

## WRITING BOOKS ON MATHEMATICS FOR PRIMARY SCHOOL ON A PMRI APPROACH

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### Abstract

Indonesian Realistic Maths Education (PMRI) started in Indonesia since 2001 and slowly spreading throughout the rest of the country. The PMRI Team in 2007 started to think about developing a mathematics book for primary school which fulfils the teaching material standards. These standards are: 1) Teaching materials are in line with curriculum; 2) Teaching materials use realistic problems to motivate students and to help students learn mathematics; 3) Teaching material intertwine mathematics concepts from different domains to give opportunities for students to learn a meaningful and integrated mathematics; 4) Teaching materials contain enrichment materials to accommodate different ways and levels of students' thinking; 5) Teaching materials are presented in such a way to encourage students to think critically, creative, innovative and stimulate students' interaction and cooperation. Subsequently a team of writer consisting of four members were formed. These members come from four Teaching Force Educational Body (LPTK): Universitas Syah Kuala, Universitas Negeri Medan, Unversitas Sanata Dharma and Universitas Surabaya. As the program progresses, the team of writer adds four primary school teachers. The writing of the book is based on the cycle of research and development. The first step was to analyse the curriculum. Basic competencies in the curriculum are broken down into learning material at every level. The material for every level is further broken down into two semesters. Each semester is further divided into four periods with twelve sessions each. We developed a two page learning material for each of these sessions. This is to ensure that it will be easier for teaChers to teach the students. The next steps are to write, to validate and to test the books. Validation was done by mathematicians and mathematics educator. After validation, the book is revised based on their input. The revised book is then tested in a classroom setting by the teachers. The test's result is then used by the writers to complete another round of revision. Up to now, we have the material for teachers' guide and students book for Primary 1 to 3; although the related books for Primary 3 have yet to be printed.

**Keywords:** Mathematics Book, Primary School, Indonesian RME.

### INTRODUCTION

Indonesian Realistic Mathematics Education (PMRI) was developed in Indonesia since 2001. PMRI is a movement towards improving the quality of learning in schools. PMRI adapted the Realistic Mathematics Education (RME) which was developed in the Netherland based on Hans Freudenthal's idea (Suryanto, 2010). Hans Freudenthal considered that mathematics is human activities. Hence in learning mathematics, students have to actively build their own knowledge.

Since developed in Indonesia, PMRI has received positive responses from both teachers and decision makers. Today, PMRI has developed in almost all part of Indonesia. TO ensure that the development of PMRI is on the right track, the PMRI Team feels that there is a need to develop a few standards. They are: 1) PMRI Teacher Standards; 2) PMRI-based Learning Standards; 3) PMRI Teaching Material Standards; 4) PMRI Lecturer Standards; 5) PMRI Workshop Standards; and 6) PMRI Research and Development Centre Standard. Among these standards, the most crucial one is the writing of the books for Primary School (SD). This is why the PMRI formed a team to develop mathematics book for primary school students. This team consists of four lecturers representing four Teaching Force Educational Bodies (LPTKs). These LPTKs are: Universitas Syah Kuala (Unsiyah), Universitas Negeri Medan (Unimed), Universitas Sanata Dharma (USD), and Universitas Negeri Surabaya (Unesa). In the subsequent development this team felt that there is a need to involve a few primary school teachers. Their involvement is needed because these teachers know better the characteristics of primary school students who will be using these books. There were four teachers involved, one from SD Antasari Banjarmasin, two from SD Al-Hikmah and one from SD Laboratorium UNESA.

**DISCUSSION**

The mathematics book with PMRI approach for SD was written based on developmental steps on Design Research. These development includes: 1) Problem Analysis; 2) Planning; 3) Realisation; 4) Validation and 5) Implementation. A micro research cycle was used for validation and implementation. The followings are the steps in developing books for Primary 2 students:

In the problem analytical phase the curriculum is scrutinised. This scrutiny is done to know the basic competencies (KD) which students must have on their respective levels. This is done by creating a learning trajectory. These KDs are then divided into the various mathematics topics. Based on the analysis, we found that the topics for Primary 2 involve: numbers, numbers operations, plane geometry, solid geometry, length measurement, time measurement, weight measurement and data manipulation. As the materials in the curriculum are the minimum, writer felt the need to increase orientation material. The added material is needed to support the development of spatial concept in students. The following is the learning trajectory for numbers.

