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Development of Science Learning Tool Based on Problem Based Learning with Google Classroom to Improve Argumentation Skill

✉Ade Cyntia Pritasari, Jumadi

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Department of Science Education, Postgraduate Program, Universitas Negeri Yogyakarta, Indonesia

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Abstract

Using science learning tools will optimize the learning process. Good learning process will train the skill needed in the 21st century, including the skills of argumentation. From this point of view, an science learning tool based on problem based learning with google classroom has developed in this study. This study aimeds to test the appropriateness of science learning tool and the effectiveness of science learning tool developed in improving argumentation skill. This study was an research and development (R&D) research using 4D method from Thiagarajan with four stages including define, design, develop, and disseminate. The product trials have been conducted in 7th grade students of State Junior High School 2 Magelang at second semester of year 2017/2018. The data collection was done by non-test and test technique. Based on the results of the research note that learning tools developed theoretically declared valid based on expert assessment with very good category and effective in improving students' argumentation skill. Learning tool based on problem based learning with google classroom is a new approach to learning with the capability to the transform education in a better quality. Implementation of learning tool based on problem based learning with google classroom provide new alternatives in improving the quality of science education achievement.

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✉ Correspondence Author:
Jl. Colombo, Depok, Sleman 55281, Yogyakarta, Indonesia
E-mail: adecyntiap@gmail.com

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INTRODUCTION

Science learning process must be well prepared to improve students learning outcome. One of them by preparing the learning tool appropriately. Learning tool becomes an important aspect in determining the success of science learning process (Parnonansia & Mustikaningtyas, 2015). Complete learning tools will help teacher in teaching also facilitate students in learning (Widowati *et al.*, 2017). Learning tools are anything that can be used to facilitate learning.

A good learning tool must fit to the needs of students and today's world. Learning tool essensial to be designed to develop minds on and hands on activity of students. Learning with problem based learning emphasizes activities that require students to work in group to seek and build knowledge based on problems (Schmidt *et al.*, 2011). Problem based learning was developed to demonstrate the relevance of learning concept by providing a more realistic context through the use of problems (Wijnia *et al.*, 2014).

The success of problem based learning often has such constraints require long implementation time and requires a deep understanding of the material of students. Another limitation of implementation of problem based learning is that it requires a lot of material to be studied (Akinoglu & Tandogan, 2007). Constraints implementation of problem based learning can be overcome by the use of alternative learning using technology and information-based applications.

Google Classroom is one of the cloud-based applications that combine the use of technology with internet based development (Pardeshi & Alliwadi, 2015). Technological advances in teaching open up many opportunities to create creative and innovative learning as well as new relationships between students and the shift of the knowledge world. Google classroom is a learning management system (LMS) that provides teaching by creating and delivering content, supervising the participation of students, and assessing students performance (Nair *et al.*, 2011).

Implementation of learning with problem based learning will result in meaningful knowledge and solve more complex problems (Widoretno *et al.*, 2016). A meaningful and thorough understanding will stimulate the development of argumentation skill. Argumentation skill is capability which plays an important role in developing critical thinking patterns and adds a deep understanding of ideas (Deane & Song, 2014). Argumentation skill is important scientific practice students need to develop throughout school years (Pallant & Lee, 2015).

Research questions in this study are 1) how is the appropriateness of learning tool based on problem based learning with google classroom, and 2) how is the effectiveness of implementation of problem based learning with google classroom toward junior high school students' argumentation skill. The purpose of this study is to know 1) the appropriateness of learning tool based on problem based learning with google classroom, and 2) the effectiveness of implementation of problem based learning with google classroom toward junior high school students' argumentation skill.

METHODS

This study used method of research and development which adapted to the 4D model of Thiagarajan et.al (1974). The research stages included define, design, develop, and disseminate. In this study, the products developed was learning tools based on problem based learning with google classroom, i.e. lesson plan, student worksheet, and assessment instrument. Products were developed on topic ecosystem.

