



## Analysis of Literacy Abilities and Self-Efficacy Mathematics through PBI-Synectics Gordon with Scientific Approach

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### ABSTRACT

The purpose of this study is to describe the characteristics of the learning instrument, PBI-Synectics Gordon, with Scientific Approach oriented in PISA and to test the effectiveness of the learning model in an effort to improve the mathematical literacy ability of high school learners. The result of the validation of the learning instrument is declared valid by experts with good and excellent classification, in addition, mathematics literacy abilities test has met the content validity, balanced difficulty level, a significant distinguishing features, and reliable. After implemented, the learning device is considered excellent, while the positive response of the students is high and the response of the teacher is excellent. The test of effectiveness provides results in the form of: (a) the average of mathematical literacy abilities of the experimental class have reached the individual and classical completeness; (b) the mathematical literacy abilities of the experimental class is better than the control class; (c) there is a positive effect of literacy skills and self-efficacy toward mathematics literacy abilities; and (d) there is an increase in the mathematics literacy abilities. This criteria achievement means that PBI-Synectics Gordon with Scientific approach oriented in PISA can effectively improve the mathematics literacy abilities of high school learners to the geometry and statistics material.

Key Word: literacy abilities, PBI-Synectics Gordon, PISA, scientific, self-efficacy

### INTRODUCTION

The quality of education is often used as a barometer of a country's development. The ability of learners to solve problems of mathematics, science and reading and its application in everyday life is used as a picture whether or not the quality of education is good. Wardani (2011, 57) said that based on the analysis of mathematical abilities of the Indonesian learners in the study of PISA and TIMSS, it is recommended to: (a) improve the learning process in schools to increase the share of reason, solve problems, argue and communicate, (b) improve the standards and practices of assessment of student learning outcomes nationally and everyday in the classroom by measuring the raw technical skills, reasoning ability, problem solving and communicating in a balanced way, c) learn the culture and internalize the cultural context in learning so that students' horizons expanded.

With the development and the demands of the learners to be able to solve the problems with the high-level reasoning, the teacher should seek a learning model that can be applied so that it can improve the learning outcomes of the students in accordance with the demands of the curriculum. Problem Based Instruction (PBI) is a learning model that allows. This is due to the fact that every human being is always faced with a problem. PBI is expected to provide training and ability of each individual to be able to solve the problems he faces. Because PBI will introduce students to the process of knowledge formation (Sholeh, 2014: 111)

In problem-solving techniques known for Synectics is a problem-solving technique that is often used in group. This technique combines creativity techniques (especially analogy and metaphor) with some more basic rules so that the session will last more structured and efficient (Sholeh, 2014: 128)

In the learning process, according to Vygotsky, the students will be able to learn the concepts well if it is

in the ZPD. The students work in the ZPD if the students can not solve the problem alone, but they can solve the problem after receiving a help from an adult or friends (peer); The helps or the support meant to make the student be able to do the tasks or problema a higher level of complexity than the cognitive developmental level of the student (Masbied, 2011: 4)

To improve the learning process, should also be considered self-efficacy. Self-efficacy can affect many parts of one's life such as level of motivation and perseverance in the face of difficulties and setbacks, resilience to adversity, quality of analytical thinking (Bandura at al, 1996 :1206).

Mathematical literacy, according to the draft assessment framework PISA 2012 : Mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals to recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens.

Mathematics literacy abilities of learners of SMA 3 Semarang is still not satisfactory, learners prefer to accept hard formulas that have been ready if asked to learn for themselves how to decrease the formula. They prefer to solve problems by using the formula that it has been obtained, so they often can not use their mathematical knowledge in everyday life, and even the learners can not use the problem solving skills when given the matter which is a little different from what they have learned.

To improve the literacy abilities of mathematics, teachers should make changes in learning and searching for a suitable strategy in order to generate mathematical literacy as desired (above minimal completeness criteria and excel in the international assessment). Mathematics learning innovation is done by selecting the appropriate learning model with the material and characteristics of the learners so as to increase the activity and self-efficacy of the students in learning mathematics that will ultimately improve math literacy.

