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## LEARNING DESIGN USING PENDIDIKAN MATEMATIKA REALISTIK INDONESIA (PMRI) APPROACH FOR THE TOPIC SURFACE AREA AND VOLUME OF CUBOID FOR 2ND GRADE JUNIOR HIGH SCHOOL

Karin Amelia Safitri<sup>1</sup>, Ratu Ilma Indra Putri<sup>2</sup>  
Sriwijaya University<sup>1,2</sup>

[karinka1803@gmail.com](mailto:karinka1803@gmail.com), [ratu.ilma@yahoo.com](mailto:ratu.ilma@yahoo.com)

### Abstract

*This research aims at developing and producing learning instruction covers student activity worksheet based on Indonesian version of Realistic Mathematics Education (RME) called PMRI with the topic about the surface and volume of a cuboid which is valid, practic, and has a potential effect through student mathematical connection ability. The validity is measured by using the aspects of contents, contruction, and language based on principles and characteristics of PMRI. Based on the experts comments, the student activity worksheet developed can be practically used for the teaching learning process. Expectedly it can help teachers and students in learning. The research subject is 22 students of the second grade of SMP Islam Azzahrah 2 Palembang. The methodology which is used in this study is a development/design research. This form of research consists of analyzing, designing, evaluation and revision. Observation and test were used in collecting data. The collected data were analyzed using qualitative descriptive. The findings show that students were enthusiastic and motivated to study. Therefore, the student activity worksheet the researcher made is not only a valid and practic product but also brought the effectivity for students grade 2nd. As well as it can be used for the learning activity. Also, according to the final score seen by the aspect of mathematical connection that some students only get trouble in correlating mathematics and another diciplines sciences to solve problems because their perception the problems which the researcher made aren't easy.*

**Keywords:** *Development/Design research, student activity worksheet, mathematical connection.*

### INTRODUCTION

In NCTM (*National Council of Mathematics Teachers*, 2000: 29), explained that five mathematical basic ability which are problem solving, reasoning and proof, communication, connections, representation. Related to five standards mentioned, so the purposes of mathematics learning which has been already set in Curicullum 2006 that released by DEPDIKNAS covers (1) connection between every concepts in mathematics and its use in solving problem, (2) reasoning and proof, (3) problem solving, (4) communication and representation, (5) afective factor.

Bruner (in Ruseffendi, 1991) says beside reasoning and proof, what influences learning achievement is the student's ability in mathematical connections. Russpiani's research (in Sulistyarningsih, 2012: 1) shows that generally, the assesment of student mathematical connections ability can be classified low. This case will be influencing student learning quality which affects to the lower of learning

achievement in school. This fact is proven by observation result in mathematics learning in 2nd grade SMP Islam Azzahrah 2 Palembang, it says student abilities in connecting mathematical ideas wasn't good enough, and students are not too understanding towards what they already study and its benefit on daily life. Others, teacher only used textbook as learning tool whose the problems are not started from daily activity, very abstract, learning approach implemented is teacher-centered. Students were getting passive, not confident, anxious and shy either in asking or giving their opinions. This not-active students case happened in the class not only caused by students itself but also disability of teacher in creating the learning atmosphere become pleasing, interactive and interesting.

One of learning approaches which can peep out ability of student in connecting and correlating mathematics with everyday life, correlating and connecting mathematics idea is Pendidikan Matematika Realistik Indonesia (PMRI). PMRI is one of promising learning approaches which will be guiding students to understand mathematical concepts by constructing themselves through their previous knowledge which has connection with everyday life, by finding itself those concepts, expectedly learning will be meaningful for students (Ilma, 2011).

Therefore, the researcher wants to develop learning instruction by producing students activity worksheet. Somakim (2009) also suggests to develop mathematics book based on Pembelajaran Matematika Relitik Indonesia because according to Zulkardi (2005:5) one of 5 characteritics of PMRI learning is intertwined (connection).

The surface area and volume of cuboid topic chosen constituted by the researcher's experience as teacher and interviews some students said this topik is pretty difficult especially problem solving type.