The subject of this study was the students of class VII in State Junior High School 2 Magelang, Central Java, Indonesia in second semester of academic year 2017/2018. The subjects to limited trial (trial I) were 32 students of class VII C. The subjects of main field trial (trial II) were 64 students composed of class VII A and VII D. The determination of the experimental class and the control class was done randomly with the results of class VII A as an experimental class (using learning tool based on problem based learning with google classroom) and class VII D as the control class (using conventional learning tool conducted daily by the teachers).

In this study the data collection was done by (1) non test techniques using product validation sheet, students' worksheet response to the readability and instructional observational sheets; and (2) test techniques used essay question of argumentation skill. Test instrument was arranged based on the aspect of argumentation skill. Argumentation skill aspects included: (1) claim; (2) evidence; (3) reasoning; (4) rebuttal; modified by McNeill & Krajcik (2006), Bulgren *et al.* (2014) and Lapp *et al.* (2015).

The limited trial test design used method of pre-experiment with one-group pretest-posttest design (Sugiyono, 2012). This experiment design was done by measuring first subject skill before and after treatment. The main field trial test used

the quasi-experiment with non-equivalent control group design (Sugiyono, 2012). In this design there were two groups taken randomly, then both group were measured before and after treatment.

The appropriateness of learning tools and students response to the legibility of worksheet were analyzed qualitatively based on the classification of four categories, i.e very good; good; poor; very poor (Widoyoko, 2012). The validity of argumentation skill questions was counted based on Aiken's V formula, it was by determining content validity coefficient. Argumentation skill questions validated by the expert judges then empirically tested on 25 students of grade VIII. Empirical test results are analyzed using Anbuso (questions item analysis) using Microsoft Excel to know the status of the questions whether it can be used or not.

The effectiveness of the implementation of the problem based learning with google classroom in the limited trial was analyzed based on the normalized gain average score gain and paired sample t test. The effectiveness of main field trial was analyzed based on the normalized gain average score and independent sample t test.

RESULTS AND DISCUSSION

The result of this study was an end product science learning tool based on problem based learning with google classroom. The developed science learning tools were lesson plan, student worksheet, and assessment instrument. The results of this study based on procedure that developed throught define, design, develop, and disseminate (4D).

This study was started with define stage. Define stage includes pre-research stage, needs analysis, and formulation of development goals. The result of define stage indicate that there is need of learning tool for junior high school which is in accordance with the curriculum 2013. The define stage was done in State Junior High School 2 Magelang. The learning tool used in school is not always using scientific approach. The learning process did not support by students' worksheet, and the evaluation test not measured high order thinking skill. Needs analysis phase obtained that the use of learning tools is very important in achieving learning objectives. In this stage formulated the objectives to be achieved is to produce valid learning tools in the form of lesson plan, students' worksheet, and assessment instrument to assess argumentation skill.

The learning tool that designed in this study is science learning tool based problem based learning with google classroom. The material used in this development research was basic competence 3.7 topic the interaction of living beings with their environment (ecosystem) class VII second semester. Lesson plan was developed with guidelines to the format of the Regulation of the Minister of Education and Culture No 22 year 2016. Lesson plan components include 1) identity; 2) indicators and learning objectives; 3) material; 4) method; 5) resources/media; 6) learning activities; and 7) assessment of learning outcomes. Learning activities in lesson plan was designed use problem based learning stage based on Tan (2003) include meeting the problems stage; problem analysis and learning issues stage; discovery and reporting stage; solution presentation and reflection stage; and integration, overview and evaluation stage. Lesson plan designed for six meetings with the allocation time of 10 hours of lessons.

Student worksheet was developed to support the learning activities that have been designed on lesson plan. The components of the student worksheet include title, user manual, basic competence and competency achievement indicators, learning objectives, activity guiding questions, and glossary. Student worksheet was design in two activities. Student worksheet activity 1 was the environment and its constituent components topic. Student worksheet activity 2 was an interaction in the topic ecosystem. Each activity presented 2 articles on environmental issues related to the ecosystem. The article is not printed in the student worksheet but is submitted in google classroom, so in its implementation the use of worksheet is integrated with google classroom.

The application of google classroom is integrated with the stages of problem based learning, especially in meeting the problem stage. Stimulus problems that become learning trigger are provided in google classroom before classroom learning begins so that students already know the problems learned while learning in the classroom is done. The google classroom application also contains material related to learning topics and practice questions.

