

LEARNING MATERIAL BASED ON REALISTIC MATHEMATICS EDUCATION (CASE STUDY IN ENHANCING STUDENTS' MATHEMATICAL HABITS OF MIND)

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Abstract

The background of this study is the lack of human resources. It can cause the low mathematical habits of mind and competitiveness of the Indonesian. Education and learning can identified as strategies that used to solve these problems. Because of that, this study aims to: (1) develop prototype learning material (LM) based on realistic mathematics education (RME); (2) produce a valid and practice prototype learning material based on RME; and (3) see the effect of LM on students' mathematical habits of mind. This is a developmental research, that consists of: analyzing, designing, evaluating, and revising. The Instruments that used consist of documentation and questioner. Document is used to see a valid and practice of learning material. Questioner is used to see students' mathematical habits of mind. The conclusion based on data analysis: (1) LM is developed in statistical topic for junior high school students; (2) LM prototype has been valid based on expert review and practice based on try out. (3) LM prototype is effective for students' mathematical habits of mind.

Keywords: Developmental Research, Learning Material, Realistic Mathematics Education, Mathematical Habits of Mind.

INTRODUCTION

Habits in the most simple sense is an activity or behavior that has been done a long time and become a part of life (Wikipedia, 2011). American Heritage Dictionary (1994) also defines a habit as a pattern of behavior that is shaped by continuous repetition. If a habit is done continuously, it can be more powerful or settle on somebody, so it will be more difficult to change and it will entrenched in the individual self. From the above description, it can be concluded that a habit can be identified as a behavior or activity that grown up because of conducted continuously.

Costa (1996) suggested that individual success was determined by their habits. One type of habits that can be developed in order to support students' success is the habit of thinking (habits of mind). The habits of mind are required by students as a tool in regulating their own learning, so that they can solve the problems in learning and organize their learning in vocationally and rational. Habits of mind can be defined as applying past knowledge to new situation through the meaning and communication. This activity will form a patterns of intellectual behavior that can encourage individual's success. Costa and Kallick (Lim , 2008) also argues that habits of mind can be identified as smart thinking when solving problems and organizing their learning vocationally, rational, or academic, especially for problems that are not immediately known its solutions. Costa (1996) adds that the habits of mind sometimes can be identified as a reflection of the abilities, attitudes, gestures, past experience, and the tendency of a person. Habits can be categorized as reflecting skills or capabilities as the capacity of a

person to behave. Habits can also indicated a person's sensitivity and tendency to behave, therefore, the habit of mind broadly categorized into the following five dimensions, namely: values, behavior, ability, and commitment.

But, there are some facts that indicated that Indonesian's habits of mind still low. The lack of human resources and competitiveness in Indonesia can be identified as the low Indonesian's habits of mind. This problems may be caused by their habits and behavior in learning during as student in primary school till university.

Cause of this problems, Indonesia currilum change their perspective in teaching and learning. In their perspective, teaching and learning process must be contained with active and creative activities, sharing idea, colaborative, conructivism, and special task (open-ended problems) now. This strategies not only choosen to increase thinking skills but also to enhance habits of mind.

One form of learning strategies that relevant to pedagogical theories is realistic mathematics education. RME approach can facilitate students to solve contextual problems in their own strategies and teachers should be as mentors, facilitators, or motivators for students when they have done exploration of ideas or discovery of a concept. Beside that, students' contribution and colaboration in learning also as important point in this strategy.

Based on that idea, researcher interst to design a learning material that relevant to realistic mathematics education approach. Because of that, this study aims to:

- 1) Develop prototype learning material (LM) based on realistic mathematics education (RME)
- 2) Produce a valid and practice prototype learning material based on RME
- 3) See the effect of LM on students' mathematical habits of mind.

LITERATURE REVIEW

Habits of Mind

Habits in the most simple sense is an activity or behavior that has been done a long time and become a part of life (Wikipedia, 2011). A habit can grow if a behavior or activity that is conducted continuously. Based on the above concept, in general it can be concluded that the habit is a repeated presentation of a stimulus in behavior.

