Development of Learning Tools Based on Realistic Mathematics Education of Ethnomatematics Nuances to Improve Mathematical Communication Skill Students in Junior High Shcool 2 Percut Sei Tuan

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Abstract **- Realistic mathematics education of ethnomatematics nuances is an activity which emphasizes students' activity to seek, find, and build their own knowledge from various problems that nuanced local culture. Development of learning tools based on realistic mathematics education of ethnomatematics nuances aims to know: 1) Validity, practicality and effectiveness of learning devices developed, 2) Knowing the improvement of students' mathematical communication skill using learning tools developed. This research was a research development (research and development), using 4-D model developed by Thiagarajan, Semmel and Semmel. The result was the implementation plan of learning, students' book, students' activity sheet and students' mathematical communication skill test. Subjects of this study were students of class VII-4 and VII-5 SMP Negeri 2 Percut Sei Tuan. The result of experiment I and experiment II were: 1) instructional device fulfilling valid, practical and effective criteria, 2) the improvement of mathematical communication skill of students obtained from improvement of average indicator of mathematical communication skill from experiment I to experiment II.**

Keywords **-** ***learning equipment, realistic mathematics education, ethnomatematic, mathematical communication skill***

I. INTRODUCTION

Before teaching a teacher is expected to prepare materials that will be taught, preparing props / practicum to be used, preparing questions and directions to lure students to be more active in learning, studying students' condition, this will be described in the implementation of learning tools. Learning tools between each other affect each other. Lesson Plans and textbooks will be used which will also require a student activity sheet (LAS). Furthermore, the assessment instrument used should be adjusted to the context of life faced by students and attempted to facilitate students in expressing their thinking skill.

Learning tools (Trianto, 2009: 121) is a number of learning resources that enable students and teachers do the learning [1]. Learning tools serve as a measurement for a professional teacher to evaluate the result of teaching. In addition, if the learning tools appropriated to students' need then the students will be easier to understand the lessons presented by the teacher.

Haggarty and Keynes (Muchayat, 2011: 201) explained that in order to improve the teaching and learning of mathematics in the classroom it is necessary to improve the understanding of teachers, students, materials which used for learning and the interaction between them [2]. For that, teachers are required to be able to create and develop these learning devices.

According to Ministry of Education (Fitriani, et al, 2014: 4) the reasons for the importance of developing learning tools include: the availability of materials according to the curriculum demands, target characteristics, and the demands of solving learning problems [3]. The characteristic of the target is one of the reasons for the need for the development of learning tools because it often does not match the learning tool with the situation and condition of the students. For example the social environment, culture, students' abilities, interest in learning as well as family background. Furthermore, students often have difficulties in understanding the learning materials, which may be caused because the material is unclear,

complicated, strange, and so on. Therefore, it is necessary to develop learning tools that can answer or solve problems or difficulties in learning.

Education and culture are something that can not be avoided in everyday life, because culture is a unified whole and prevailing in society, and education is a fundamental need for every individual in society, especially mathematics. The existence of the relationship between mathematics, community life and culture, it is appropriate to develop a realistic learning tools based on mathematics education of ethnomatematics nuances.

If reviewed from the current curriculum changes, realistic mathematics education is one of the learning approaches that conforms to the change [4]. In realistic mathematics education, learning must be started from something real so that students are involved in the learning process meaningfully. learning tools based on realistic mathematics education are just stories that are often experienced in everyday life, but with the ethnomatematics nuances, there will be an addition to the culture of the story such as the image of a traditional house, or a regional custom. It will be something new also to the students, because without being realized by students that many activities contain mathematical concept, besides that they also know their culture. For example, about how rice sellers are actually familiar with the concept of symmetry of plane, where they are capable of transforming rectangular oil paper into a circle that has a curved shape at the top, using folding and cutting techniques.

