

# Mathematizing Process of Junior High School Students to Improve Mathematics Literacy Refers PISA on RCP Learning

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**Abstract.** Mathematizing process (MP) is the process of modeling a phenomenon mathematically or establish the concept of a phenomenon. There are two mathematizing that is Mathematizing Horizontal (MH) and Mathematizing Vertical (MV). MH as events changes contextual problems into mathematical problems, while MV is the process of formulation of the problem into a variety of settlement mathematics by using some appropriate rules. Mathematics Literacy (ML) is the ability to formulate, implement and interpret mathematics in various contexts, including the capacity to perform reasoning mathematically and using the concepts, procedures, and facts to describe, explain or predict phenomena incident. If junior high school students are conditioned continuously to conduct mathematizing activities on RCP (RME-Card Problem) learning, it will be able to improve ML that refers PISA. The purpose of this research is to know the capability of the MP grade VIII on ML content shape and space with the matter of the cube and beams with RCP learning better than the scientific learning, upgrade MP grade VIII in the issue of the cube and beams with RCP learning better than the scientific learning in terms of cognitive styles reflective and impulsive the MP grade VIII with the approach of the RCP learning in terms of cognitive styles reflective and impulsive This research is the mixed methods model concurrent embedded. The population in this study, i.e., class VIII SMPN 1 Batang with sample two class. Data were taken with the observation, interviews, and tests and analyzed with a different test average of one party the right qualitative and descriptive. The results of this study demonstrate the capability of the MP student with RCP learning better than the scientific learning, upgrade MP with RCP learning better compare with scientific learning in term cognitive style of reflective and impulsive. The subject of the reflective group top, middle, and bottom can meet all the process of MH indicators are then the subject of the reflective upper and intermediate group can meet all the MV indicators but to lower groups can only fulfill some MV indicators. The subject is impulsive upper and middle group can meet all the MH indicators but to lower groups can only meet some MH indicator, then the subject is impulsive group can meet all the MV indicators but for middle and the bottom group can only fulfill some MV indicators.

## 1. Introduction

Since PISA was first implemented in 2000 Indonesia has been involved from the beginning in the administration of PISA, the results achieved by students in the PISA Indonesia is far from satisfactory. In PISA 2000, Indonesia was ranked 39 out of 41 countries [1], in PISA 2003 was ranked 38 out of 40 countries [2], in PISA 2006 was ranked 50 out of 57 countries [3], in PISA 2009 was ranked 61 out of 65 countries [4] and in PISA 2015 was ranked 62 out of 70 countries [5]. From the PISA results showed a low ability of Indonesian students MP means that students have not been able to interpret the mathematization ability in everyday life in various contexts.

MP is a process for mathematics phenomenon. Mathematics could be interpreted as a phenomenon mathematically model (in the sense of looking mathematics relevant to a phenomenon) or building a mathematical concept of a phenomenon [6]. [7] distinguishes mathematization into two kinds, namely MH and MV. [8] defines the MH is an activity change contextual problems into mathematical problems (symbol), while the vertical is to formulate mathematization problems in a variety of settlement mathematics by using some the corresponding mathematical rules.

According to Freudental in [6] a science will be meaningful to the learner if the learning process involves a realistic problem. One model of learning that emphasizes the significance of science is realistic mathematics education(RME). Judging from the use of MH and MV[7] distinguishes four approaches mathematics learning, namely mechanistic approach (mechanistic), structuralistic, empiristic, and a realistic approach. Mathematization mechanistic approach both horizontally and vertically is not used. In empiristic approach simply uses MH. The structural approach using only MV. While the realistic approach both horizontally and vertically MP used [7]. So as to improve the ability



of students can use the MP realistic approach, a realistic approach to mathematics is the approach RME.

According to Gravemeijer (1994: 90) as cited [7] there are three key principles in designing learning realistic mathematics (1) (guided reinvention and progressive mathematizing) (2) didactical phenomenology) (3) (self-developed models ). Three key principles of RME in implementation bore characteristics of mathematics learning realistic, namely: (1) the use of context, (2) the use of models, bridging by vertical instrument, (3) student contribution, (4) interactivity and (5) the intertwining [6].