Product Appropriateness Results

Validation data from learning tools from each expert judges are tabulated. The total average score of each expert judges was counted. The results of the appropriateness of lesson plans are presented in Table 1. Table 1 notes that the lesson plan developed in the very good category with an average score reached 3.80. The results of the assessment of the expert judges show that the

developed lesson plan was eligible for use in the learning process after being revised in accordance with the advise and input of the expert judges.

Table 1. Result of Lesson Plan Validation by Experts

Aspects	Average Score	Category
Lesson plan identity	3.93	Very good
Formulation of indicators and learning objectives	4.00	Very good
Selection of material	3.93	Very good
Selection of method	4.00	Very good
Selection of resources / media	3.50	Very good
Learning activities	3.79	Very good
Assessment of learning outcomes	3.50	Very good
Language	3.71	Very good
Characteristics of problem based learning with google classroom	3.86	Very good
Average	3.80	Very good

The results of the appropriateness of student worksheet presented in Table 2 show that the student worksheet that was developed in the very good category with an average score reached 3.81. The result of the assessment indicated that the developed worksheet was eligible for use in the learning process after being revised in accordance with the advice and input of the expert judge. Suggestions and improvements provided by expert judge to lesson plan and student worksheet are presented in Table 3.

The feasibility of the argumentation skill assessment instrument based on the expert judge assessment results presented in Table 4. The results of the assessment are then analyzed based on the content validity coefficient of V Aiken, the results obtained in Table 3.

Table 2. Results of Student Worksheet Validation by Experts

Aspects	Average Score	Category
Content	3.79	Very good
Language	3.71	Very good
Presentation	3.93	Very good
Graphic	3.81	Very good
Characteristics of problem based learning with google classroom	3.81	Very good
Average	3.81	Very good

Table 3. Suggestions and Improvements from Expert judge

Lesson plan	Student worksheet
Typing error Correction in apperception and motivation because of the inverted stages Clarify time allocation	Typing error Added glossary Adjustment of articles to the level of ability of learners

Table 4. Recapitulation Result of Argumentation Skill Questions Validity

Aspects	Number of Questions	V	Note
Claim	1	1.00	Valid
	2	1.00	Valid
Evidence	3	1.00	Valid
	4	1.00	Valid
Reasoning	5	1.00	Valid
	6	1.00	Valid
Rebuttal	7	1.00	Valid

The results based on the Table 4 are known to be valid. Questions that have been valid then tested empirically on the students of class VIII. Empirical test results are then analyzed based on Anbuso (questions item analysis) using Microsoft Excel. The results of the analysis are shown in Table 5. The results of further empirical tests are also used to determine the reliability of the question. Test reliability using Alpha Cronbach formula. Based on the test, reliability level of questions 0.92. The category of questions is very high reliability.

Table 5. Results of the Decision on the Use of Questions

Level of difficulty	Category of difficulty	Level of difference	Criterion of questions
0.73	Medium	0.13	Used
0.70	Medium	0.10	Used
0.60	Medium	0.17	Used
0.80	Easy	0.15	Used
0.57	Medium	0.10	Used
0.46	Medium	0.18	Used
0.49	Medium	0.12	Used

Limited Trial of Science Learning Tool

Limited trial conducted on 32 students of VII C. Limited trial conducted on the implementation of lesson plan based learning, student worksheet legibility, and effectiveness argumentation skills. Based on the observation sheet on the implementation of lesson plan, the results presented in Table 6. The results of the calculation of the implementation of learning percentage shows that implementation of learning included in the category of very good.

Table 6. Percentage of Learning Implementation in Limited Trial

Learning activities	Percentage of implementation
PBL cycle I (meeting I, II, III)	86.67
PBL cycle II (meeting IV, V, VI)	93.33

The recapitulation data from students' response to worksheet was presented in Table 7. Based on Table 7, developed student worksheet had very good category. So the developed student worksheet was appropriate to be used in learning process.

