NUMBERS AND OPERATIONS AT PRIMARY SCHOOLS: PROBLEMS AND REFORMATION ALTERNATIVES

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ABSTRACT

This paper is a conceptual paper of a result of literature reviews, observations, reflections, and opinions on the numbers and operations both at preservice primary school teachers and at primary school teachers and students. The opinion expressed in this paper was based on the comparison between literatures review and the actual need of today's mathematics at school. The ideas are strengthened by observation, discussion with mathematics lecturers in primary teacher education department, preservice primary school teachers, and primary school teachers. The results of observation were also compared to the previous research findings at local and international levels. From all source of information, it suggests that students' performance on numbers and operations is still far from expectation. The consequence of these phenomena is the need for reformation on both the teaching approaches and the taught contents.

Keywords: numbers, operations, preservice primary school teachers

INTRODUCTION

Teaching and learning at primary school in Indonesia still remain many problems. One of the problems is the understanding of numbers and operations among the students and is still low (Handayani, 2008). The low level of understanding even found in students studying at universities prepared for future teachers (Mohini Mohamed et al., 2008; Yang et al., 2009; Sengul, 2013). It is very often found that students get a little worried when they asked if the result of $\frac{1}{4}+\frac{1}{3}$ is less or more than 1 in which they feel unsure what the right answer is. This reality is widely found among students from primary to high school level and even to university level (Reys & Yang, 1998; Singh, 2009; Sengul, 2013). This big problem might be the results of the previous mathematics teaching and learning experienced by the students. This phenomenon can be true due to the mathematics characteristics as a hierarchical subject (Hudojo, 1998).

Some factors that can be considered as the main causes of the problem above are the lacks of meaningful mathematics instruction at lower level of schools, the believe that mathematics at primary schools is a trivial subject and easy to handle, less qualified mathematics teacher, some difficult topics were skipped (not introduced) and any other factors. If we look for the main problem intensively, we will find that the core problem is that the process of teaching and learning is highly tend to emphasis on rote learning and procedural approaches rather than an equal balance with meaningful and conceptual approaches (Marzuki, 2016). The learning orientation is to pass the examination with a high score by remembering standard written algorithm to solve problems that look like to be appeared in the examination or test (Reys & Yang, 1998).

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Today's Numbers and Operations at Primary Schools

The instruction on numbers and operations at primary schools currently dominated by rote learning which mean that the teaching and learning process merely follow the standard procedures prescribed on textbooks (Zulkifli & Mohini Mohamed; 2007; Sengul, 2013; Marzuki, 2016). The procedures are followed without any critical thinking or a query of why the procedures make sense in that way. The important elements of mathematics instruction such as how to communicate around mathematical ideas, critical thinking, and reasoning on the answer are rarely appears.

Based on the interview with some preservice primary schools teachers at Almuslim University about estimation on a question of fraction (Mohini Mohamed et al., 2008), most of them said that they have never gotten such a question in their previous experience of mathematics learning. The question was "Without calculating, the best estimate for $\frac{12}{13} + \frac{7}{8}$ from four answer choices 1, 2, 19, and 21? (Reys &Yang, 1998)." All they knew was the addition of fraction was performed by adjusting the numerator and denominator until it was obtained the common denominator. For them, the operation could not be performed without finding the common denominator first. The viewpoint has many interpretations. One of the interpretations is that the process of mathematics teaching and learning at primary schools never touched this domain and therefore they felt unfamiliar about this kind of problem (Handayani, 2008; Ekawati, 2008).

From the preservice primary school teachers' response we may conclude that they learnt numbers and operations at primary schools without sense. They just memorised and applied the rules prescribed and drilled at schools when they were at primary and secondary schools. The effects of this approach are quite uncomfortable in term of expecting students to understand numbers and operations meaningfully. Rote learning and drill only will produce students just as a mechanics, and do not make them to be flexible, creative, and critical thinkers in any cases of numbers and operations. To illustrate the condition, let us have a look at the instruction on fraction in many classrooms.

In the case of fraction addition, it is very difficult for them to estimate the result of fraction addition without giving meaning toward the numbers. What students know about fraction is just arranging the numerator and denominator in a special arrangement to meet the condition as an equivalent expression with the common denominator that represents the original fraction. With this in their mind, it is not surprising that students have great difficulty in trying to estimate a question such as in the above estimation problem. The question above will be easily answered if they understand that the two fractions are close to 1 so that the estimation answer is 2.