From the description above, the research prople is how is characteristic of learning instruction for the topic surface area and volume of cuboid based on PMRI which is valid and practic, and how is the potential effect of the learning instruction developed towards mathematical connections ability in second grade SMP Islam Azzahrah 2 Palembang.

#### **Student Activity Worksheet based on PMRI**

Student activity worksheet is the papers contain the tasks for the students. Trianto (2007:148) explained student activity worksheet is to guide students to conduct trouble-shooting or investigation activity. Compilation of activity worksheet intended to give student amenity in comprehending items taught in course of study.

According to Ilma R, (2010) expressing PMRI is an approach which adapted from RME determined by view of Freudenthal about mathematics. His two important views are 'mathematics must be connected to reality and mathematics ace human activity'. First, mathematics have be to near to student and have to be relevant with everyday life situation of student. Second, he emphasize that mathematics as human being activity, so that the student have to be given a chance to learn to do activity of all topic in mathematics. Student activity worksheet designed by the researcher is student activity worksheet made based on 3 principles and 4 characteritics of PMRI. Zulkardi (2010:11) says that PMRI according to RME principles.

### 1. *Guided reinvention and didactical phenomenology*

Because mathematics in RME learning is as activity of human being, hence Guided reinvention can be interpreted that student in the mathematics learning have to be given a chance to experience by themselves the same process of moment of mathematics found.

### 2. *Progressive Mathematization*

Situation that comprises phenomenon taken as substance and area of application in instruction of mathematics shall leave from real circumstance before reaching level of formal mathematics.

### 3. *Self-Developed Models*

Role Self-Developed Models represent 'bridge' for student from situation real to concrete situation or from informal of mathematics become formal mathematics. It is meaning that student make model by their ownself in finishing problem.

Four characteristics of PMRI according to Zulkardi (2002) that is using contextual problem, using model or bridge by vertical instrument, using student contribution, Interaktivitiy, integrated by the topic of other study.

#### **Research Method**

This research used development research method uses a type of formative evaluation. It has been conducted at even semester 2012/2013 in SMP Islam Azzahrah 2 Palembang. Research Subject is class VIII At-Tirmidzi, 22 students.

#### **Research Procedure**

This research is consisted of two phases that is phase preliminary covering desain analysis, and phase formative Evaluation covering self evaluation, expert reviews and one-to-one ( low resistance to revision), and small group, and also the field test ( high resistance to revision) ( Tessmer,1993; Zulkardi, 2006). The steps visible at Figure 1.

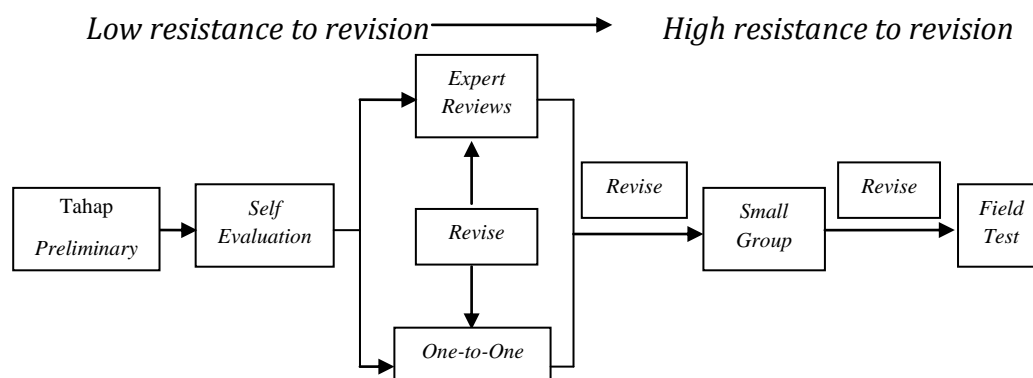


Figure 1 . Flow Chart of Development Research

#### **Data Collecting Technique**

Technique of collecting data from this research is document, walkthrough, observation of PMRI learning process, written test, documentation (photos and videos).