Table 7. Recapitulation of Students' Response toward Worksheet in Limited Trial

Aspects	Score	Average Score	Category
Content	3.34	3.43	Very good
Language	3.52		
Layout	3.43		

The implementation of learning using lesson plan based on problem based learning with google classroom and students response toward worksheet in limited trial are used as correction and input for improvement before conducting main field test. A little improvement needs to be done is to be more conditioned students to implement the problem based learning with google classroom exactly in accordance with the allocation of time prepared. The instructions contained in google classroom are made clearer so not to confuse the students.

The effectiveness of the implementation of leaning tools based on the normalized gain average score from pretest and posttest argumentation skill. The result of the analysis of the average score of the normalized gain was 0.48, in medium category. Furthermore, the effectiveness of learning tool based on problem based learning with google classroom on argumentation skill was analyzed using paired sample t test. Statistical test results on pretest and posttest score are presented in Table 8.

Table 8. Statistics Result of Pretest-Posttest Score

	Mean	N	Std. Deviation	Std. Eror Mean
Pretest	38.1244	32	7.56947	1.33811
Posttest	67.0838	32	7.12125	1.25887

Based on Table 8, it can be seen that the mean of posstest was higher than pretest. Based on Table 9, it also can be seen that the significant value of correlations was 0.004 < α (0.05). So, there is a relationship between pretest and posttest with the implementation of learning tool based on problem based learning with google classroom with correlation level of 0.500.

Table 9. Result of Correlations

	N	Correlation	Sig.
Pair Pretest & Posttest	32	.500	.004

The result of paired sample t test to the difference of pretest and posttest score after treatment is sig. (2-tailed = 0.000) < ½ α (0.025). So based on the results, there are differences in pretest and posttest values after the implementation of learning tool based on problem based learning with google classroom. In order words, the implementation of learning tool based on problem based learning with google classroom affects the posttest result of students argumentation skill.

Main Field Trial of Science Learning Tool

Main field trial was conducted on 32 students of class VII A (experiment class) and 32 students class VII D (control class). The result of observation on the implementation of learning in

the experiment class presented in Table 10. Based on the result, the implementation of learning categorized as very good.

Table 10. Percentage of Learning Implementation in Main Field Trial

Learning activities	Percentage of implementation
PBL cycle I (meeting I, II, III)	100
PBL cycle II (meeting IV, V, VI)	100

The recapitulation data from students response toward worksheet was presented in Table 11. Based on Table 11, developed student worksheet had very good category. So the developed student worksheet was appropriate to be used in learning process.

Table 11. Recapitulation of Student Responses toward Worksheet in Main Field Trial

Aspects	Score	Average Score	Category
Content	3.41	3.54	Very good
Language	3.67		
Layout	3.53		

The effectiveness of the implementation of learning tool based on problem based learning with google classroom toward students argumentation skill was measured by comparing the average gain score between the experimental class and control class. The results of the analysis of the normalized average gain score on each class are presented in Table 12. Based on Table 12, the improvement of argumentation skill in the experimental class and in the control class were categorized as medium. Based on the value of <g>, the argumentation skill in experimental class was greater than the control class.

Table 12. The Results of the Average Normalized Gain Score Analysis

Class	<% pre>	<% post>	<g>	Category
Experimental Group	39.58	73.85	0.57	Medium
Control Group	45.94	66.67	0.38	Medium

The comparison of effectiveness difference between the implementation of problem based learning with google classroom and the implementation conventional learning were statistically analyzed by using independent sample t test to the single student normalized gain score. The result of independent sample t test to single student normalized gain score of the students' argumentation skill can be seen in Table 13.

Table 13. The Result of Independent Sample T Test

T	Df	Mean Difference	Sig. (2-tailed)
7.073	62	0.19281	0.000

Based on Table 13, the result of independent sample t test to the single student normalized gain score of students' argumentation generate sig. 0.000. The generated sig. value is lower than 0.05. It means, there is significant difference between students' argumentation skill in experimental group and control group. So, based on independent sample t test to the single student normalized gain score at significant level 0.05, the implementation of problem based learning with google classroom is effective in improving the students' argumentation skill.

