluded that *blended learning* model based project had better result before using *blended learning* based on project.

Ambarwati (2015) stated that *project based learning* is an appropriate learning to improve mathematics communication skill because it could trigger activeness of students and provide chance for students to do physical and mental activities which lead to a product or project. Riqi's finding (2016) also supports that *blended learning* could improve mathematics communication skill of students so students would be easy to express mathematics ideas.

CONCLUSION

It could be concluded that PB2L with *moodle* was effective to improve mathematics communication skill of the students. Based on analysis result of mathematics communication skill under poor, moderate, and high categorizations, it was known that students with poor category had not been able to express again a mathematics explanation and were not able to understand conjectures, arrange argument, and formulate definition. However, they could illustrate ideas into mathematics model properly and structured. It was started from the known thing and the question thing although there were several incorrect answers. The students with moderate category could illustrate ideas, situations, and mathematics relations into structured figures but they were inaccurate to create conjecture, arrange argument, and formulate mathematics definition. Students with high category were almost able to do all five mathematics communication skill indicators well and structured. They could solve mathematics

problem on questions although there were several students whom did not understand to read with certain understanding of a mathematics representation.

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