Solving mathematical problems always occur MP, and students will use a variety of strategies. According to [10] mathematical problem solving strategy turned out to be heavily influenced by the student's cognitive style. According to Susan, as cited by [10], that "general problem solving strategies such as These are further influenced by cognitive style". When students have different cognitive styles, the way of solving mathematical problems are also different, so the difference it will also trigger different processes, mathematization students. According [11] cognitive styles are individual characteristics regarding feel, remember, organize, process, and problem solving. [12] cognitive styles are classified as follows: (1) differences in cognitive styles psychologically, including cognitive style field dependent and field independent, (2) differences in cognitive styles are conceptually tempo, include: cognitive style impulsive cognitive style reflexive, ( 3) differences in cognitive styles based way of thinking, including intuitive cognitive style-inductive and deductive logic.

Kagan as cited by [13], cognitive style grouping into two groups, are: (1) cognitive style are a reflective cognitive style that has the characteristics of slow in responding to the problem, but carefully or thoroughly, so the answer tends to be true. (2) the impulsive cognitive style is a child's cognitive style that has the characteristics of quick in answering the problem, but no or less carefully, so that the answers tend to be wrong.

## 2. Method

This type of research is the combination research (*mixed methods*) *embedded concurrent*. According [14], a combination of methods concurrent embedded or design is qualitative and quantitative research methods by mixing these two methods are not balanced. The research design used *pretest-posttest control group design*. The population in this study were all students of class VIII SMP 1 Batang in the academic year 2015/2016. The samples in this study using simple random sampling technique selected two samples is class VIII C as the experimental class was subjected with RCP learning and VIII F as a control class with scientific learning. Decision The subject of research in a qualitative study using purposive sampling technique of determining where the subject is done with certain considerations [15]. Taking the subject of the research is done with consideration of test results of cognitive style and a preliminary test value i.e. selecting students from the class of experiments each of two Subjects from the upper class, the middle and the bottom of the students with cognitive styles reflective and each of two Subjects from the upper class, the middle and the bottom of the students with cognitive style impulsiveness. The necessary data in this study were obtained through observation, documentation, tests, and interviews with the subject in depth. Analysis of initial data including normality test, homogeneity, and the equality test average. Final data analysis including normality test, homogeneity test, different test average right side.

## 3. Result And Discussion

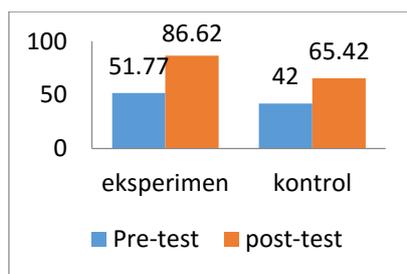
Cognitive style measurement results as follows the number of students Reflective 38.24%, the number of students Impulsive 35.29%, the number of students slow-inaccurate 11.76%, while students fast-accurate 14.71%. This shows that the proportion of students who have the characteristics of a reflective-impulsive are 73.53% higher than the students who have the characteristics of fast and precise/accurate in answering or slower and less precise/less accurate in answering, are 26.47%. Then based on Reflective the number of students 35.29%, the number of students Impulsive 38.24%), the number of students slow-inaccurate 14.71%, while students fast-accurate 11.76%. This shows that the proportion of students who have the characteristics of a reflective-impulsive 73.53% higher than the students who have the characteristics of fast and precise/accurate in answering or slower and less precise/less accurate in answering 26.47%. These results are consistent with previous research, the study [13] the proportion of children reflective-impulsive 73.7% and the proportion of children who

have the characteristics of fast and precise/accurate in answering or slower and less precise/less accurate in answering 26.3%. t test was conducted to determine the ability MP of the student with RCP learning better than the ability MP of student with a scientific learning. The results as in Table 1.

**Table 1.** Results Of The Test The Average Difference Mathematization Process Capability

$t_{Count}$	$\alpha$	$t_{table}$	Conclusion	It Means
3,873	5%	1,669	$t_{Count} > t_{table}$	Ability to process mathematization math class VIII student on materials cubes and blocks with RCP learning the problem more than the ability of class VIII student mathematization process on the material cubes and beams with a scientific learning.

