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**PROCEEDING**  
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**FACULTY OF EDUCATION  
STATE UNIVERSITY OF MALANG**

**theme:**

**Improving the Quality of Education and Training  
through Strengthening Networking**

**INTERNATIONAL CONFERENCE  
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**2nd ICET Theme:  
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**Malang, 4-6 November 2016  
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## PREFACE

The International Conference on Education and Training (ICET), Faculty of Education, State University of Malang, 2016 took place in Malang, Indonesia, between 4 and 6 November, 2016. ICET is an international conference covering research and development in the field of education and training. The conference aims at creating a forum for further discussion for an education and training field incorporating a series of issues and/or related to quality improvement in education and training. Therefore, the call for papers was addressed to scholars and/or professionals of the field of education and training. Driven by the fast-paced advances in the education field, this change is characterized in term of its impact on the education implementation.

During the conference, 4 keynotes speakers were held in order to advance and contribute to specific research areas in the field of education. More than 250 pre-registered authors submitted their work in the conference. The ICET 2016 finally accepted and hosted 200 original research papers. All papers submitted to the conference were reviewed using a double-blind peer review process. The conference committee decided about the acceptance or not of the submitted papers, with the contribution of competence and expertised reviewers.

We would like to thank all members that participated in any way in the ICET 2016, especially: (a) the Inderscience Publisher for supporting and receiving the selected papers to be published as the Special Issues Edition of the International Journal of Innovation in Education; (b) the Co-organizing Universities and Institutes for their support and development of a high-quality conference; (c) the members of the scientific committee that honored the conference with their presence and provided a significant contribution to the reviewer of papers as well as for their indications for the improvement of the conference; and (d) all members of the organizing committee for their willing to organize the conference as good as possible.

Dean,

Prof. Dr. Bambang Budi Wiyono, M.Pd



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## PRIMARY TEACHERS' ABILITY IN DESIGNING AND SOLVING CONTEXTUAL PROBLEMS IN DIVISION WHOLE NUMBERS

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### ABSTRACT

*This study was aimed to describe primary school teachers' ability in designing and solving contextual problems especially in division of whole numbers. This research was held in KanisiusDemangan primary school in Yogyakarta with the subject 14 teachers. Data collection was gathered in the form of the written test at the end of the workshop. The test showed that there were 8 teachers that had good ability in designing and solving contextual problems in division whole numbers, 3 teachers not written the contextual problem, and the other, 3 teachers had study to design contextual problem in division whole numbers. From the analysis, we found that a teacher is struggling in understanding the concept of the division on whole numbers and there were 5 strategies used by the teachers in solving the problems. The strategies are multiplication invers, using horizontally repeated subtraction, vertically repeated subtraction, and modeling the contextual problem using pictures that closely related to the context.*

**Keywords:** primary teachers, ability in designing and solving problem, contextual problems, division.

Nowdays, the quality of mathematics educations in Indonesia needs to be improved. The result of PISA and TEAMS shows that the competence of students in mathematics is still lacking. Indonesia was in rank of 64 from the 65 participating countries in 2012 and in 2015 Indonesia was in rank 69 from the 75 countries participating in PISA. PISA evaluates literacy skills, the skill to solve contextual problems in mathematics and application problems in mathematics. From the result indicates that ability in solving contextual problems in mathematics is still lacking.

TIMSS evaluates mathematics ability on 8th grade student in the content of number, algebra, geometry, data and change. One of competence in number especially whole numbers is compute (+, -, ×, ÷) with whole numbers (Gronmo, et all, 2015). The result of TIMS shows that mathematics achievement of Indonesia students was in rank 36 from the 49 countries in 2007 and in 2011 was in rank 39 from the 43 countries participating in TIMSS. We can say that ability in numbers domain is still lacking.

There are many factors that influence the lacking of ability both on numbers ability or literacy ability that include ability to solve contextual problems. One of the factors is teacher, especially primary teachers. Campbell, et all (2014) said that mathematics ability and pedagogy ability of primary teachers have positive correlation with student achievement in mathematics. Primary teachers teach basic competence in mathematics for the children, they formalize thinking pattern in

mathematics to the students. Because of that, it is necessary to improve mathematics skill of primary teachers.

The result of study that done by Hadi (2002) shows that developing model to improve teacher's professionalism is introducing a new approach in learning mathematics that can enrich knowledge and increase teachers ability in mathematics. That approach is PMRI. Learning trajectory in PMRI is illustrated as ice-berg that concludes of mathematical world orientation, model material, building stone; number relations, and formal notation (Atmini, 2010). Mathematical world orientation means using contextual or daily problems to construct mathematics thinking. The solving of that problem is using model material, number relations, and formal notation. Based on the reasons, this study aims to describe primary school teachers' ability in designing and solving contextual problems especially in division of whole numbers. KanisiusDemanganBaru primary school wants to improve students achievement in mathematics, so this study is held in KanisiusDemanganBaru primary school.

