DEVELOPING LEARNING TOOLSOF A GAME-BASED LEARNING THROUGH REALISTIC MATHEMATICS EDUCATION (RME) FOR TEACHING AND LEARNING BASED ON CURRICULUM 2013

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Abstract

This study aims at developing learning tools of a game-based learning through Realistic Mathematics Education (RME)approach including syllabus, lesson plan, game-based learning media, students' worksheets and assesment, and determining the effectiveness of the implementation of learning mathematics using game-based learning through RME and the learning tools on the topic of Numbers at junior high school.This research is aResearch and Development (R&D) research. The research and development method carried out in this research referring to the steps of research developed by Borg and Gall. The results and discussion indicate that the games-based learning through RME approach in learning mathematics at the junior high school produced inaccordance with the determined criteria/valid. The results of field test show that the average of students' test results and the average of students' problem solving skill are increase.

Keywords: *Developing, RME, Games*

Introduction

The challenge of curriculum 2013 is that every subject has to contribute to students' characters building, attitudes, skills, and knowledge. Furthermore, it has been explained that the depth of subjects matter taught in school has to be in line with the demand of international standard which is at the level of reasoning. Therefore, students are able to reach the higher level than the results of PISA 2009 and TIMMS 2011. Referring to the framework of 21^{th} centurycompetencies(Nuh, 2013), then the learning has to be able to create learning exercises that allows students to collaborate, to learn things relevant to the world contexts, so that the learning process should be able to create learners that are innovative and creative. In addition (Nuh, 2013) stated that the ability of innovative, creative, and intelligent can be obtained by observing, questioning, and experimenting.

This innovative way could be using an appropriate learning approach and creating a conducive environment to learn. Many learning approaches which has been developed as a step to create a condusive environment to the learning proccess are expected to increase

students' achievement. One of the learning approach is Realistic Mathematics Education (RME), which is a mathematical learning that emphasizes problem solving informally before using a formal way. This informal way could be games, song, or anything that closed to students. RME is started from informal problems which are then directed towards the formal. Kamii (Turmudi, 2002) suggested that the games are used as a form of approach in the study of mathematics. In learning mathematics, Ernest (1986b) explained that (1) games are able to provide reinforcement and train their skill, (2) games can motivate, (3) games assist the acquisition and development of mathematics concepts, and (4) through games, students can develop strategies to solve problems.

Based on the descriptions, it is necessary to develop learning tools which can accommodate the situation and condition of students. Therefore, a conducive and fun learning environment can be created.

Research Methods

A. Research Approach

This research is a *Research and Development* (R&D) research. The steps conducted refer to the steps of R&D developed by Borg and Gall. Therefore, the research method (restricted to limited trial) is presented in Figure 1.