In the same conditions as operations and fractions, the rigid procedural equipments of operation on decimal also appear in all students. They even did not know why they had done in that way. The common single answer given by them was the way they must do if they want to do any operations on decimals. For example, when a multiplication problem on decimal was given to them, they hurriedly solve it using standard procedure and do not have any other way to solve it. When they were given a problem that required an intuitive way to solve it, almost all of them had no idea. A decimal multiplication problem such as 534,5 x 0,545 has been done by a calculator with the result 291357 but the decimal point is not there (Reys &Yang, 1998). The students were asked to put the decimal point in the appropriate place.

With the procedural equipment in their hands, they simply gave the decimal point in between 9 and 1 (29.1357) with the reason of putting the decimal point that correspond to the numbers

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of digits after the decimal points in the problem. These responses showed that they have not possessed the sense of the operation. We can see that the operation is actually equivalent to the 50% of 500 and here is the 50% of more than 500. Consequently, the result of the operation is more than 250, therefore the result 29.1357 is logically wrong.

Suggested Reformation Alternatives

There are so many preservice primary teachers with an inadequate understanding of numbers and operations that need a real breakthrough should be taken immediately to overcome this crucial problem (Mohini Mohamed et al, 2008; Yang et al., 2009; Sengul, 2013). Regarding to this problem, we hereby try to offer some approaches that look like might reduce a little bit of the problem and give new ways to the solutions.

The current teaching and learning of numbers and operations generally focus on the memorisation of facts, procedures, and algorithms without enough conceptual backgrounds. All of these equipments are ready to use to solve numbers and operations without knowing if the answer is logic or not. To overcome this problem, the teacher should find innovative and creative ways of teaching in order for students to understand numbers and operations meaningfully. Once they understand the problems and their solution, the students' feeling of operations will change towards positive manner.

Teaching meaningfully means teaching students to see the objects in their mind, not just a meaningless rote on their tongue. Teaching mathematics is quite different from teaching any other social science subjects that do not require prerequisite knowledge. Meaningful learning must start from what students have already known (Gravemeijer, 1994; Gravemeijer, 2011; Makkink, 2010. This is in line with the characteristics of mathematics that require a pre-requisite material to learn a certain higher level topic. Mathematics is different from any other social subjects such as history and laws that do not require any background knowledge to learn a certain topic. In mathematics, to learn concept B that require concept A, students must master the concept A firstly before continuing to concept B (Hudojo, 1998). This is the most important items that require an extra special attention among mathematics teachers or educators if they wish mathematics to be one of the favourite subjects among their students.

Reflecting on meaningful learning, the instructional approach the preservice teacher experienced in their years at primary schools was, those were far from meaningful, the rote learning (Mohini Mohamed et al, 2008). They learnt just to memorize all prescriptions that had been provided by mathematician written in the textbook. The main task of the learner was to memorize the materials and retrieve them on the examination. This approach was quite different from the characteristics of mathematics that put high doses on problem solving (Dougherty & Crites, 1989). Problem solving requires meaningful learning rather than rote learning.

To improve the quality of teaching and learning in mathematics, particularly on numbers and operations, reformation action should immediately be taken from current static teaching approaches to more flexible teaching approaches (Reys & Yang, 1998). The planned instruction must be based on the instruction that starts from what the learners have known, therefore the materials they learn can be easily connected to the existing knowledge so that the learning can be meaningful.

To reform the current practice of mathematics instruction at schools, hereby we propose two main approaches that seem might be able to bring mathematics to a better position of students' viewpoint. The first approach is the instructional modes and the second is the material substances.

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Reforming the Instructional Approaches

Referring to instructional theories and models, there are so many instructional approaches that can be used and adapted to improve the quality of mathematics teaching and learning, particularly on numbers and operations. Monotonous drill teaching style can not only discourage students' motivation to learn but also not necessarily be appropriate for certain topics. Teachers who have developed a wide range of teaching repertoires will be more effective than those who always use the same style on every occasion.

To make instructional approaches meaningful in mathematics instructions, it is important to consider that mathematics is a unique subject among any other subjects. It imply to the teaching on numbers and operations also. The instructional approaches that are suitable for students are the approaches that enable students to see mathematics in their minds and make mathematics full of sense. In this viewpoint, there are so many instructional approaches that will work. With so many approaches that will give students opportunities to construct, discover, verify, predict, and many others activities that make them immerse in the learning process, in this paper, we will discuss two of them. They are Realistic Mathematics Education, Open Ended Approach.