PMRI is adapted from RME, Realistic Mathematics Education that occurred in Netherland. Realistic mathematics education is founded by Freudenthal. RME take starting point in the activity of mathematics, whether pure or applied mathematics. Activity of mathematics is as an activity of problem solving, looking the problems and organizing a subject matter-whether mathematical matter or data from reality. Marpaung... said that Learning trajectory in PMRI is illustrated as ice-berg that concludes of mathematical world orientation, model material,

building stone; number relations, and formal notation (Atmini, 2010).

The key process and goal for realistic mathematics education is mathematizing, this can involve mathematizing mathematics and mathematizing reality. Realistic mathematics education elaborates three key principles that can be seen as heuristics for instructional design. They are 1) reinvention/mathematizing, 2) didactical phenomenology, and 3) self-developed models (Gravemeijer, 1994).

Reinvention/mathematizing similar solution procedures create the opportunity for the reinvention process. Reinvention process can be look at figure below.

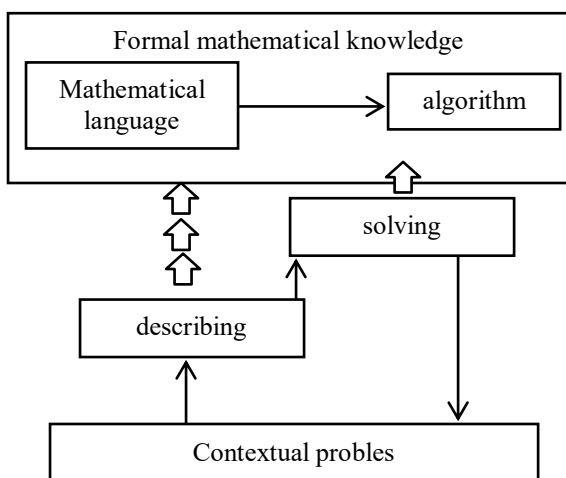


Figure 1. Reinvention (Gravemeijer, 1994: 94)

According to didactical phenomenology, situations where a given mathematical topic is applied are to be investigated to reveal the kind of applications that have to be anticipated in instruction and to consider their suitability as points of impact for a process of progressive mathematics (Gravemeijer, 1994: 90). Self-developed models play in bridging the gap between informal knowledge and formal mathematics.

The three principles of realistic mathematics education approach explain that to learn a material such as long division is based on student activities. First, division is associated with real-life activities, here students bring on their situation knowledge and strategies and apply them in the situation. This step is not boundaries by procedure. The next, students create a model of this situation, division problem is modelled by repeated subtraction. The last, the students write algorithm for long division.

From the explanation of realistic mathematics education, PMRI also based on the

mathematics philosophy that mathematics as human activity. Similar with in realistic mathematics education, in PMRI a problem is called realistic problem if that problem can be imagine by students. PMRI approach is a method used in teaching and learning mathematics by associating learning to imaginable situation by students or to daily life problems (Wijaya, 2011).

**METHOD**

The subject is 14 KanisiusDemanganBaru primary teachers. The teachers are not only mathematics teacher but also class teachers. This is a qualitative research and data collection was gathered in the form of the written test. Primary teachers' ability in designing and solving contextual problems in division of whole number is based on PMRI approach which to explain division whole number must be presented in contextual problems in real life before be solve with many strategies. Based on PMRI, there are many strategies to solve division problem. There are informal procedures (dividing on a geometrical basis, distributing one by one, grouping, using multiplications fact) and formal procedures (repeated subtraction and long division). Data are analyzed qualitatively by data reduction, data presentation, and conclusion (Miles and Huberman, 1994).

**FINDING AND DISCUSSION**

After primary teacher school is introduced about PMRI approach, they do test to measure ability in designing and solving contextual problems. Based on PMRI theory, teaching and learning must be associated with imaginable problems or daily life (Wijaya, 2011). First problem in test is how to design contextual problem  $48 \div 6$ . After designing in contextual problem, teachers solve the problem. There are many solutions wrote by teachers.

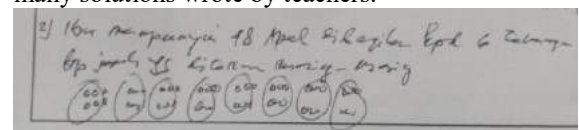


Figure 2. Error Sample in Modeling Contextual Problem in Division

Figure 2 shows that teacher has problem in solving contextual problem especially modelling the problem. Modelling the problem is unstructured procedure to make imaginable problem for students. The correct one, division number i.e 6 must illustrate the number of circle and not number of apple. Besides that, teacher only write the contextual problem without solve the problem.