Habits are categorized into two , namely: in the habit of behaving (habituated) and in the habit of mind (thinking). Habits in behavior is the impact of the activity or motoric activity that is carried out repeatedly, whereas habit of mind is an activity that involves the impact of the thought process that also performed repeatedly. Habits of mind also can be interpreted as the brain synergizing behavior when doing something, both right brain and left brain. In other words, the habit of mind include synergizing intellectual and emotional behavior. Based on this concept, habit of mid is as habit of thinking that synergizing left and right brain. Right brain consist of cognitive, exact, supple, and silly. Left brain consist of control, understanding, and sensorial.

Next, Costa (1996) divided habit of mind in seven dimensions, namely : cognitive, precision, control, comprehension or understanding, responsive, flexible, and humor.

The following figures represent the seven dimensions and 16 aspects related to the habit of mind.

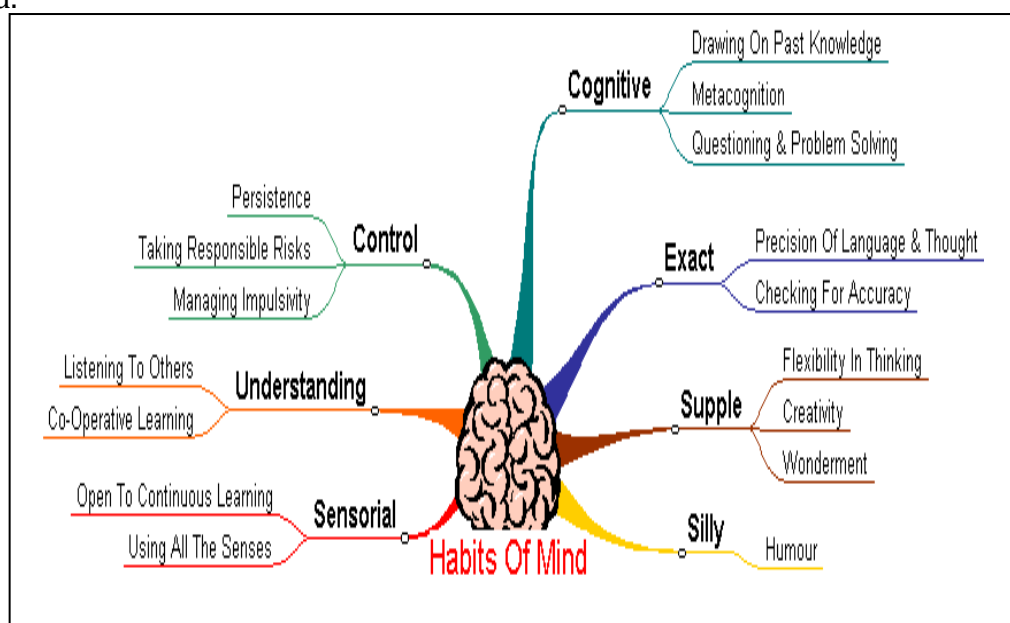


Figure 1. Habits of Mind

Realistic Mathematics Education

The philosophy of RME is mostly determined by Freudenthal's view on mathematics (cf. Freudenthal, 1991). Two view of his important points are: (1) mathematics must be connected to reality, and (2) mathematics should be seen as a human activity.

First, in order to start from reality that deals with phenomena that are familiar to the students, Freudenthal's didactical phenomenology, i.e. the view of learning as starting contextual experience is used. Second, by the guided reinvention principle through progressive mathematizations, students are guided didactically and efficiently from one to another level of thinking. These two principles and the concept of self-developed models (Gravemeijer, 1994) are used as design principles both in developing the learning materials.