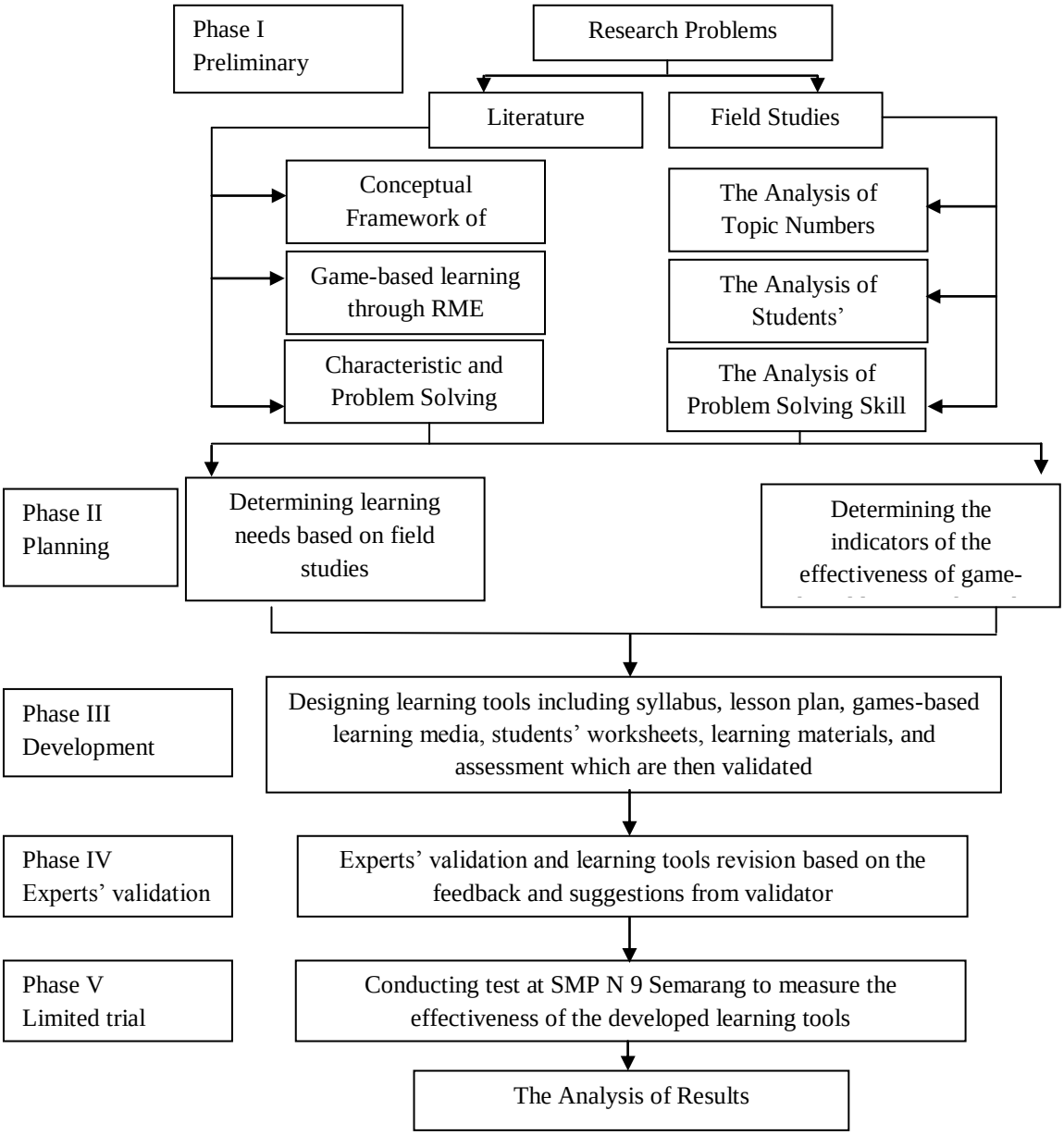

Figure 1. Research Method

B. Procedures of Data Collection

The instruments developed in this study is based on the needs of the study. The procedures of data collection in this study are presented in the following table.

Table1.The procedures of Data Collection

Aspects	Indicators of success	Data resources	Instruments	Time
Learning tools of games-based learning through RME	Learning tools and teaching materials fit for use	The results ofFocus Group Discussion(FDG) and experts' validation	The draft forFDG and validation sheets for syllabus, lesson plan, students' worksheets, media, learning materials, and assesment. The data is statements of experts on the aspects of learning tools	Early development tools, before the limited trial
Teaching and learning proccess	Teachers' ability to manage learning	Teachers' activities in teaching and learning proccess	Observation sheet and video recording	The proccessof limited trial
	Students' activities are increased	Students' activities in teaching and learning activities	Students' portfolio, observation sheet of the learning activities, and video recording	The proccess of limited trial
The efectiveness of games-based learning through RME	- Individual mastery (at least 75) and at least 85% of the number of students - Students' learning outcomes are better - An increase in learning outcomes through Gain test	Students' scores	Achievement test instrument	Learning evaluation and analyzed before and after learning proccess

C. Data Analysis

Methods of data analysis is conducted by using triangulation mixed-method design, which is simultaneously analyze data from quantitative and qualitative data, as well as the combined data. Moreover, the results of the analysis are used to understand the research problems. The rationale of this data analysis design is a shortage of one type of data will be supplemented by other types of data. The quantitative data provides a way to generalize while qualitative data provides information about the context and setting.

