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Development Guided Reinvention Principle In PMRI Approach In Use The Teacher Guide In Elementary School

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Abstract

Since 2001, four teacher education institutes (LPTK) are developing a localized, Indonesian version of realistic mathematics education. It is known as PMRI, Pendidikan Matematika Realistik Indonesia. PMRI is an adaptation of Realistic Mathematics Education (RME) as it has been developed by the Freudenthal Insitute in Netherlands. Since 1968, Dutch researchers, developers and educational designers have been working on the ongoing development of RME.

Considering the number of schools in the country, the scale of the pilot project is small. For a large scale implementation of PMRI, the PMRI movement goes into a new phase while maintaining the basic principles. The pilot model uses close cooperation between teacher educators and teachers and a bottom-up approach, meaning teachers, principals, and to some extent parents, are involved in the various stages of development. However, in large scale dissemination, sustainable top-down support is required. The challenge then is to find a dissemination strategy that keeps the principles of the movement.

The partners agreed upon two strong pillars under the dissemination strategy,i.e

a. Establishment of an expanding network of local PMRI resource centers at each participating LPTK (later, called P4MRI) as starting points for further dissemination.
b. Developing teaching materials based on classroom experience and classroom research.

As far as I know, PMRI team does not do a research about teacher guide. So, as a writer for the PMRI book (the student and teacher book), I have two questions for teacher that can the teacher book help teachers to teach mathematics with PMRI approach? and can the teacher book help teachers to develop the PMRI characteristics?

I want to know how students in grade 1 to solve problems about addition, subtraction, and mixed between addition and subtraction. Because of that reason, I made a student sheet. The content of the student sheet are problems about how many passenger in a train which moves from one station to another. I used the PMRI approach to develop the student sheet.

I develop a teacher guide which help the teacher to use the student sheet and to do the teaching learning process with the PMRI approach. The content of the teacher guide are teaching learning goals, mathematics concepts, tools and materials, time, and student and teacher activities.

At 8 October 2010, I get an opportunity to try out the student sheet and the teacher guide on class II C, Kanisus. Based on my observation, there are two strategies which are used by students to solve the problems in the student sheet, that is

1. Stacked to bottom (almost every students used this strategy);
2. "Menghitung ke samping" (only one student used this strategy).

One of indicators from the guided reinvention principle in PMRI approach is that students can find a new concept or strategy from a teaching learning process which is followed by the students. Base on my observation in the classroom, the indicator from the guided reinvention principle in PMRI approach does not appear on the lesson of that day. So, I can say that in the teaching learning process on that day the guided reinvention principle in PMRI approach does not appear.

From my explanation, there are some problems which are solved by the research, i.e.

1. How is a teacher's understanding about the guided reinvention principle in PMRI approach on a primary school which is used PMRI approach?
2. How the guided reinvention principle in PMRI approach can be appeared by a teacher on a primary school which is used PMRI approach?
3. What are indicators that a teacher can appear the guided reinvention principle in PMRI approach on a primary school which is used PMRI approach?

4. How is a teacher understanding about the mathematics concepts which are found by students in the teaching learning process which uses PMRI approach?
5. How is the process to design a teacher guide which helps teachers to appear the guided reinvention principle in PMRI approach on a primary school which is used PMRI approach?

If I will answer those research questions, then I will do a qualitative and design research. I will develop a valid, practice, and effective teacher guide which helps teachers to appear the guided reinvention principle in PMRI approach on a primary school which is used PMRI approach when I do a design research.

Key words: student book, teacher book, PMRI,and a guided reinvention principle.

A. Background

Since 2001, four teacher education institutes (LPTK) are developing a localized, Indonesian version of realistic mathematics education. It is known as PMRI, Pendidikan Matematika Realistik Indonesia. PMRI is an adaptation of Realistic Mathematics Education (RME) as it has been developed by the Freudenthal Insitute in Netherlands. Since 1968, Dutch researchers, developers and educational designers have been working on the ongoing development of RME.