One model of learning mathematics that can lead to a positive impact on the ability of mathematical literacy learners is PBI-Synectics Gordon with Scientific Approach. PBI-Synectics Gordon with Scientific Approach is a problem based learning model with the Synectics problem-solving techniques, namely the combination of different elements or ideas that seems irrelevant, while Scientific Approach in learning covers

the activities to observe, ask, reasoning, trial, and collaborative learning.

The advantage of the application PBI- Synectics Gordon includes helping learners how to transfer their knowledge to understand the real-life problems and then to solve them, show the students that mathematics courses is basically a way of thinking and not just learning from a teacher, Synectics technique with analogy can develop creativity because in analogy there is an attempt to link between what is already known and what is to be understood

PISA is an ongoing program and offering the idea for the policy and practice of education. PISA results may provide findings that enable the policy-makers around the world to measure the knowledge and skills of the students in their country compared to other countries. Assessment in the learning of mathematics with PBI-Synectics Gordon would be optimal if supported with questions oriented in PISA. This, can help to develop the ability of learners to solve the problems as in PISA.

Three components identified in the PISA study are the content, process and context. Component of content in the PISA study is defined as any content or subject of mathematics learned at school. The material tested in the component of content based on PISA 2012 Mathematics Framework covers the change and relationship, space and shape, quantity, uncertainty and data.

The component of process in the PISA study is interpreted as things or someone steps to solve a problem in a particular situation or context by using mathematics as a tool so that the problems can be solved. The ability of the process is defined as a person's ability in Formulating situations mathematically, Employing mathematical concepts, facts, procedures and reasoning, Interpreting, applying and evaluating mathematical outcomes.

Seven components of mathematical literacy assessment which includes capability of Communication, Mathematising, Representation, Reasoning and Argument, Devising Strategies for Solving Problems, Using Symbolic, Formal and Technical Language and Operation, Using Mathematics Tools are developed in accordance with a process capability indicators on PISA

Components in the context of the PISA study is defined as a situation which is reflected in a problem. There are four contexts for the focus, namely: personal, occupational, social, scientific.

Based on the background described, the problem formulated in this study are as follows. How the characteristics of learning instrument of PBI-Synectics

Gordon with Scientific approach and PISA oriented? Does the learning with PBI-Synerctics Gordon with Scientific Approach and PISA oriented get a positive response from teachers and learners? How is the learning atmosphere with PBI-Synerctics Gordon with Scientific Approach and PISA oriented? Can learning with PBI-Synerctics Gordon with Scientific Approach and PISA oriented effectively improve the mathematics literacy ability of high school learners? How does the description of the effectiveness of the learning with PBI- Synerctics Gordon with Scientific approach and PISA oriented in improving the ability of mathematical literacy of high school students?

Consistent with the formulation of the problem above, the objectives to be achieved through this research are: describing the characteristics of the learning tool with PBI-Synerctics Gordon with Scientific Approach and PISA oriented, obtaining a positive response from teachers and students towards the learning with PBI-Synerctics Gordon with Scientific Approach and PISA oriented, describing the learning environment with PBI-Synerctics Gordon with Scientific Approach and PISA oriented, testing the effectiveness of the learning model in an effort to improve the mathematical literacy ability of high school learners, describing the learning effectiveness of PBI- Synerctics Gordon with Scientific Approach and PISA oriented in an effort to increase the mathematical literacy ability of high school learners.

qualitative and the effectiveness of the results is investigated with the quantitative methods namely experiments with pretest-posttest control group design.

This research was conducted at SMA N 3 Semarang in the school year 2014/2015. The population is grade X Mia. This study has two samples randomly selected classes by researchers, one class as the experimental class (Class X Mia 3), and the other class as the control class (Class X Mia 4), whereas for the MLAT test class is from grade XI Mia 1 with consideration that the class has got the material of geometry and statistics. In addition, other data sources is a validator team consisting of a team of experts and peers.

The variables in this study are: (1). Characteristics of learning device with PBI- Synerctics Gordon with Scientific approach and PISA oriented, (2). Self-efficacy, skills and ability of mathematical literacy, (3) the process of implementing the learning model PBI-Synerctics Gordon with Scientific approach and PISA oriented.

The problem of this research will be answered with qualitative and quantitative data. The qualitative data is obtained from the data collection techniques with interview, observation and documentation. The quantitative data is found from the data collection techniques with questionnaire, observations and test. Table 1 below shows the formulation of the problem, data collection techniques and data sources.