Furthermore, these principles are operationalized into five basic characteristics of realistic mathematics education or five tenets of RME (Gravemeijer in Zulkardi, 2002). In short those are: (1) use of contextual problems (contextual problems figure as applications and as starting points from which the intended mathematics can come out); (2) use of models or bridging by vertical instruments (broad attention is paid to development models, schemas and symbolization rather than just offering the rule or formal mathematics right away); (3) use of students' contribution (large contributions to the course are coming from student's own constructions, which lead them from their own informal to the more standard formal methods); (4) interactivity (the social live in the classroom including explicit negotiation, intervention, discussion, cooperation and evaluation among pupils and teachers are essential elements in a constructive learning process in which the student's informal strategies are used as a lever to attain the formal ones); (5) intertwining of learning strands (the holistic approach implies that learning strands can not be dealt with as separate entities, instead, an intertwining of learning strands is exploited in problem solving).

METHODOLOGY

Participant

Participant in this study consist of three categories. They are participant in small group, large-scale, and dessimination. In this study, there are 2 students in small group, 28 students in large-scala, and 97 students in dessimination.

Design and Procedure of the study

The design used in this study is a Research and Development. This study not only focuses on the development of learning materials based on realistic mathematics education, but also to see its effect on students' mathematical habits of mind. Because of that, in this consist of developing process and dessimination process. For dessimination process, the pretest-postttest design also used to see effect of learning material on students' MHoM. The following chart illustrates the steps to be performed in this study.

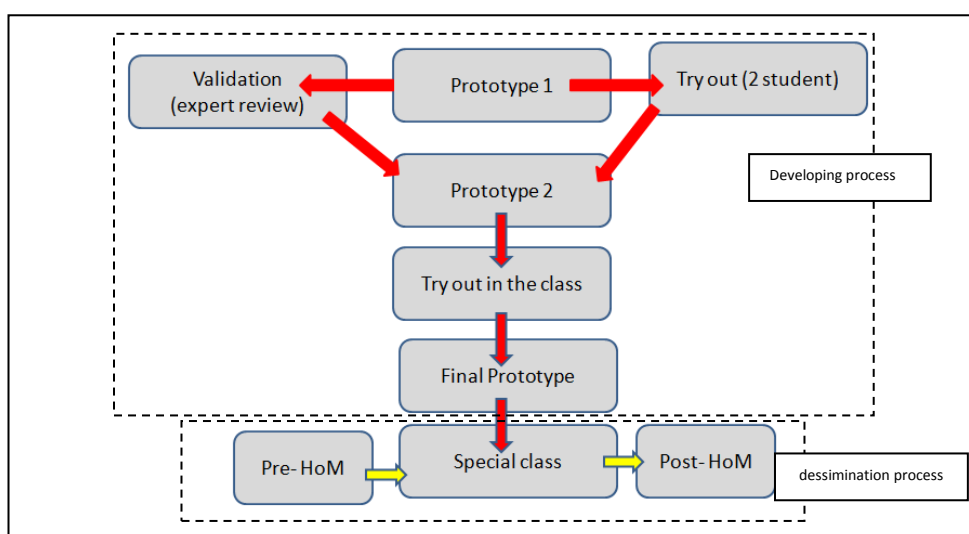


Figure 2. Procedure of Study

Instruments and Data Analysis

Document of learning material and validation sheets are instruments used in this study. Beside that, a questioner of MHoM also used to see effect of learning material on students' mathematical habits of mind.

To answer the statement of study, qualitative methods were used to analysis data from document of learning material and validation sheets. Beside that, pre-respons and post-respon from questioner also analyzed in descriptive qualitative.

FINDINGS OF THE STUDY

Developing process

Before developing learning materials, researchers conducted a literature review. literature review was conducted in order to collect the learning theories that are relevant to realistic mathematics education and habits of students' mathematical thinking. The results of the literature review was used to develop learning material based on RME that related to mathematical habits of mind.

Based on literature review, learning material that will be developed must consist of difficult task, complex problem, but realistic. The advantage of this special task used to fasilitate students for colaboration, cooperation, discussion, negotiation, develop self

model (informal and formal strategies), and develop students habits of mind. These are example of learning material that can enhance students habits of mind.

This stage consist of two phases, namely: paper-based and computer-based. Paper-based started with making sketch on the paper, and this result called as initial draft. Next, this initial draft is made in computer, and its result called as computer-based.