The first step which was taken by PMRI team fixed over the teaching learning process in elementary schools. One of the efforts would be done by this team made students sheet and teacher guides which appropriate with PMRI philosophies.

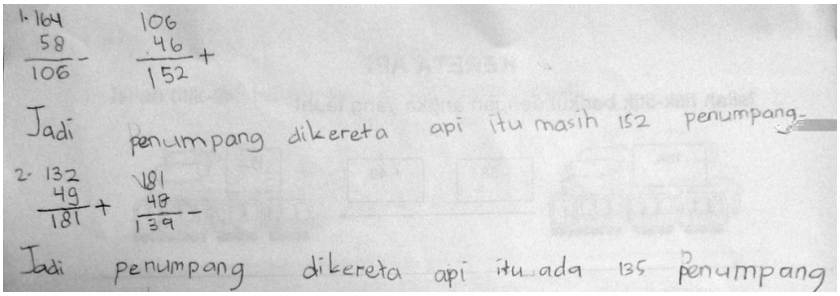
As far as I know, PMRI team does not do a research about teacher guide. So, as a writer for the PMRI book (the student and teacher book), I have two questions for teacher that can the teacher book help teachers to teach mathematics with PMRI approach? and can the teacher book help teachers to develop the PMRI characteristics?

I want to know how students in grade 2 to solve problems about addition, subtraction, and mixed between addition and subtraction. Because of that reason, I made a student sheet (look figure 1). The content of the student sheet are problems about how many passenger in a train which moves from one station to another. I used the PMRI approach to develop the student sheet.

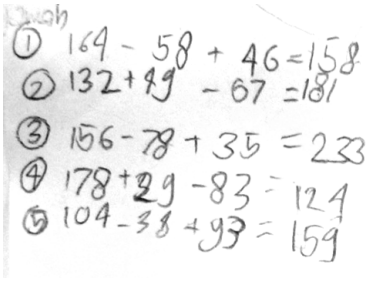
I develop a teacher guide which helps the teacher to use the student sheet and to do the teaching learning process with the PMRI approach (look figure 2). The content of the teacher guide are teaching learning goals, mathematics concepts, tools and materials, time, and student and teacher activities.

At 8 October 2010, I get an opportunity to try out the student sheet and the teacher guide on class II C, Kanisus. Based on my observation, there are two strategies which are used by students to solve the problems in the student sheet, that is

1. Stacked to bottom (almost every students used this strategy);



2. "Menghitung ke samping" (only one student used this strategy).



One of indicators from the guided reinvention principle in PMRI approach is that students can find a new concept or strategy from a teaching learning process which is followed by the students. Base on my observation in the classroom, the indicator from the guided reinvention principle in PMRI approach does not appear on the lesson of that day. So, I can say that in the teaching learning process on that day the guided reinvention principle in PMRI approach does not appear.