The results of limited and main field trial show that the implementation of learning tool base on problem based learning with google classroom was actually improving students' argumentation skill. The results are consistent with the results of research by Afisha (2015), that there is an influence model problem based learning on the ability of argumentation. Implementation of problem based learning with google classroom in the classroom is also a determinant factor in improving students' argumentation skill. Mastering the learning does not enough just to prepare a lesson plan in the form of scenario used to teach. Plan implementation which was compiled become more important than preparing lesson plan (Widoretno *et al.*, 2016). In the main field trial showed that the implementation of lesson plan reaches 100%, which means learning is done very well.

Learning tool that are developed for learning and teaching a lesson have an important role in creating a constructivist classroom environment (Birisci & Metin, 2010). For science education, teachers must eliminate the pedagogical practices centered on the formalized and excessively generalized presentation, and promote the teaching learning models axed on action, experimentation, investigation, and problem solving

(Gorghiu *et al.*, 2015). Problem based learning is a motivating, challenging, and enjoyable learning approach (Masek & Yamin, 2011). The learning stage of problem based learning enables students to learn while engaging actively with meaningful problems and given the opportunities to problem solve in collaborative setting, create mental models for learning, and form self-directed learning habits through practice and reflection (Yew & Goh, 2016).

Instructors by using the advantages of e-learning encourages students to continue their education. Implementation learning combine with technology is a new and different philosophical approach to learning, an incorporating classroom, and communications technology with the capability to the transform education in a better quality (Haghparast *et al.*, 2014). The implementation learning with assisted technology influencing the way students learn. Technology for learning can open new options for students to learn science. *Google classroom* give opportunity for teachers to post announcements and assignment to the class page and attach document, video, link, and even connect in Google Drive (Izenstark & Leahy, 2015).

The problem based learning has been successfully in use in the education. In problem based learning students have the opportunity to see what and why they are learning and be prepared better to their future careers (Erdogan & Senemoglu, 2014). Combination of strength of problem based learning and e-learning using google classroom create a unique learning experience to achieve educational goals such as enhance argumentation skill. Argumentation is the core of science practice and an essential aspect of science. Argumentation skill is one of the important practice that help students establish knowledge of science (Sampson & Blanchard, 2012). Engaging in argumentation, students construct scientific knowledge through justifying, evaluating, and challenging different views on scientific and socio-scientific issues (Jin *et al.*, 2015).

CONCLUSION

Based on data and the results analysis, it could be concluded that science learning tool based on problem based learning with google classroom were: (1) appropriate to use for science learning tool with topic the interaction of living beings with their environment (ecosystem) for students grade VII of junior high school, (2) effective in improving argumentation skill of students grade VII State Junior High School 2 Magelang. Science teachers are expected to use this learning tool during learning process at school. Futher research can be conducted to determine the effectiveness of an learning tool based on problem based learning with google classroom in the other science subjects.

REFERENCES

Afisha, H.M., Jalmo, T., & Maulina, D. (2015). Pengaruh Model Problem Based Learning terhadap Kemampuan Berargumentasi dan Hasil Belajar Siswa. *Jurnal Bioterdidik*, 3 (5), 1-8.

Akinoglu, O., & Tandogan, R.O. (2007). The Effect of Problem Based Active Learning in Science Education on Students Academic Achievement, Attitude and Concept Learning. *Eurasia Journal of Mathematics, Science & Technology Education,* 3 (1), 71-81.

Birisci, S., & Metin, M. (2010). Developing an Instructional Material Using a Concept Cartoon Adapted to the 5E Model: A Sample of Teaching Erosion. *Asia-Pasific Forum on Science Learning and Teaching*, 11 (1), 1-16.

Bulgren, J., Ellis, J., & Marquis, J. (2014) The use and effectiveness of an argumentation and evaluation intervention in science classes. *Journal of Science Education and Technology,* 23 (1), 82-97.

Deane, P., & Song, Y. (2014). A Case Study in Principled Assessment Design: Designing assessments to Measure and Support the Development of Argumentative Reading and Writing Skills. *Psicologia Educativa*, 20 (2), 99-108.

Erdogan, T., & Senemoglu, N. (2014). Problem Based Learning in Teacher Education: Its Promises and Challenges. *Procedia-Social and Behavioral Sciences*, 116 (2014), 459-463.