Table 1 Formulation Issues, Data Collection Techniques and Data Sources

No	Formulation of The Problem	Data Collection Technique	Data Source
1	Characteristics of the learning model	Documentation Validation sheet	Expert team and peers
2	The response of the students and teachers to learning	Questionnaire	Students and colleagues
3	Learning atmosphere (effectiveness of the process)	Observation	Students
4	Effectiveness results	Test, questionnaire, observation	Students
5	Description effectiveness results	Interview, observation	Students

## METHODS

This study uses a combination of a concurrent triangulation design started with the formulation of qualitative issues and continued with quantitative issues. All the formulation of the problem will be answered with a qualitative and quantitative methods in balance. The formulation of the qualitative problem in this research is characteristics of the learning tools that will be answered with the validation device of the process analysis, while the response of teachers and learners were analyzed quantitatively by analyzing the questionnaire responses with a Likert scale, but also analyzing documents questionnaire responses qualitatively. The effectiveness of the process is investigated with the method of

The qualitative data analysis during the research in the field is with a model of Miles and Huberman (1984) where the activity in qualitative data analysis is done interactively and continued until complete, so the data is already saturated. The activities in the data analysis are data reduction, data display, dan conclusion drawing/verification (Sugiyono, 2011: 334).

Quantitative data analysis includes the analysis of the validity of the learning instrument, analysis item test of mathematical literacy ability, and analysis of the effectiveness of learning which includes mastery test, comparative test, test the effect and the increase test. The mastery test of mathematical literacy is conducted twice, ie, individual and classical completeness. The individual mastery test see, the completeness of the average value

obtained by the learners, whether less or more than the minimum completeness criteria which is 75. The individual mastery test uses the average test of one group with a significant level of 5%. While the classical completeness test uses the proportion test of the group by taking the classical completeness 80%. Comparative tests of the control and the experimental groups uses average different test and proportions different test. The effect test of self-efficacy and mathematics literacy skills for mathematics literacy ability uses multiple linear regression. The increase test of mathematical literacy uses the paired t test and Gain test.

**RESULT AND EXPLANATION**

PBI- Synectics Gordon with Scientific approach and PISA oriented for geometry and statistics materials is designed to improve the mathematics literacy ability and to develop the mathematics self-efficacy of the learners with mathematical literacy skills assessment which emphasizes the development of students individually and in group.

The implementation of PBI-Synectics Gordon with Scientific approach and PISA oriented starts with preliminary observations followed by making the learning tools that will be used. Based on the research results, it has been found that the learning tools that will be used is valid. The validity here was obtained through the expert validation for the syllabus, lesson plans, worksheet, book, and Mathematical Literacy Ability Test. Table 2 shows the results of the validation performed by three validator

mathematical literacy in the control and experimental classes.

After the learning tools is stated valid, during the implementation in the experiment class, the quality of the learning observations is done with the average percentage of the result from the two observer is 87.78% and it is concluded that the learning process has been well conducted.

The results of the learners responses are taken through a questionnaire expressed in high category as the average positive response is 74.53%. The positive response is expressed in terms of learning readiness, test preparation, class attendance, response to the book and worksheet, willingness to do the work, participation to every stage of learning, all of it is directed toward the Learning Model PBI- Synectics Gordon with Scientific approach and PISA oriented which is implemented in the experiment class.

The results of the teacher's response to the implementation of the learning tools provide an average of 4.57 with a very good category. They argue that PBI-Synectics Gordon with Scientific approach and PISA oriented can be used as the main learning model in teaching and learning mathematics. Obstacles are encountered in that PBI-Synectics Gordon with Scientific approach and PISA oriented is in analogy and analysis of the problems, learners have different ideas and abilities. The advantage PBI-Synectics Gordon with Scientific approach and PISA oriented is that the analogy will facilitate learners in solving the problems of application, train students to analyze problems with the analogies objects close to their daily lives.