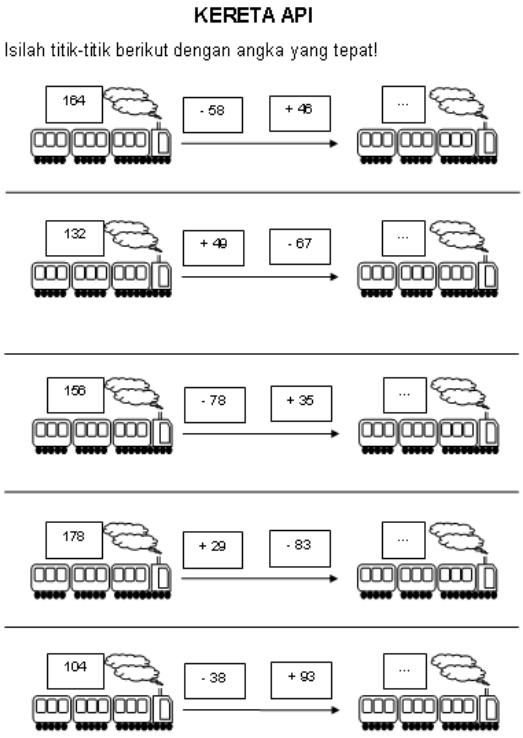


Figure 1. A Student sheet was developed by writer

Lembar Petunjuk Guru Pertemuan 3

1. Tujuan: siswa dapat menjumlahkan dan mengurangkan dua/lebih bilangan.
2. Konsep Matematika: penjumlahan dan pengurangan.
3. Alat dan Bahan: sedotan, dan beberapa gelas.
4. Waktu: 2 jam pelajaran (70 menit).
5. Aktivitas siswa dan guru:
   a. Tanyakan kepada siswa, apakah ada di antara siswa yang mempunyai pengalaman naik kereta.
   b. Minta seorang siswa menceritakan pengalamannya naik kereta. Guru menekankan pada proses naik dan turunnya penumpang. Sebelum siswa menceritakan pengalamannya, guru meminta siswa yang lain untuk memperhatikan cerita dari siswa tersebut.
   c. Berikan masalah berikut: Banyak penumpang yang naik kereta Prameks dari stasiun Tugu ada 170. Kereta Prameks berhenti di stasiun Klaten. Di stasiun Klaten turun 27 penumpang,dan naik 14 penumpang. Ada berapa penumpang di dalam kereta Prameks ketika kereta tersebut meninggalkan stasiun Klaten?
   d. Minta siswa menyelesaikan masalah tersebut.
   e. Minta seorang siswa untuk menjelaskan jawabannya. Sebelum siswa menjelaskan jawabannya, guru meminta siswa yang lain untuk memperhatikan jawaban dari siswa tersebut.
   f. Minta siswa yang lain untuk menjelaskan jawabannya, jika strategi penyelesaiandari siswa tersebut berbeda dari siswa yang sebelumnya.
   g. Minta siswa mengerjakan lembar kerja siswa secara individu.
   h. Minta beberapa siswa yang menjawab dengan jawaban yang berbeda untuk menjelaskan strategi dan jawabannya. Sebelum siswa menjelaskan jawabannya, guru meminta siswa yang lain untuk memperhatikan jawaban dari siswa tersebut.
   i. Diskusikan jawaban siswa.

Figure 2. A teacher guide which helps the teacher to use the student sheet and to do the teaching learning process with the PMRI approach was developed by writer

B. Research Questions

From my explanation, there are some problems which are solved by the research, i.e.

1. How is a teacher's understanding about the guided reinvention principle in PMRI approach on a primary school which is used PMRI approach?
2. How the guided reinvention principle in PMRI approach can be appeared by a teacher on a primary school which is used PMRI approach?
3. What are indicators that a teacher can appear the guided reinvention principle in PMRI approach on a primary school which is used PMRI approach?
4. How is a teacher understanding about the mathematics concepts which are found by students in the teaching learning process which uses PMRI approach?

5. How is the process to design a teacher guide which helps teachers to appear the guided reinvention principle in PMRI approach on a primary school which is used PMRI approach?

C. PMRI

There are three basic tenets of RME, namely guided reinvention, didactical phenomenology and the mediating models principle. All these tenets are inspired by Freudenthal's view of '*mathematics as human activity*''. This notion places a heavy emphasis on students' activity in their reconstruction of mathematical ideas and concepts under the guidance of the teachers (R. K. Sembiring, Sutarto Hadi, and Maarten Dolk, 2008).

The first principle of RME is called "guided reinvention and progressive mathematization" (Gravemeijer, 1994 in Dian Armanto, 2002). The pupils should be given the opportunity to experience a process of reconstructing or reinventing mathematical ideas and concepts through encountering many varieties of contextual problems. This principle assumed that knowledge can not be instructed by the teacher, but it can only constructed by the learners (Dian Armanto, 2002).