Validation and Try out Process

Validation of prototype 1

Validation phase (prototype 1). This stage is a continuation of phase previously. This stage aims to obtain a good LM based on content and construct. There are five expert that validate this LM. They are consist of lecture, mathematics teacher, and expert in language. This stage begins with a review of content and construct validity.

Content validity done by looking at the suitability of items were tested in accordance with the given subject matter, learning achievement indicators (topic: statistics), indicators of mathematical habits of mind, and the level of difficulty for the junior class IX students.

Construct validity based on the clarity or legibility of text sentences, as well as the clarity or legibility of the pictures or illustrations used in the test item. The clarity or legibility in terms of language or editorial usage, presentation, and accuracy (accuracy) images or illustrations used.

Based on validation process, it can conclude that there are some revision: (1) select and use context that exist and close to the students (using familiar context); (2) learning material must facilitate student in thinking; (3) don't use many hint in learning material; (4) let student thinking themselves; and (5) editorial usege.

Try out (Small Group)

This stage aims to look at the practicality of prototype 1 in the small group (two students). This stage is also used to strengthen the results of validation process. Based on try out in small group, research make some conclusion, such as: (1) students have some difficulties in unfamiliar context (population census), (2) making conclusion, (3) open-ended problems.

Revised Prototype 1

Revisions to the prototype 1 was conducted based on the suggestions of the validator and the results of the analysis of try out in small group. Following table represented revision based on validation and try out in small group.

Table 1. Revisions of Prototype

Results	Revisions
Contextual problems	Change with familiar context
Editorial	Revise its editorial
Hint in problem	Decrease some hint in problems, but sometimes increasing hint

Prototype 2

Prototype 2 is developed based on revisions of prototype. There are some modification in prototype 2, such as: contextual problem, editorial in language and display.

Try out (Large Scale)

This stage also aims to look at the practicality of prototype 2 in large scale (more than 20 students). This stage is also used to see students' difficulties when solving problem in learning material. Based on try out in large scale, research make some conclusion, such as: (1) with familiar context, students can understand and solve problems; (2) if this learning material done him/her self, some students still have difficulties in making conclusion and solving open-ended problems.

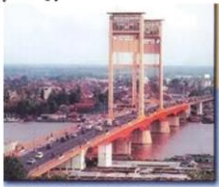
Revised Prototype 2

In this section, revisions used to get final prototype. Based on try out in large scale, following figures represented example of learning material.

Learning Material

Habits of Mind

JEMBATAN AMPERA



Gambar. Jembatan Ampera

Jembatan Ampera merupakan jembatan kebanggaan masyarakat Palembang. Jembatan Ampera menghubungkan kawasan Seberang Ulu dan Seberang Ilir. Setiap hari puluhan ribu kendaraan melalui jembatan tersebut.

1. Catatlah jumlah kendaraan yang melalui jembatan ampera dalam 30 menit!
2. Kelompokkan jenis kendaraannya sebagai berikut: sepeda, beca, bajaj, motor, mobil, pick up dan truk.
3. Sajikan data di atas dalam bentuk tabel!

Using familiar context, so students can use their past knowledge, flexible in thinking, and using all the senses in learning

Figure 3. Example of Learning Material

Learning Material

Habits of Mind

1. Hasil ulangan harian Dewi pada mata pelajaran matematika adalah sebagai berikut: 6, □, □, 9, 4, 8, 6, 8. Dapatkah kamu menebak berapa nilai kedua bilangan pada kotak tersebut, jika modulusnya 8 dan mediannya ??
Petunjuk: Gunakan konsep modus dan konsep median.

