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# Developing a Learning Trajectory on Fraction Topics by Using Realistic Mathematics Education Approach In Primary School

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***Abstract:*** *This research and development was purposed at (1) developing a learning trajectory on fraction topics by using Realistic Mathematics Education approach in Primary School; and (2) determining the validity, practicality, and the effectiveness of the learning trajectory. The results of this research were (1) a learning trajectory on fraction topics in the form of Teacher's Guide Book and Student's Book. (2) Teachers' Guide Book and the Student's Book of learning trajectory were considered valid, practical and effective after being judged by experts in Mathematics Educators, Language Educators, Experienced Teachers and an Educationalist. Based on the research results, it can be concluded that the learning trajectory on Fraction Topics by using Realistic Mathematics Education Approach can be effectively used to improve the learning effectiveness on Fraction Topics in Primary School.*

*Keywords: Learning Trajectory, Fraction Topics, Realistic Mathematics Education Approach, Primary School*

## I. Introduction

Math in primary school has three aspects, numbers; geometry and measurement; and data processing. From the three aspects above the fraction is one of the subjects which is implemented in everyday life. Therefore, concepts and principles of fractions should be planted as early as possible in order the students are able to solve the problems in everyday life. Clarke, et.al (2007) states that the material of fraction is very important for students to develop algebraic reasoning skills to the next class and to develop problem solving skills, especially in algebra and statistics.

Learning fraction topic should be meaningful to the students, but majority of primary school students have difficulty in understanding the concepts and solve the problems related to fraction. It means that there are problems on students' learning outcomes related to the topic of fraction. This problem occurs both internationally and nationally. Some studies show students' difficulties in understanding the concept and calculation of fraction. Mark (1988) states that the concept of fraction is a topic that is more difficult than the integers. In line with this, the test results of NAEP (National Assessment of Educational Progress) in the United States also mentioned that students in grade 6-8 weak on the concept of fraction (Wearne & Kouba, 2000). Nationally, many research results stating that the students' learning outcomes on the fractions topic were still low, (1) Soedjadi, et al. mentions that the fraction is a topic that is considered difficult by Primary school students. Difficulties on the topic of fraction lies in implementing the operational fraction and write fraction related to the overall picture and a collection of objects; and (2) the report Depdikbud RI indicated that many students at first grade of secondary school in East Java, Central Kalimantan, South Sulawesi (in September and October 2006) who answered correctly about fraction only 53.3%.

Based on the results of preliminary studies conducted in several Primary Schools Padangsidimpuan found one factor that becomes the source of the problems affecting the quality of learning is the curriculum on fraction topics. The curriculum is less in stimulating the thinking of students. Topics fractions is packaged in the form of formulas, then it is explained how the use of formula followed by the question related to the use of formula. Supposedly packaged curriculum is designed to wake up the students' thinking. In other words, teaching materials are written only in outline in the form of "subject matter". The task of teachers only describe the subject matter, therefore the teaching materials are not complete.

In terms of learning groove, there is a sequence of learning which is not right. In Primary School grade 3, 4, and 5 the topic of fraction is always taught, but there is a separation of teaching materials which are less precise. When the lesson begins, there will be repetition of material. Separation of topics does actually less precise, because it should be done in a comprehensive way of teaching it. Such conditions would spend more time for teachers to teach the topic fraction in order to break up students' thinking on fractions. Chronology of learning needs to be developed in order to obtain the learning of fractions effectively and efficiently. Learning which is done tends to limit on solving the problems in the textbooks that does not meet the standards expected.

Based on the problems above, it is necessary to design a learning path on the topic of addition and subtraction of fractions based RME for third grade students. In the preparation of this learning path it begins by analyzing curriculum, textbooks, and students' characteristics. Learning path is developed to help students and

teachers in the learning process. This learning path published in the form of teacher's book and student's book. This learning path is expected to motivate and to attract students to study the topic of fractions.

Stephan & Cobb (2013) has conducted research based educational design class. This study aimed at generating a sequence of learning path that produces the learning theory to the topic of addition and subtraction of integers. This research resulted the learning theory to the topic of addition and subtraction of integers that can be guided by other teachers in other contexts. From the results of this study showed that educational research design can produce the learning theory to specific topics in mathematics.

Kwon, et al (2013) has conducted educational research design in Seoul, Korea on instructional design based on the theory of Realistic Mathematics Education. This study showed that educational research design is an appropriate research approach in developing various capabilities. This research resulted the design of learning which enable to improve the mathematical eighth grade students, educational design research can help to build a theory of argumentation and justification of students through a learning-oriented path of investigation, and educational research design to develop the professionalism of teachers.

Armanto (2002) has conducted a research on realistic mathematics education in primary schools about multiplication and division of multi-digit numbers. In this research, locally instructional theory was developed and formulated in three components (1) the purpose of teaching; (2) the expected flow of teaching; and (3) the planned teaching material. Local instructional theory was developed for learning multiplication which started from the contextual solving problems that lead students to rediscover summation repeated 10 numbers, multiplication 10, and short multiplications. While the learning trajectory on division the contextual question direct students to reinvent reduction unstructured, structured on limited, structured, and the division of tiered down. Research results showed that the grooves were developed can be applied in the classroom and it can improve the students' learning outcomes.

From the research findings above, it can be concluded that 1) educational design research can develop and produce learning path on a particular topic; 2) learning using realistic mathematics approach can provide a great opportunity to improve students' mathematical abilities. As a logical consequence of the above results, there is still a gap that needs to be done further research to develop and enrich the knowledge of learning trajectory on the topics of mathematics. This research provides a positive influence on the quality of learning in mathematics.