The second principle of RME relates to the idea of didactical phenomenology (Freudenthal, 1983 in Dian Armanto, 2002: 32). The didactical phenomenology means that the contextual problem and situation chosen to introduce the mathematics topic should be in favor of two purposes, i. e. to reveal the kind of applications that have to be anticipated in instruction and to consider their suitability as an impact for a process of reinvention and progressive mathematization (Dian Armanto, 2002).

The third principle of RME is found in the role of which the emerged model plays in bridging the gap between informal knowledge and formal mathematics (Gravemeijer, 1994, Dian Armanto, 2002). In RME, models are presented and developed by the pupils themselves. They enhance the models by using their former models and knowledge about mathematics. At first the model is used as the model of situation they encounter in the problem that is familiar with them. By the process of formalizing and generalizing, the model is developed and used as a model for mathematical reasoning until they acknowledge of the formal understanding of mathematics.

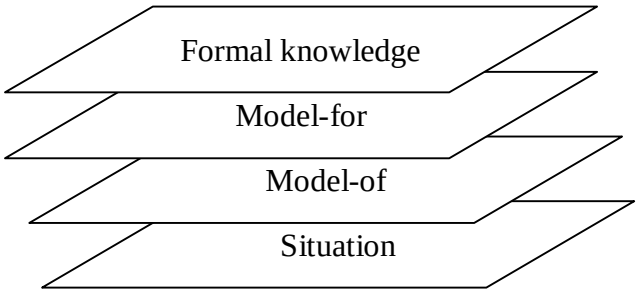


Figure 3. The emerged model of RME

Gravemeijer noted that it is not always possible to have students reinvent models on their own. Sometimes, models are given to students but in that case these models should support the transition of students' thinking about more formal mathematics (R. K. Sembiring, Sutarto Hadi, and Maarten Dolk, 2008).

D. The PMRI Influence

Furthermore, research conducted by Hadi (2002) indicated that Indonesian teachers could implement the RME materials after they were properly trained. There were noticeable changes in teachers' lesson structure during and after in-service training. The results of classroom observations during classroom practices indicated teachers' ability to translate RME principles into classroom lessons. With the support of RME exemplary curriculum materials (student's book and teacher's guide) the teachers could perform instruction that was different from their usual practice (R. K. Sembiring, Sutarto Hadi, and Maarten Dolk, 2008).

In their daily practice, teachers perform their lesson following this sequence: opening – example – exercise – closing. Their lesson structure was dominated by traditional 'chalk and talk' that put intellectual authority in the hands of the teachers, and limited students' activities to note-taking. This unfortunate nature of the 'traditional' learning process makes students into passive learners with little aptitude for mathematical thinking and reasoning (R. K. Sembiring, Sutarto Hadi, and marten Dolk, 2008).

In the classroom practice during and after the in-service training programme, teachers tried to structure their lessons by emphasing the students' learning. Although it was rather difficult because the students were used to being spoon-fed, the teachers

always asked their students to explain their thoughts, or commented on their response, or facilitated discussion (R. K. Sembiring, Sutarto Hadi, and Maarten Dolk, 2008).

A transition from a more traditional, skill-oriented approach towards a problem-based, reform approach to school mathematics in Indonesia would constitute a major and complex transformation. It would require not only the introduction of new instructional sequences and activities, but also new roles for the teacher and new social and socio-mathematical norms. It would be the teachers' responsibility to foster a problem-solving classroom culture which challenged students to move on from their current, more passive, receptive roles toward more active, participatory roles. The students would need to take the initiative, and learn to think and reason for themselves. In addition, teachers would have to learn to guide the new learning process by choosing or designing instructional tasks that generated productive mathematics thinking at any given time. They would need to organize and orchestrate whole-class discussion that helped students to think creatively. The role of the teachers would consequently need to change from an authoritarian, instruction-oriented orientation toward a more supportive, student-centered and constructivist orientation (R. K. Sembiring, Sutarto Hadi, and Maarten Dolk, 2008).