Alternatif Penyelesaian

a. Jika modulusnya 8 (tunggal) maka alternatif jawabannya adalah
1, 4, 6, 6, 6, 8, 8, 8, 9
2, 4, 6, 6, 8, 8, 8, 9
4, 5, 6, 6, 8, 8, 8, 9

Dan seterusnya

b. Jika modulusnya 8 (tetapi tidak tunggal) maka alternatif jawabannya adalah
1, 4, 6, 6, 6, 8, 8, 9, 9
4, 6, 6, 6, 8, 8, 8, 9


Dan seterusnya

Special or Difficult task can facilitate students to creative, checking for accuracy, persistence, flexible in thinking, taking responsible risks, managing impulsive

Figure 4. Example of Learning Material

Learning Material

5 මිතුරු



Gambar 5 Saudara

1. Bu Siska memiliki lima orang anak.
 Anak pertama usianya dua kali anak ke lima.
 Anak kedua usianya dua tahun lebih muda dari anak pertama.
 Anak ketiga usianya dua tahun lebih tua dari anak kelima.
 Anak keempat usianya satu tahun lebih tua dari anak kelima.
 Jika rata-rata usia anak Bu Siska adalah 17 tahun. Berapakah usia masing-masing anak tersebut?
Petunjuk: Ubahlah dalam model matematika dan gunakan konsep rata-rata.

Habits of Mind

If this learning materials worked in groups, some HoM can be increase such as: listening to others, co-operative learning, open to continuous learning, and precision of language and thought

Figure 5. Example of Learning Material

Learning Process

Learning process can not be done in haste, because the ultimate goal is students understand the learning material. In addition , the process of the invention concept or contextual problem solving in the classroom is much more utilizing simple media, such as: paper, nuts, candy, or stick. this learning process also causes the time required to complete the learning becomes longer than the planned time.

In classroom activities, PMR is also dominated by high- ability students, for example discussion in small group and class discussions. One of the causes of the low-ability students tend to be insecure and less confident in conveying their idea, and sometimes tend to be afraid of in expressing ideas that they have. At each meeting , the teacher always monitor and motivate low-ability students, as well as continue to provide the opportunity for them to be actively involved the learning, both in class discussions and group discussions.

The core of the learning process is horizontally and vertically matematisasi. Matematisasi horizontal and vertical processes in the classroom PMR done by using simple objects such as candy, nuts, cups of mineral water, and paper . Atmosphere in the classroom can be seen in Figure 4.2 below.



Figure 6. Dessimination

Dessimination

Dessimination process is aim to see effect of learning material on students' mathematical habits of mind. To see this effect, a questioner given before and after

learning process. Based on data analysis, it can be concluded: there are 96,59% students have enhancing in their mathematical habits of mind. Following figure represented result of dissemination process.

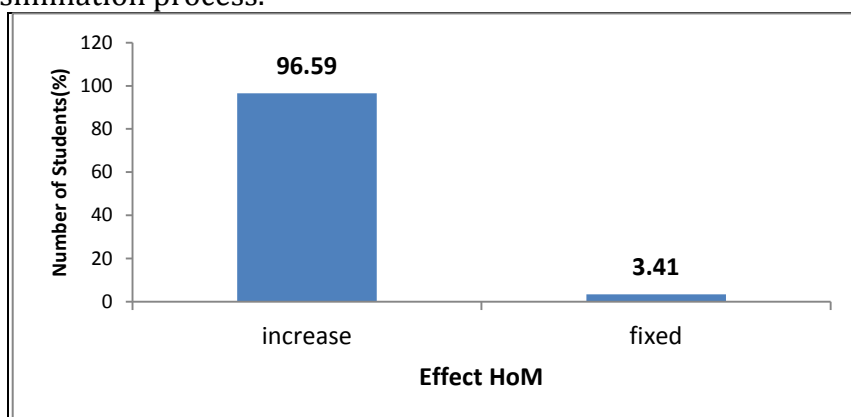


Figure 7. Effect Learning Material on Students' HoM

Through these development process, learning material based on realistic mathematics education had categorized as valid and practical. Beside that, this learning material also have effect on students' mathematical habits of mind.

CONCLUSION

Based on data analysis,

- (1) LM is developed in statistical topic for junior high school students;
- (2) LM prototype has been valid based on expert review and practice based on try out.
- (3) LM prototype is effective for students' mathematical habits of mind.

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