From Table 1, the research concluded that the ability MP student with RCP was learning more than the ability MP student with a scientific learning. The achievement was attributed to several factors one of the factors that influence it Problem Based Learning(PBL). According to [16] PBL as a student-centered learning that encourages students to construct their own knowledge, foster critical thinking skills, find and solve problems independently. PB requires students to be able to think critically about the information he got from the activity of thinking is emphasized in this study. Another factor influencing the approach is RME with the problems of daily life are used for learning where in line with the opinion of [8] who said that mathematics should be associated with reality and mathematics is a human activity. This is consistent with [17], [18], [19] and [20] research that the RME category PBL approach is very good and positive effect of increasing the ML including MP.



**Figure1.** Histogram Improving Ability MP of Students Reflective

Figure 1 describes about the increase in MP. The increase in class experiment(RCP learning) regarding cognitive style reflective reached 34.85 where the average pre-test 51.77 increased to 86.62 on an average post-test. Average index gain reflective students in the experimental class 0.72 are included in the high category. The increase in class control (Scientific Learning) regarding cognitive style reflective reached 23.42 where the average value of the pre-test 42 rose to 65.42 on an average post-test. The average index of reflective students gains the control class of 0.40 in the medium category. Improving the ability of MP represents the difference between the pre-test and post-test students' reflective MP further after the test is calculated by one side (right) using the t test result as in Table 2.

**Table 2.** The Result of The Difference In Average Increase Students' Reflective Ability MP

$t_{Count}$	$\alpha$	$t_{table}$	Conclusion	It Means
3,205	5%	1,669	$t_{Count} > t_{table}$	The increase in the ability of class VIII student mathematization process on the material cube and beam-assisted learning with RME approach the problem better card than on improving the ability of class VIII student mathematization process on the material cubes and beams of learning the scientific approach regarding cognitive style reflective.

From Table 2, the research concluded that an increased the MP of the student with RCP learning better than the MP of the student with scientific learning in terms of cognitive style reflective.

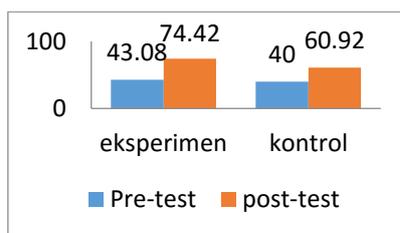


Figure 2. Histogram Improving Ability MP of Students Impulsive

Figure 2 describes the increase in MP. The increase in the class experiment regarding cognitive style impulsive reached 31.34 where the average pre-test 43.08 increased to 74.42 on an average post-test. Average index gains impulsive students in the experimental class 0.55 which is included in the medium category. The increase in class control regarding cognitive style Impulsiveness reached 20.92 where the average value of the pre-test 40 rose to 60.92 on an average post-test. Average index gain control class students impulsive at 0.35 in the medium category.

Table 3. The Result of The Difference In Average Increase Students' Impulsive Ability MP

$t_{count}$	$\alpha$	$t_{table}$	Conclusion	It Means
2,729	5%	1,71.	$t_{count} > t_{table}$	The increase in the ability of class VIII student mathematization process on the material cube and beam-assisted learning with RME approach the problem better card than on improving the ability of class VIII student mathematization process on the material cubes and beams of learning the scientific approach regarding cognitive style impulsive.

From Table 3, the research concluded that an increased the MP of a student with RCP learning better than the MP of a student with scientific learning regarding impulsive cognitive style. Increasing the capability this occurs because the MP of learning processes that occur in class experiments under the theory of the Bruner points out that in the learning process of the child passes through stages of enaktif, iconic, and symbolic. In PBL learning with realistic approach aided problem cards, enaktif stage occurs when students manipulate objects through a matter of contextual and symbolic and iconic stage occurs when the students answer the questions on the student worksheet. Moreover, the Meaningfulness of this material can be obtained by directly connect him with daily life with the approach of the RME. Through the approach of the material can be accepted by RME students due to logical and relevant to a problem that is common in the environment students

### 3.1. Mathematizing Process Students Reflective

Based on an MP students reflective group of top, middle and bottom indicate that the indicator for identifying relevant math concepts with real world problems of subjects either group of top, middle, and bottom of the conduct of such activities. In the process of MH, indicator represents the problem with a variety of different ways, including organizing problem under the relevant mathematical concepts, and to formulate appropriate assumptions; either by making a drawing or restates the problem in their own words a good group of top, middle and bottom meet. On the indicators are looking for connections between "languages" problem with symbol and "formal mathematical language" so that the real problems can be understood mathematically, a group of top, middle or bottom meet. On the indicators look for regularity, relationships, and patterns that are associated with the problem; all groups either top, middle, or bottom of doing this activity. On the problem of translating the indicators into mathematical form, namely in the form of mathematical models, all groups either top, middle or bottom translate problem so that solutions are obtained from its perception is true.