Obviously, in-service and pre-service teacher education would have to be a key component of the reform process. Co-teaching in classrooms would need to become much more commonplace, as would the production of supportive textbooks and teacher manuals. The expectation that the intended innovation would fit Indonesian education and social contexts would also be important. In this respect, an important prerequisite for success would be the development of a sense of ownership by the teachers and teacher educators who would be involved. A bottom-up approach was therefore called for, in which Indonesian teachers and teacher educators reinvented a form of realistic mathematics education that fitted Indonesian contexts and priorities (R. K. Sembiring, Sutarto Hadi, and Maarten Dolk, 2008).

Considering the number of schools in the country, the scale of the pilot project is small. For a large scale implementation of PMRI, the PMRI movement goes into a new phase while maintaining the basic principles. The pilot model uses close cooperation between teacher educators and teachers and a bottom-up approach, meaning teachers, principals, and to some extent parents, are involved in the various stages of

development. However, in large scale dissemination, sustainable top-down support is required. The challenge then is to find a dissemination strategy that keeps the principles of the movement intact (R.K. Sembiring and Kees Hoogland, 2007).

The partners agreed upon two strong pillars under the dissemination strategy (R.K. Sembiring and Kees Hoogland, 2007).

1. Establishment of an expanding network of local PMRI resource centers at each participating LPTK (later, called P4MRI) as starting points for further dissemination.
2. Developing teaching materials based on classroom experience and classroom research.

E. Methodology

If I will answer those research questions, then I will do a qualitative and design research. I will develop a valid, practice, and effective teacher guide which helps teachers to appear the guided reinvention principle in PMRI approach on a primary school which is used PMRI approach when I do a design research.

Some descriptions will be made by researcher to use a qualitative research, i.e.:

1. Teacher's understanding about reinvention principle in PMRI.
2. What are steps which are done by teachers to arise reinvention principle in PMRI.
3. Indicators that a teacher arises reinvention principle in PMRI.
4. Teacher understanding about concepts which will be found by student in teaching learning processes which use PMRI approach.

F. Location and Research Subjects

Subjects in this research are two grade one teachers and their students. Steps will be done by researcher when I will choose teachers as research subjects, i.e.:

1. Make an interview manual which will be used to dig teachers knowledge about PMRI principle, addition, mathematics concepts which relate with addition, strategies which are used by teacher to solve problems about addition.
2. Interview some teachers.
3. Choose two teachers who will be become research subjects.
4. Make description about teacher understanding about reinvention principle in PMRI.

5. Make description about teacher understanding about addition, mathematics concepts which relate with addition, strategies which are used by teacher to solve problems about addition.

If I am not find two teachers as research subjects, then I will give a workshop for some teachers about PMRI. After the workshop finish, I will interview the teachers who follow the workshop to find two teachers as research subjects.

G. Steps to Make The Description about Steps to Arise Reinvention Principle in PMRI

In outline, steps to make the description about steps to arise reinvention in PMRI, i.e.:

1. Make indicators about reinvention principle in PMRI.
2. Make an observation sheet.
3. Make an interview manual to dig the impact from teaching learning processes which are done by teacher concerning to develop student concepts.
4. Make observations and recordings about teaching learning processes to observe how the teachers arise reinvention principle in PMRI.
5. Make observations, interviews, recording about students to observe the teaching learning impact concerning to develop student concepts.
6. Make transcriptions.
7. Make descriptions about steps which are done by teachers in grade one to arise reinvention principle in PMRI.
8. Make descriptions about student knowledge which are constructed by students.

H. Steps to Develop The Student Sheet and The Teacher Guide

In brief, there are four big steps which will be done by researcher to develop the student sheet and the teacher guide, i.e.:

1. Make PMRI teaching learning syntaxes which develop guided reinvention principle.
2. Design teaching learning plan which appropriate with the syntaxes.
3. Try out the design in two grade one classes.
4. Do retrospective analysis.

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