This research had two hypotheses 1) motivation of students after using the learning path with realistic mathematics approach is better than before; and 2) the ability of students to use problem-solving learning path with realistic mathematics approach is better than the use of conventional learning path. Here is the following chart frame of this research.

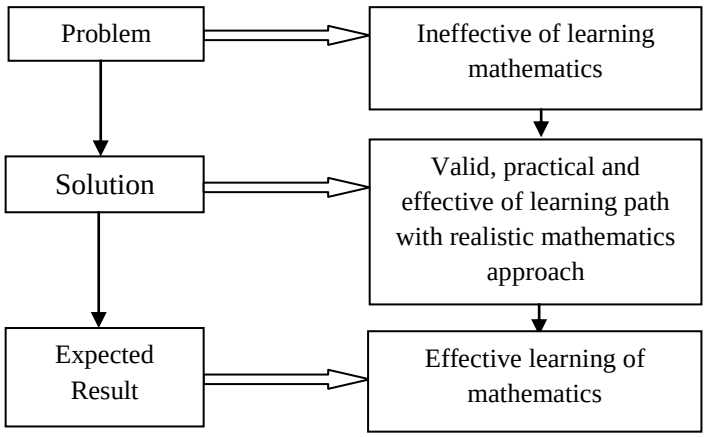


**Figure 1**: Research Paradigm

This research was limited on learning trajectory on fraction topics by using Realistic Mathematics Education approach in Primary School. This also limited on determining the validity, practicality, and the effectiveness of the learning trajectory.

## II. Research Design

The type of this research was a design research. This research combined Plomp (2013) version and Gravemeijer and Cobb (2006) version. Plomp (2013: 16) states that design research is divided into development and validation studies. The development studies is a systematic analysis, design and evaluate educational

interventions aimed at building the research based solutions in education. Development studies aimed at the design principles to develop innovative interventions are relevant for educational practice.

Design research is a kind of validation studies to develop theory or validate theory (Plomp, 2013: 16). Validation studies aimed at the educational intervention (such as learning and learning environment) which aimed at developing or validating the theory. Validation studies aimed at developing a theory of learning and teaching, such as Realistic Mathematics Education (Gravemeijer & Cobb, 2006). Nieveen (1997) and Van den Akker (1999) state there are three main phases in the research design (see also Plomp, 2013), the front-end analysis/preliminary study; the prototype stage, and assessment phase, which consists of a summative evaluation of the final product.

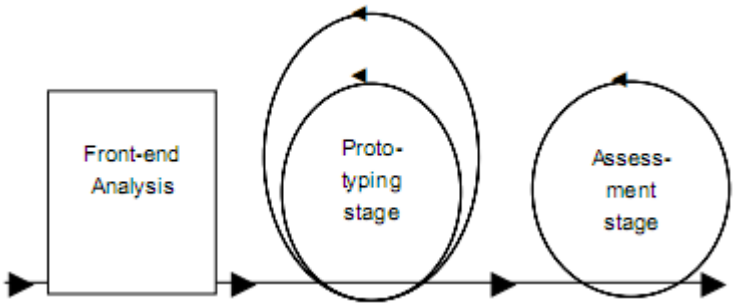


**Figure 2**: The form of design research (Plomp, 2013 and Fauzan, 2002)

The procedures of this research were preliminary research which consists of 1) need and context analysis (need analysis of fraction topic; curriculum; concept; students and teachers); 2) review of literature; and 3) development of conceptual and theoretical framework for the study. The second phase was prototype which consists of 1) design prototype; 2) evaluate formative (Tessmer, 1994); and 3) revise prototype. The third phase was assessment; on this phase the researcher did summative evaluation to know the effectiveness of the product.

The respondents of this research were Primary School Bunayya (25 students), Primary School Teladan (37 students), and Primary School Batunadua (15 students) in Padangsidimpuan, North Sumatera. The instruments of this research were observation; interview; questionnaire and test.

## III. Finding And Discussion

The results of this research were (1) a learning trajectory on fraction topics in form of teachers' guide book and students' book. (2) learning trajectory, teachers' guide book and the students' book were considered valid, practical and effective after being judged by experts in Mathematics Educators, Language Educators, Experienced Teachers and an Educationist. Based on the research results, it can be concluded that the learning trajectory on Fraction Topics by using Realistic Mathematics Education Approach can be effectively used to improve the learning effectiveness on Fraction Topics in Primary School. This research suggests for further similar study for different school levels to development learning trajectory on other topics by using RME Approach and determine the effect on the students' learning.

The learning path in this research meets the principles disclosed by Van den Huivel Panhuizen (2000: 5-9). The learning path in this research refers to the fundamental principle expressed by Gravemeijer (1994) and Freudenthal (1991). The finding in this research reinforce and complement the findings of Fauzan (2002), Armanto (2002), Zulkardi (2002), Hadi (2002), Saragih (2007), Arifin (2008), Musdi (2012), Kwon, et.al, (2013), Wawro, et.al, (2013), Prediger & Zuetszchler, (2013), and Stephan & Cobb (2013) which concluded that the RME approach can improve and develop students' mathematical abilities.

## IV. Conclusion

A learning trajectory on Fraction Topics were developed in form of teachers' guide book and students' book and were considered valid, practical and effective. The learning trajectory on Fraction Topics by using Realistic Mathematics Education Approach can be effectively used to improve the learning effectiveness on Fraction Topics in Primary School.

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