**Table. 1. Learning Trajectory for Numbers in Primary 2**

Topics	Period 1	Period 2	Period 3	Period 4	Period 5	Period 6	Period 7	Period 8
Numbers	- Understanding numbers up to 200  - Review additions up to 100	- Counting on numbers line  - Counting up to 200	- Counting with certain structures (10,20, 30,...; <500)	- Counting with a structure of 5  - Structure on	- Understanding numbers up to 500  - Counting with number cards and	- Counting on an empty number line (number	- Counting up to 500  - Step counting	- Numbers sequence up to 500



	- Counting with beads and number cards	- Step Counting up to 100  - More than and less than relations hip		coins (100 ,200, 500)	beads  - More than and less than relationshi p up to 500	positio n)		
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The split into eight periods in a year is based on the consideration that the number of effective weeks is a year is between 34 – 38 weeks. We then calculated how many sessions is required for each topic. The scrutiny of the curriculum is meant to fulfil Standard 1 of teaching materials which says that *teaching materials are in line with curriculum*.

On the planning stage, writers agreed that each semester is split into four periods and each period is further divided into twelve sessions. For each session, we developed two pages worth of teaching material. This is to ensure that it is easier for the teachers to teach and easier for the students to learn. In a session, both teachers and students do not have to flip open books. They can concentrate on these two pages. Writers also planned that the contents of the book is using 2 – 1 – 2 – 1 pattern. The meaning of this pattern is: 2 sessions for numbers, 1 session for geometry, 2 sessions for numbers and 1 session for data manipulation. Other than that, writers also agreed that the writing of teaching material has to pay attention to the context around students and that the activities planned are those which students are familiar with. As much as possible the topics are also inter-related. This is intended to fulfil Standard 2 and 3 of teaching materials, i.e. *teaching materials use realistic problems to motivate students and to help students learn mathematics and teaching material intertwine mathematics concepts from different domains to give opportunities for students to learn a meaningful and integrated mathematics*. In the realisation stage, writers split the writing tasks based on topics. This is to ensure the coherence of writing and also to prevent overlapping. Written results are then arranged in the previously agreed patterns.

Once the book is arranged, validation is performed. There are two validations: internal and external. Internal validation is to ensure the coherence of the material and the appropriateness of activities. This is done by the Writers Team. A revision is done based on the result of validation to ensure the coherence of the material and add, reduce or improve activities.

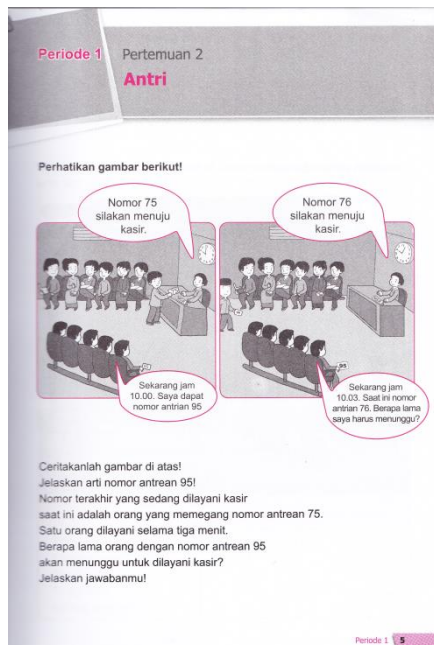
Subsequently, an external validation is conducted. This is done to validate content and structure. Content validation is to ensure the correctness of the material while structure validation is to ensure the appropriateness of the book for Primary 2 students. Hence, the validators are chosen from mathematicians and senior teachers in Primary 2. This validation and revision is repeated; resembling smaller cycles.





In the picture on the left, we are showing a sample page of a students' book. In this picture, it can be seen that to put a number cards on a number line students are assisted with a string of beads. According to the picture, students can imagine that to the left of the number 20, there are 20 beads. Hence when students put the number cards, there are something concrete which he can think about. Beads are regular objects which the students encounter. They are used to seeing a string of beads in the form of necklace or bracelet.

Graph1. A sample of students book using Activities with materials common to students



To fulfil Standard 4 & 5 which says : *teaching materials contain enrichment materials to accommodate different ways and levels of students' thinking; and Teaching materials are presented in such a way to encourage students to think critically, creative, innovative and stimulate students' interaction and cooperation*, we present below a sample in the students book. This material is intended to enrich students and to encourage students to think critically, creative, innovative and stimulate students' interaction and cooperation. In the teachers' book, it is explained that to solve this problem, students can discuss with his friends and can use various methods; e.g. subtracting first then add, or with a number line, This material is also using context which students find in their daily living. Other than that, this material is also linking the topic on numbers with time measurement.

Graph 2. An example of students book which intertwine and encourage students to think critically, creative, innovative and stimulate students' interaction and cooperation.

In the implementation stage, teachers conduct learning using teachers' book which also include students book. During learning, teachers just need to bring teachers' book. After the learning session, teachers write a report of completion of learning and provide feedback to improve the book.

**CONCLUSION**

From the above explanation, we can say that design research is very appropriate to be used to develop a book. The book is fulfilling the learning standards developed by PMRI Team.

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