Table 2. Results Validation Learning Instrument

No	Instrument	Geometry					Statistics				
		Average Score Each Validator			Average	Classification	Average Skor Each validator			Average	Classification
		I	II	III			I	II	III		
1	Syllabus	4.0	4.6	4.27	4.29	Very good	4.0	4.6	4.27	4.29	Very good
2	Lesson plans	4.0	4.74	4.24	4.33	Very good	4.0	4.62	4.24	4.29	Very good
3	Book	3.54	4.23	3.69	3.82	Good	3.54	4.15	3.69	3.79	Good
4	Worksheet	4.0	4.5	4.2	4.23	Very good	4.0	4.5	4.2	4.23	Very good
5	MLAT	4.0	4.56	4.13	4.23	Very good	4.0	4.56	4.13	4.23	Very good

As for MLAT is still continued with the items of the validity test, the level of difficulty test, distinguishing matter test, and reliability test, which is based on research results it is expressed that MLAT is ready to be used as the instrument for the data collection of

The learning atmosphere in the experiment class observed through the activities of learners generates an average of 4.48 which is included as the excellent category. The activity is the activity in following the lesson which implementing the model PBI-Synectics Gordon with Scientific approach and PISA oriented.

The effectiveness of learning with model PBI-Synectics Gordon with Scientific approach and PISA oriented on geometry and statistical material shown by (1) The classical completeness of MLAT in experimental class based on results of the proportion test has reached 80%, with minimal completeness criteria 75 and the individual mastery test using average test of one group with a significant level of 5% has reached an average value above 75 ( $\bar{x} = 83.25$  (geometry) and  $\bar{x} = 82.13$  (statistics)). (2) Based on different average test, the average MLAT of the experimental class is better than the control class, while the different proportion test shows that the proportion of mastery of the experimental class better than the control class. (3) The effect test by using SPSS with multiple regression test reveals that the regression equation is linear so that there is a significant effect of self-efficacy and mathematics literacy skills for mathematics literacy ability of the students in the material of geometry and statistics. Self-efficacy and mathematics literacy skills together affect the mathematical literacy ability of the geometry material of 77.6%, and the remaining 22.4% is influenced by other factors. Whereas, the influence on statistical material is 80%. (4) The result of an increase in the mathematics literacy ability in geometry and statistical material of experiment class is the average of Gain Normalization of 0.6422 and 0.598 which is has the included in the medium category. The control class average result of Gain Normalization of geometry and statistics material in a row at 0.4603 and 0.3523 which is also in the medium category. Judging from the results of the different average test of score gain, it is concluded that the average score gain of the experimental class is higher than the average score gain of the control class. While in the paired t-test, it was concluded that the average of the mathematical literacy ability of learners after learning with PBI- Synectics Gordon with Scientific approach and PISA oriented is better than the average of the previous learners.

Based on the initial observations, the mathematical literacy ability of SMAN 03 Semarang is still low. It can be seen from the pre test of MLAT which generally shows the answers of the learners have not been systematical, they are still many who have not demonstrated the ability of interpreting, this indicates that the mathematical literacy assessment component, namely communication, mathematising and representation of learners is still low. After using PBI-Synectics Gordon with Scientific approach and PISA oriented, the mathematical literacy ability of learners of

geometry and statistical material improvements, especially for the ability employing and interpreting, for formulating has an increase slightly in geometry because on average they have the maximum ability, whereas the statistical material increases because in the pre-test, the ability of formulating is not maximum.

The improvement of the mathematics literacy ability of learners here can occur because PBI-Synectics Gordon with Scientific approach and PISA oriented let learners construct their own knowledge to solve the problems of mathematical literacy, thus helping students develop their thinking process. The utilization of book and worksheet is also very helpful in giving a reference and guidance to learners, as well as providing information on the PISA with mathematical literacy, which is still strange to them.

The data analysis and a serious interview to 8 students in the experimental class provides a description as shown in the following bar chart