In the process of MV, not all subjects fulfilling all the indicators. Using a variety of indicators of different mathematical representation, all the groups either top, middle and bottom using a representation. Indicators Using symbols, "language" and the process of formal mathematics; This relates to MH process, which, if in the process of linking the subject MH problems with it in the process of mathematization symbols vertical during the process of formal mathematics also use symbols in arithmetic operations. In the group of top, middle and bottom meet. In the group of top, middle and bottom meet Indicators make adjustments and development of mathematical models,

combine and incorporate the various models on student reflective some difficulties in combining and incorporating a wide range of models tailored to the issues. In the group of top and middle of this indicator is met, but at the bottom of the group does not meet. Subject research not able to make any adjustments or development concept, but in combining and combining these three subjects experiencing errors. Indicators in making mathematical argumentation, the group of top and middle of this indicator is met, but at the bottom of the group does not meet. The group under its mathematical argumentation reveals the difficulty of the problems presented and its mathematical resolution so that the answer of the solution have not been correct. Indicators of generalities the indicator meets the top of the group while in the middle of the group and below do not meet as it does not make a generalization or not conclude appropriately.

### ***3.1. Mathematizing Process Students Impulsive***

Based on the MP impulsive student group, the top, middle and bottom indicate that the indicator for identifying relevant math concepts with real world problems of subjects either group of top, middle, and bottom of the conduct of such activities. On the process of MH indicators, represents a problem with a variety of different ways, including organizing the issue by the relevant mathematical concepts, and to formulate appropriate assumptions; either by making a drawing or restates the problem in their words, either group over the middle and bottom groups can meet. On the indicator for the relationship between the "language" problem with symbols and "language" of formal mathematics that the real problem can be understood mathematically, top and the middle group can meet these indicators, while the bottom group does not have an associate problem with the symbol. In indicator for regularities, relations, and patterns related to the problem, both groups of upper, middle, or bottom of this activity. In the indicator of translating the problem into mathematical form, namely a mathematical model, the groups either top, intermediate and lower translate problem to obtain the correct solution of perceptions.

In the process of MV, not all subjects fulfilling all the indicators. Indicators using a variety of different mathematical representation, a group of top, middle and bottom using a representation in finding a solution. Indicators Using symbols, "language" and the process of formal mathematics; This relates to MH process, if in the process of MH subject problem does not associate with it in the process of mathematization symbols vertical during the process of formal mathematical calculations directly on the operation. In the group of top and middle of the meet while in the bottom group did not meet because during the process of formal mathematical symbols and do not use directly on arithmetic operations. Indicators make adjustments and development of mathematical models, combine and incorporate the various models of most of the difficulties in combining and incorporating a wide range of models tailored to the problem. At the top of the group meet the indicator while the middle and bottom all the subjects did not meet either it is not appropriate when doing the adjustment, development, combine or merge them. Indicators in making mathematical argument in the top group meet these indicators, while the middle and bottom are not making the argument in solving the problem so that the obtained solution is not correct. Indicators on generalizing groups meet these indicators to make decisions with the right while in the middle, and bottom groups do not generalize or not concluded.

## **4. Conclusion**

Based of research and discussion, the conclusions can be obtained. (1) the capability of the MP that one component of ML of student with RCP are better than the MP of student with scientific learning, (2) Students with cognitive style reflective the increase ability of the MP of student with RCP learning are better than the MP of student with scientific learning, (3) Students with cognitive style impulsive the increased ability of the MP of student with RCP learning more good than the MP of student with scientific learning, (4) Subject reflective top and middle groups identified all indicators of MP meet both MH and MV; and reflective subject in a bottom group identified all MH process indicators are met and not all the indicators are met MV processes, (5) Subject impulsive group on MP identified all of the indicators are met both MH and MV process; Subject impulsive middle group identified all MH process indicators are met and not all the indicators are met MV process; Subject impulsive at bottom group identified that not all indicators of MH and MV processes are met.

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