Teaching and learning mathematics realistically that is well known as Realistic Mathematics Education (RME) is one of the instructional approaches based on constructivism philosophy and it was originated from the Netherland (Freundenthal, 1991). By following this kind of approach, it must start from what students have already known or whatever the students can see by their mind. Teachers function as facilitators who will provide a conducive and appropriate environment for students to construct and develop their new knowledge. Currently, RME is being adopted to apply in Indonesian context (Sembiring et al., 2000). Based on some projects it seemed that it work well especially in instruction on numbers and operations. By using this approach in teaching and learning numbers and operation students will see the fundamental approach of the numbers and operation themselves. To illustrate the difference of two instructional approaches, let us see two approaches of instructions (rote learning approach and realistic approach). To teach operation on multiplication such as 9 x 15, the teachers who used rote learning just have students memorise that the result of 9 x 15 can be gotten by remembering the respectively from 1 x 15, 2 x 15, until 9 x 15. And the other common way is by arranging it in two lines before performing it procedurally.

Contrary to the rote learning approach, the realistic approach uses the basic meaning of multiplications so the students can perform it meaningfully that results in an in-depth understanding. The steps start by introducing the multiplication as a repeated addition, in this case the students are introduced that 9 x 15 means nine times 15. By knowing this basic meaning of multiplication, students can explore flexibly in various ways to get the answer. The answer for this problem can be reached by not only adding nine times 15 respectively subtracting one time 15 from 10 times 15, adding four times 15 from five times 15, etc.

In line with constructivism philosophy, Japanese mathematics educators have developed an approach that is in line to this philosophy. The approach was known as *open-ended* approach (Shimada &Becker, 1997). Open-ended approach has a big impact on students' creativity. Students will explore freely and widely, and deeply around the given problem (topic). The activity will enable them to experience deeply by exploring possibilities of unlimited answer of a task (problem). This approach is also suitable applied in topic of numbers and operations. Multiplication problems can also be introduced as open-ended problems rather than just introducing as single-answer problem.

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The problem such as 30 x 25 is a static problem that can be solved by following the standard procedure (algorithm). The situation will be different when the problem is changed into open-ended problem. The problem might be "find as many as possible numbers in pair that give the product 750. To solve this problem, students may explore all possibilities that give the product. The answer for this problem is not single. Students can use calculator to explore the possibilities of the answer as calculator is good to use in mathematics classes to enhance the problem solving activities (Forrester, 2003). The answer for this problem will be unlimited if the numbers in pair involved fractions and decimals. If this approach is used in classroom as supplemental teaching approach, the difficulty of mathematics can slightly be reduced.

Reforming the Taught Contents

Due to many materials available in numbers and operations, we will discuss here a small part of them that represent the whole. It is about whole numbers, fractions, and a bit about operations. The discussion is about the need of contemporary mathematics related to numbers and operations.

Current modes of mathematics teaching and learning with the emphasis only on facts and standard algorithms have shown that mathematics achievements, particularly on numbers and operations, among students were not satisfied. Introducing students a whole numbers by telling them as a fact that should be memorise is not enough. Students need to associate the numbers with a variety of viewpoints in order for them to understand better. For example, Introducing number 8 alone will not give students any additional meanings and insight about the number. The number should be seen as a number that is 2 less than 10, 3 more than 5, half of 16, twice of 4, etc. Having many associations with working a number like this will give students a rich, deep understanding. This number association may also be good for fractions and decimals.

Similar to understanding the whole numbers, understanding fraction also need some associations or comparisons and also pictorial representation (real life situation) in order for students to understand it meaningfully. Introducing students a fraction such as $\frac{3}{4}$ can be seen as a number that $\frac{1}{4}$ less than 1, $\frac{1}{4}$ more than $\frac{1}{2}$, 3 times $\frac{1}{4}$, etc. It also means that it is the same as 0.75 in decimal, and 75% if it is converted to percentage. Students need these associations or comparisons to prevent superficial understanding of fractions. This is very important because it is very difficult for students to grasp a more advanced topic when the students see fractions as two numbers that is separated by a line (numerator is above the line and denominator is below the line).

The important of good basic understanding of numbers is highly related to the ability to understand operation meaningfully, particularly operation that involved estimation. Students cannot estimate that the sum of $\frac{3}{4} + \frac{5}{6}$ is close to 2 unless they have already known that the two numbers are close to 1. It is very often in classrooms that students responded to this kind of problem by arguing that the problem cannot be answered without solving it first by following the addition procedure for fractions.

CONCLUSIONS

Based on the current practice of the teaching and learning on numbers and operations and learning achievement reached by students and preservice primary teachers, the reformation on both instructional approaches and contents of materials to improve the quality of numbers

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and operations is highly expected. This is important because of a good understanding of numbers and operations are the key to be successful in advanced mathematics.

The starting point to reform for the better in the future may be start at the teacher education institutes as the producers of future teachers. This means that the curriculum and instructional approaches at preservice primary teacher must be reformed first to provide them sufficient balance knowledge of procedural and conceptual.

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