#### **Result of Development of Learning Instruction**

This Research yields learning instruction in the form of a valid and practic student activity worksheet based on PMRI approach, and has pottential effect towards student mathematical connection ability for the topic surface area and volume of cuboid. This student activity worksheet designed pursuant to principles and characteristics of PMRI those are guided reinvention and didactical phenomenology,

progressive mathematization, self-developed models, using contextual problem, using model or bridge with vertical instrument, using student contribution, interactivity, integrated by the topic to other study (Zulkardi, 2002). Process of development learning instruction covers two steps which are preliminary, and formative evaluation.

On phase preliminary, a mathematics SMP curriculum analysis conducted and obtained by result of analysis that is :

Standard of competency : 5. Comprehending the nature of cube, cuboid, prism, pyramid, and also determine its size measure.

Basic competency : 5.3. calculating surface area and volume of a cube, cuboid, pyramid and prism .

Next step is designing a prototype that is based on principles and characteristics PMRI, namely: guided reinvention and didactical phenomenology, progressive mathematization, self-developed models, using contextual problems, using a model or a bridge with a vertical instrument, using the contributions of students, Interactivity, integrated with other learning topics (Zulkardi, 2002).

The second step is formative study. This phase was executed through self evaluation, expert review, one to one, small group, and the field test.

a. Self Evaluation

Assessment by ownself to design teaching instruction (student activity worksheet) based on PMRI made. (the first prototype )

b. Expert Review and One-To-One

Prototype I which is in the form of student activity worksheet validated by 3 experts which does aim to product a valid learning instruction cover student activity worksheet. Experts gave review towards prototype I of pursuant to format, fill and the language. Then, parallelly with experts review process, conducted also one to one. Researcher asked 2 students of SMP Srijaya Negara as tester. This phase was done as a mean to see how far the substance teach.

c. Revise

Suggestion and result of validation of experts and also the students of 'one to one' comments made basis for revise prototype I

d. Small Group

On this step, prototype II was tried out at small group, consisted of 6 students of class VIII-B SMP Islam Azzahrah 2 Palembang, it aims to yield substance learning instruction covers student activity worksheet

e. Revise

After prototype II had been tried out, students of small group asked to give response on prototype II. Pursuant to student response and result of researcher perception during learning process, prototype revised again. Result of revising prototype II expected will yield practic and valid learning instruction.

f. Field Test

After yielding prototype III expressing practic and valid student activity worksheet. Hence, executing field test conducted to see potential effect towards mathematical connection ability. Field test executed on February 28th - March 7 th 2013 in class VIII At-Tirmidzi SMP Islam Azzahrah 2 Palembang amounting to 22 students who

divided to become 7 heterogeneous groups which have members 3 until 4 people. PMRI learning process executed during 2 times meeting.

### Observation Data

Observation conducted to see student activity during PMRI learning process took place. Observation data analysed with descriptive analysis that is counted from all descriptors in each indicator which emerge divided with many descriptors got value.

Learning using PMRI approach made students got enthusiastic to learn about the surface area and volume of a cuboid. It was caused they were given the real context how to cover the cuboid with gift paper so they did find out about finding the surface area of a cuboid.

According to interviews to some students, they all confessed that they were happy "if the teacher made the learning become joyful like this so we can learn together in group, we can cooperate" (they meant the PMRI learning is joyful). And they hoped PMRI will always be used for the next meeting.

### Assess Student's Ability of Mathematical connection

Student ability of mathematical connection is how students correlate every concepts of mathematics and also correlate mathematics with another diciplines science (non mathematics). According to NCTM ( 2000: 64), mathematics connection divided to 3 clarifications, that is (a) connection between inter-topic of mathematics (b) connection between mathematics with another diciplines sciences (c) conection between mathematics and everyday life. Indicators of mathematical connection:

1. Identifying known and asked materials of the problem.
2. Using related previous topics with topics which is learned to solve problem.
3. Using related mathematics with another diciplines sciences to solve problem.