Gorghiu, G., Draghicescu, L. M., Cristea, S., Petrescu, A. M., & Gorghiu, L. M. (2015). Problem Based Learning-An Efficient Learning Strategy in the Science Lesson Context. *Procedia-Social and Behavioral Sciences*, 191 (2015), 1865-1870.

Haghparast, M., Nasaruddin, F. H., & Abdullah, N. (2014). Cultivating Critical Thinking Through E-learning Environment and Tools: A Review. *Procedia-Social and Behavioral Sciences*, 129 (2014), 527-535.

Izenstark, A., & Leahy, K. L. (2015). Google classroom for librarians: Features and opportunitiesnull. *Library Hi Tech News*, 32(9), 1-3.

Jin, H., Mehl, C. E., & Lan, D. H. (2015). Developing an Analytical Framework for Argumentation on Energy Consumption Issues. *Journal of Research in Science Teaching*, 52 (8), 1132-1162.

Lapp, D., Grant, M., & Johnson, K. (2015). Teaching Students to Write a Well Supported Argument. *International Literacy Association*. doi: 10.1598/e-ssentials.8070.

Masek, A., & Yamin, S. (2011). The Effect of Problem Based Learning on Critical Thinking Ability: A Theoritical and Empirical Review. *International*

Review of Social Sciences and Humanities, 2 (1), 215-221.

McNeill, K.L., & Krajcik, J. (2006). Supporting Student's Construction of Scientific Explanation through Generic versus Context-Specific Written Scaffolds. *Americans Educational Research Association Journal*.

Nair, C.S. Patil, A. & Mertova, P. (2011). Enhancing the Quality of Engineering Education by Utilising Student Feedback. *European Journal of Engineering Education,* 36 (1), 3-12.

Pallant, A., & Lee, H. S. (2015). Constructing Scientific Arguments Using Evidence from Dynamic Computational Climate Models. *Journal of Science Education and Technology,* 24, 378-395.

Parnonansia, S.J., & Mustikaningtyas, D. (2015). Development of Life Skill-Based Learning Instruments: Biotechnology Material in Junior High School. *Biosaintika*, 7 (1).

Pardeshi, V.H., & Alliwadi, S. (2015). Google Apps: An Alternative to Learning Management System. *IOSR Journal of Business and Management,* 75-78.

Sampson, V., & Blanchard, M. R. (2012). Science Teachers and Scientific Argumentation: Trends in Views and Practice. *Journal of Research in Science Teaching*. DOI 10.1002/tea.21037, pp. 1-27

Schmidt, H.G., Rotgans, J.I.,& Yew, E.H.J. (2011). The process of problem-based learning: what works and why. *Medical Education*, 45, 792-806.

Sugiyono. (2012). *Metode Penelitian Kombinasi (Mixed Methods)*. Bandung: Penerbit Alfabeta.

Tan, O. S. (2003). *Problem Based Learning Innovation : Using Problems to Power Learning in the 21 Century.* Singapore: Thomson.

Thiagarajan, Semmel & Semmel .(1974). *Instructional development for training teacher of exceptional children*. Bloomington Indiana: Indiana University.

Widoretno, S., Dwiastuti, S., & Sajidan. (2016). Proportion: Claim, Rebuttal, and Backing Data Based on Teacher Questions as Reasoning Indicator of Problem Based Learning in Highschool System Reproductions. *Jurnal Pendidikan IPA Indonesia,* 5 (2), 304-309.

Widowati, A., Nurohman, S., & Anjarsari, P. (2017). Developing Science Learning Material with Authentic Inquiry Learning Approach to Improve Problem Solving and Scientific Attitude. *Jurnal Pendidikan IPA Indonesia,* 6 (1).

Widoyoko, S.E. (2012). *Teknik Penyusunan Instrumen Penelitian*. Yogyakarta: Pustaka Pelajar.

Wijnia, L., Loyens, S., van Gog, T., & Derous, E. (2014). Is there a role for direct instruction in problem-based learning? Comparing student-constructed versus integrated model answers. *Learning and Instruction*, 34, 22-31.

Yew, E. H. J., & Goh, K. (2016). Problem Based Learning: An Overview of its Process and Impact on Learning. *Health Professions Education*, 2 (2016), 75-79.