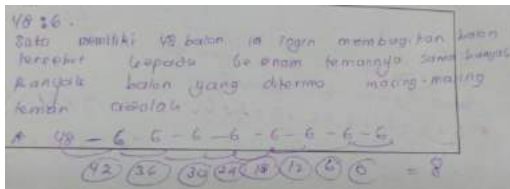


Figure 3. Correct Sample in Designing Contextual Problem in Division

Figure 3 shows that teacher can design the contextual problem and solve the contextual problem. The contextual problem solve by horizontally repeated subtraction strategy. 6 other teachers, 3 of them don't write the contextual problem and 3 of them had study to design contextual problem as a Figure 3. The similar error also is found on answering other division problem in figure below.

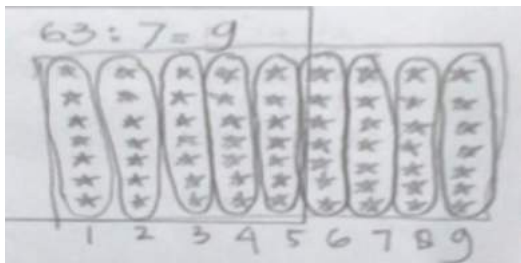


Figure 4. Other Error Sample in Modelling Problem

After teacher designing the division problem to contextual problems, the teachers solve the contextual problems. Data test show that there are many strategies used to solve the division problems. The strategies are horizontally repeated subtraction, vertically repeated subtraction, long division, and using multiplication invers. The strategies can be seen in many figures below.

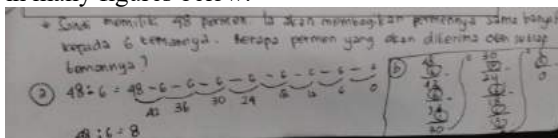


Figure 5. Horizontally and Vertically Repeated Subtraction Strategies

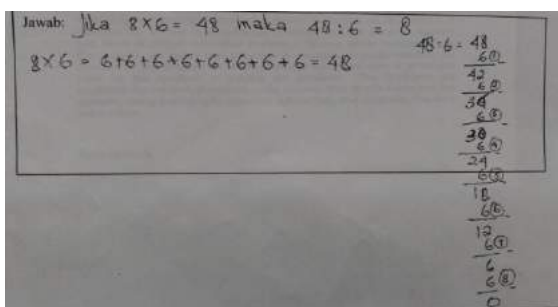


Figure 6. Vertically Repeated Subtraction Strategy and Multiplication Invers Strategy

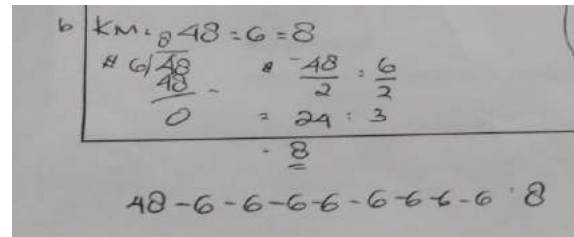


Figure 7. Long Division Strategy

Although many teachers can write the solution in division problems, many of them only write a strategy to solve contextual program. The completely data about primary teachers' ability in designing and solving contextual problem in whole number can be seen in table below.

Table 1. Completely Data of Primary Teachers' Ability

	Ability in Design CP			Strategies to solve CP
	Correct	Incorrect	No Solution	
T1			√	-
T2	√			Long Division(1), Horizontally Repeated Subtraction(2)
T3			√	Multiplication invers(3), Vertically Repeated Subtraction(4)
T4		√		Modelling (5)
T5		√		Not Correct in modelling (5)
T6			√	-
T7		√		Vertically Repeated Subtraction (4)
T8	√			Horizontally Repeated Subtraction(2)
T9	√			
T10	√			-
T11	√			Vertically and Horizontally Repeated Subtraction (2) and (4)
T12	√			Modelling (5)
T13	√			Vertically Repeated Subtraction (4)
T14	√			-

From the table, researcher can't conclude the ability of T1 and T5 in design and solving contextual problem of division. But there is one teacher that misunderstanding in solving division problems.

### CONCLUSION

The test showed that there were 8 teachers that had good ability in designing and solving contextual problems in division whole numbers, 3 teachers not written the contextual problem, and the other, 3 teachers had study to design contextual problem in division whole numbers. From the analysis, we found that a teacher is struggling in understanding the concept of the division on whole numbers and there were 5 strategies used by the teachers in solving the problems. The strategies are multiplication invers, using horizontally repeated subtraction, vertically repeated subtraction, and modeling the contextual problem using pictures that closely related to the context.

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# 2<sup>nd</sup> ICET

## CERTIFICATE OF APPRECIATION



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Awarded to

**HONGKI JULIE**

Who has presented the paper:

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DIVISION WHOLE NUMBERS  
in the 2<sup>nd</sup> ICET**

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# Universitas Negeri Malang

**Malang, 7<sup>th</sup> November 2016**



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