To know students mathematical connection:

$$\text{final Score} = \frac{25 \text{ activity worksheet} + 30 \text{ exercise} + 45 \text{ lastest test}}{100}$$

Students	score	Students	Score
Student 1	71,13	Student 12	69,435
Student 2	78,117	Student 13	82,6025
Student 3	88,4765	Student 14	90,6305
Student 4	66,559	Student 15	75,477
Student 5	72,8095	Student 16	95,9985
Student 6	90,9285	Student 17	72,7
Student 7	83,074	Student 18	70,8795
Student 8	79,935	Student 19	77,376
Student 9	97,875	Student 20	73,2
Student 10	87,25	Student 21	82,2
Student 11	91,059	Student 22	97

Table 1. Final Score Of Students Mathematical Connection, Class VIII-A

Final value of ability of students mathematical connection on class of VIII.A got from affiliation assess student activity workshhet, score from exercise 1 and 2, and final (lastest) tes. As a whole, more than 80% student getting final value < 90 getting not really good value on exercise 2 and final tes. Following its formulation.

Student 1 getting value 71,13, because of his value 'fall' in exercise 2 and final tes. Student 2 only has 'problem' on final tes while to assess student activity worksheet,

practice 1 and 2 have very good. All value which got student 3 have very good include; worksheet value, exercise 1 and 2, and final tes, so that got a final value of mathematical connection ability 88,48. Student 4, practice value 1 and 2 still less, for lastest tes value which got in category enough, because of that, final value is 66,56. Student 5, getting 'bad' score at exercise 2 so that dinal score id dissatisfactory achievement. Student 6, have very good include;cover all value. Student 7, exercise value 2 less but good on final test. Student 8, same as student 7 however difference at final test which determining due to its wight 45% on calculating the final score is the biggest wight. Student 9 have very good. Student 10 also have good include;cover all value. So also with student 11, also very good mathematical connection.

At exercise 2 and final tes which less make final value of mathematical connection ability of student 12 not too good ( enough). Student 13 and 14 have good and very good include; value of worksheet, exercise and final tes. Student 15 getting value which not too satisfying of final test, because of wight of final tes ( 45%) representing biggest wight among practice wight (30%) and wight LKS ( 25%) making final value of mathematical connection ability not too good. Student 16 getting final value of connection ability very good. Student 17 and 18 also ' fall' on exercise 2 and final test. Student 19 getting value which not too good on final test so that the final value not too gratify. Student 20 ' falling' on doing exercise 2 and final test while student 21 only ' fall' of final tes. For student 22 have very good the final value of mathematical connection ability because of no bad value on doing worksheet, exercise and final test.

## CONCLUSION

This Research yields product that is in the form of student activity worksheet( LKS) based on PMRI approach and have been tried out at students of class VIII.A in SMP Islam Azzahrah 2 Palembang. Pursuant to solution and research result, hence obtained bya conclusion there are:

1. Learning instruction covers student activity worksheet (LKS) of surface area and volume developed based on PMRI approach categorized practic and valid. valid based on pursuant to content, language, and according to context used by students in process 'one to one' and practical that learning instruction is convenient and easy for student in using the student activity worksheet in process of 'small group'.
2. This research yield learning instruction (student activity worksheet) which having potential effect that is:
  - a. Students got enthusiastic and active when studying used PMRI approach
  - b. According to final value of students seen from mathematical connection aspect that students were having trouble to solve the problem through correlating mathematics and another diciplines science (the third indicator) specifically on problems of lastest test number 3. Also, how students did correlate related previous topics with the learned (the second indicator) for the second problem of the lastest test also isn't really satisfying. Proven by some interviews to the students that have wrong answers on the 2nd problem, they evenly told, that they forgot about the materials of the previous topic in solving the problem. So for the first indicator, there is no crucial trouble to identify known and asked materials of the problem for students.



### Suggestion

1. For the teacher, expected to apply PMRI approach in class so that can train students ability of mathematical connection in learning mathematics. Others, teacher better make students accustomed to discuss and present in learning, so the students get accustomed to give opinion to many people. Reflect on the 'teacher centered' approach implemented nowadays which isn't effective, so PMRI is suitable to innovate our learning technique.
2. For students, to make a satisfying learning achievement, it's good to keep practicing your mathematical connection ability (connection : inter-topics of mathematics, mathematics and another diciplines sciences, mathematics and everyday life so you can gain more knowledge.
3. Next researcher, can develop student activity worksheet based on PMRI approach designed to peep out students ability of mathematical connection specially for using another diciplines sciences to solve mathematics problem.

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