The quantitative test is conducted statistically to evaluate the response of students and teachers during the learning proccess of games-based through RME, determining the efectiveness of the implementation of game-based learning through RME, and improving students' learning outcomes after receiving the application of game-based learning through RME. While the qualitative descriptive analysis performed on the data from validation sheet, observation sheet to the stages of the implementation of games-based learning through RME. In addition, qualitative analysis will also be used to describe the students' ability to solve problems during the learning using games-based learning through RME.

Results and Discussion

A. Observation of Learning Proccess

1. The effectiveness of Learning

   The effectiveness of learning shows that the effectiveness is 92,3%. It showed that the learning has been done very well. The effectiveness of this learning is influenced by several factores such as communication and perception within the framework of research between the researchers and the teacher as the model conducting the learning.

2. Teachers' Observation

   The observation of the teacher in the learning of the topic of Numbers using games-based learning through RME in the learning of mathemmatics at the junior high school indicates that during the learning activities value (which is taken from the value on the last observation because it indicates an increase), showed that the percentage of the value is 92.5. This shows that the teacher gives excellent response to the learning mathematics using games-based learning through RME.

3. Students' Observation

   The observation of students' responses in the learning of Numbers using games-based learning through RME at junior high school level indicates that the students' activities during the four meetings showed an average of 87.5%. This shows that the students gave an excellent responses to the activities designed by the researchers and implemented by the teacher.

B. Results of Field Test

1. Hypothesis Results of Completeness Results.

A learning is said to be complete if it is qualified mastery learning, which means the average scores of students' learning results is at least75.

Table 4.1 Output (Statistic Group) of Students Learning Results

One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Nilai	32	95.72	5.531	.978

Table 4.2 The Analysis of Students' Mastery

One-Sample Test

	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Scores	21.189	31	.000	20.719	18.72	22.71

Based on the probability, if Sig < 0,05 then H_0 is rejected.in other words, students master the learning or the learning results are complete. Moreover, the Proportion Test is used to determine the proportion of the data of students learning results of the experiment class whether results are classically master with the proportion of students who are master about 85%. For the hypothesis test, it is conducted by using proportion test.

$$Z = \frac{X - np_0}{\sqrt{np_0(1-p_0)}} = \frac{32 - 32.0{,}85}{\sqrt{32.0{,}85\ (1-0{,}85)}} = 2{,}376$$

It is obtained the Z_{value} = 2,376 withZ_{table} =1,65. Therefore, it indicates that $H_0$is received where$Z_{value} > Z_{table}$which means that the results of the students have been reached mastery learning at least as much as 85% from the total number of students (the amount of students who are mastering is 100%).

2. Comparative Results of Learning Results

The hypothesis test used in this analysis is the average difference test, the test of the right side of the t-test formula. The test is then usde to determine the effectiveness of learning.

Table 4.3 The Results of Comparative Tests of Learning Outcomes

Paired Samples Correlations

		N	Correlation	Sig.
Pair 1	Nilai1 & Nilai2	32	-.015	.935

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference Lower	Upper			
Pair 1	Nilai1 - Nilai2	32.281	18.191	3.216	25.723	38.840	10.038	31	.000

Consider the table 4.3, it is obtained that $t_{value} = 10{,}038 > t_{table} = 1{,}645$ so that H_0 is rejected. This shows that the average of the post-test results/outcomes of students competence test is better than the pretest. The average of control class and experiment class can be described in Table 4.4 below.

Table 4.4 The Difference of Control Class and Experiment Class

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Nilai1	95.72	32	5.531	.978
	Nilai2	63.44	32	17.248	3.049

From Table 4.4, it can be explained that the average of post-test scores is 95.72 and the average of pretest scores is 63.44. Then, the average of the post-test scores is greater than the average of the post-test scores.