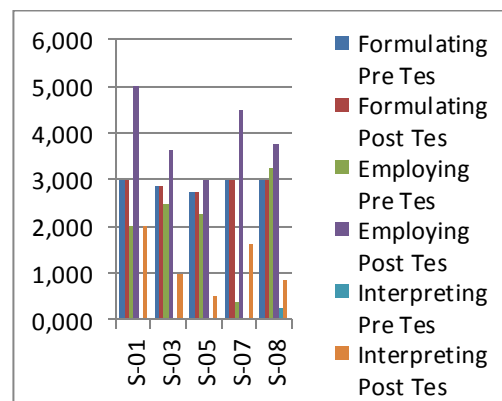


Figure 1. Mathematical Literacy Ability of Geometry Material

In general, the five subjects in Figure 1 above has the ability of formulating is high, among those students, the most low is the S-05. For employing and interpreting capabilities there is dramatical increase, except in the S-08. This informs that PBI-Synectics Gordon with Scientific approach and PISA oriented is useful in improving the ability to load components of mathematical literacy assessment, namely communication, using symbols and mathematics tool, reasoning and argument, mathematizing and representation. As for the ability of formulating that also involves the communication components, using symbols, and devising a strategy has already owned by the learners well from the beginning. The S-08 did not have high increase, despite the fact that he already has a good basic ability. The cause has been revealed in an interview, it is because S-08 was not much involved during the learning.

Besides, his mathematical literacy skills are only in the satisfactory category in all indicators, and self-efficacy in the dimensions of generality is in the enough category.

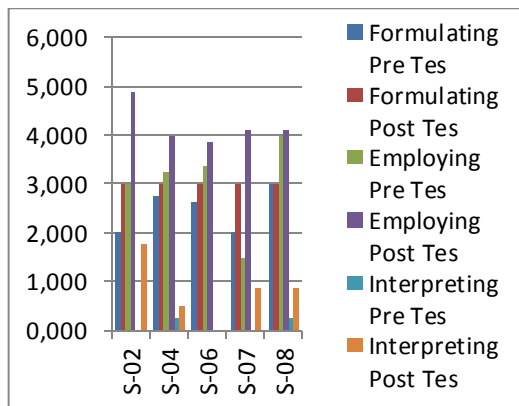


Figure 2. Mathematical Literacy Ability of Statistical Material

In Figure 2, the five subjects had an increase in formulating, employing and interpreting abilities, except for S-08 only increased in interpreting it. It is informed that PBI-Synectics Gordon with Scientific approach and PISA oriented was useful in improving the ability whose components of mathematical literacy assessment, are communication, devising strategies, using symbols and mathematics tool, reasoning and argument, mathematizing and representation. While the formulating ability whose components are communication, using symbol, and devising strategy has been understood by the learners before. For S-08 in the statistical material is also not increased high, despite the fact that he already has a good basic ability. The cause has been revealed in an interview that S-08 was not much involved during the learning. Besides, his mathematics literacy skills is only in the category of satisfactory in all indicators, and self-efficacy on the dimensions of generality in the enough category.

The results of this study support the research conducted by Noer (2012) on the student self-efficacy in mathematics Program FMIPA FKIP Unila which states that positive effect of self-efficacy on mathematics, the research also shows that self-efficacy also gives a positive effect on mathematics in particularly the material of geometry and statistics in grade X SMA. The same thing is done by Lusby (2014), the study conveys a positive correlation of self-efficacy on the achievement of learners. In addition, this study is a follow up of a research conducted by Rusmining, Waluyo, and Sugianto (2014) which states that mathematical literacy ability of learners in grade XI SMK Roudlotus Saidiyah

Semarang is still low, even also at SMA N 3 Semarang, based on a preliminary investigation before the study, but after the research is conducted it can be improved by using a model of PBI-Synectics Gordon with Scientific approach and PISA oriented.

## CONCLUSION

Based on the objectives and the results of the study, the conclusion can be stated as follows. The characteristics of learning with PBI-Synectics Gordon with Scientific approach and PISA oriented on geometry and statistics material have got validation from a team of experts as well as colleagues and it is declared valid. The results of the analysis of the response of teachers and learners towards learning PBI-Synectics Gordon with Scientific approach and PISA oriented generated a positive response. Learning PBI-Synectics Gordon with Scientific approach and PISA oriented creates a good learning atmosphere. Learning PBI-Synectics Gordon with Scientific approach and PISA oriented effectively improves the mathematical literacy ability of the geometry and statistics material particularly to improve the ability of employing and interpreting.

Based on the conclusion above, there are some things to advice : (1) PBI-Synectics Gordon with Scientific approach and PISA oriented can be used as an alternative to the process of learning of geometry and statistics, (2) Self-efficacy and literacy skills of learners have positive effect on mathematics literacy ability of learners. So teachers have a role to pay attention on how these two factors can grow and develop optimally in self-learners, self-efficacy on the dimensions of generality needs special attention, (3) Need for further research as the development of different grade level or material

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