C. Discussion

The developed learning tool consists of syllabus, lessson plans, games-based students' worksheets, teachers' observation sheets, students' observation sheets, and test results of students' learning. Furthermore, the learning tool is validated by experts, in order to obtain a learning tool in accordance with the determined criteria/valid. Then, it can be obtained a valid mathematics learning tool using games-based learning through RME. Vygotsky (in Slavin, 1994: 49), emphasizes the sociocultural nature of learning, that students learn through interaction with adults and peers. This Vygotsky's theory is in line with the main components in the context, which are learning society, interaction between one student and other students, as well as between students and

mentors (teachers). In addition, the discovery strategy (inquiry), the teachers' assistances are only limited on questioning students in the beginning of solving contextual problems given by teachers until students understand the intent of the given problems.

The emphasizes is that the implementation of learning through contextual approach should consider the characteristics and the learning style, which means that learning should involve students' mental proccesses, fun, encourage students' activities, give students the opportunity to construct their learning experiences so that learning becomes meaningful. In this case, the role of teachers is as facilitators in learning which the estuary towards the creation of an effective learning environment. This theory is used as a based or direction in the proccess of learning or teaching mathematics in this study.

The effectiveness of learning based on the findings at SMP Negeri 9 Semarang show that students and teachers responded well to the learning mathematics using games-based through RME. The grouping of students with high, moderate, and low level of ability allows students to interact and discuss well. They can perform the task well and the competition also occurs between members of the group. The positive attitude of the students after learning mathematics using games-based learning through RME is supported by a number of factors which can be described as follows.

1. The learning atmosphere is not tense/awkward and students were able to play around and be creative.
2. The game used has been able to attract the attention of students because it is completed with an attractive appearance and questions for students' understanding.
3. The students feel that they get a new learning experience and quite different from their previous learning experiences.siswa merasa memperoleh pengalaman belajar yang baru dan cukup berbeda dengan pengalaman belajar sebelumnya.

Then, the mathematics teachers at SMP Negeri 9 Semarang have good responses in the subject of mathematics using games-based learning through RME. Several things that can be seen as contributing factors for the positive responses are the

willingness of teachers to enhance students' creativity in mathematics through a variation of learning. furthermore, the results showed that:

1. The mathematics learning using games-based learning through RME is conducted well.
2. The students gave positive responses to the activities of learning mathematics using games-based learning through RME.
3. The teacher gave a good response to the mathematics learning using games-based learning through RME

In addition, from the learning using games-based learning through RME, it was obtained that the students' average score is 95.71; the classical completeness became 100% (the minimum is 85%). The results in this study showed that the average of students' ability to understand the problems is 5.00; the average of students' ability in problem-solving plan is 4.76; the average of students ability to carry out the problem solving plan is 4.67; the averageof students ability in problem solving rechecking results is 4.67. The results of the analysis of this study showed that the average of students' problem solving abolity is still at a very good level.

Conclusion and Suggestions

A. Conclusion

Based on the results of developing learning tools and the results of this study described in chapter IV, then the conclusion can be described as follows.

1. The learning tools developed consist of syllabus, lesson plan, games-based students' worksheets, teacher observation sheet, students' observation sheet, and test results of students' learning. Furthermore, experts validate the learning tools in order to obtain valid learning tools.
2. The learning implementation is effective which is characterized by: a) the average of students' outcomes individually are greater than KKM = 75, and classically more than 85% of students scored 75.

B. Suggestions

Based on the conclusions set out above, the researchers expect:

1. In the use and the implementation of a strategy, it has to consider towards the achievement of indicators and learning objectives. The implementation of learning must be based on a right strategy, so that the implementation of learning can be done well. If the strategy has been appropriate, a teacher can add appropriate learning media, such as games, which can really help students to learn.
2. By using a valid learning material, it will produce a tool system, which can be an alternative in the implementation of learning. Hence, a good learning tool is a tool, which has to be consulted with experts in the field to produce a tool that is in accordance with the criteria. Afterwards, it can be implemented in learning activities.

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