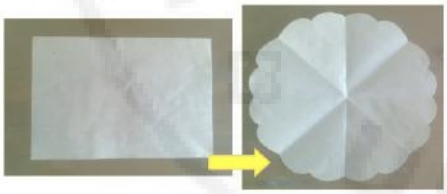

Figure 1. Rectangular Transformation to Circle

The definition of ethnomatematics by Supriadi (2014) it comes from the word that refers to the ethno-social context of cultures consisting of language, jargon, codes of behavior, myths and symbols [5]. This is same with the opinion of Begg (Riska, 2014: 74), ethnomatematics means cultural mathematics, referring not only to ethnic culture, but also to common experiences such as language, belief, customs, or history [6]. Shirley (Hartoyo, 2012) holds that nowadays the field of ethnomatics, mathematics that grows and develops in society and in accordance with local culture, can be used as the center of the learning process and teaching methods, although it is still relatively new in the world of education [7]. So that the development of learning tools based on realistic mathematics education ethnomatematics nuances considered harmonious to be combined.

Communication is an important component in the learning process likewise in learning mathematics. Sierpinska (1998) states that communication is same with the education system [8]. Emori (Inprasitha: 2012) says that almost all mathematics education is concerned with learning of mathematical communication [9].

The connection between language and mathematics, Cooke and Buchholz (2005) suggests that teachers must be able to make a connection between mathematics and language [10]. This relationship will help students are able to express a mathematical problem into a symbol language or mathematical model. Awareness of the importance of paying attention to students' ability to communicate using mathematics learned in schools needs to be grown, as one of the functions of mathematics lessons is as a way of communicating ideas in a practical, systematic, and efficient way. Thus it is clear that mathematical communication is one of the important capabilities that must be developed in students.

Baroody (1993) mentions at least two important reasons why communication in learning mathematics needs to be grown developed among students, that is mathimatics not just a tool of thinking, aids finding, solving problems or drawing CONCLUSIONs, but also as a mathematical social activity in learning mathematics; mathematics as a vehicle for interaction between students, and also between teachers and students [11].

Teaching activities that have been used by teachers have not been able to help students to answer questions in problems form, active in the learning process, motivate to find student ideas and even the lack of openness between students with teachers, so many students are reluctant to ask about the subject matters. So with the development of learning tools based on realistic mathematics education ethnomatematics nuances intended to create a learning tool that is valid and effective and can improve students' mathematical communication skills.

II. METHOD

Type Type of research that would be conducted was development research. With the model that would be used was 4-D Thiagarajan development model and the product in this research was learning tools based on realistic mathematical approach. Thiagarajan, and Semmel & Semmel (1974) describe that there are four stages to be implemented in development, known as 4-D models define, design, develop, and disseminate [14].

a. Define

The purpose of this step is to define and define what is needed in instructional. There are five steps to follow in this stage:

1) Froat analysis

Investigate on the basic issues that teachers felt, understand the teacher's performance level. During this investigation the better and more efficient learning alternatives can be considered.

2) Learner analysis

Identify the character of the students. The characters are students' competence and background of the student's experience, general behaviors on the topic of learning, media selection, format and language.

3) *Task analysis*
Identify the main skills which are needed to describe them in more specific and necessary skills.

4) *Concept analysis*
Identify the main concepts that will be taught, organize the concept into a hierarchy and detail the properties or characteristics of each concept. This analysis helps identifying a set of thoughts about the examples and not examples that can be sung in the development path.

5) *Specifying instructional objectives*
Convert the results of task analysis and concept analysis became the goals that will be expected. This set of goals became the basis for the preparation of tests and the design of learning. And furthermore this goal is integrated into the learning materials.

b. *Design*
The purpose of this stage is to design the initial draft of the learning materials. This stage can be started if the purpose of the learning materials has been established in the previous stage. There are four steps at this stage:

1) *Constructing criterion-referenced test*
This step is a connection phase I and phase II. The criteria developed convert the objectives into the framework of the learning materials.

2) *Media selection*
Selection of appropriate media to present the content of learning. This process includes adjusting concept analysis and task analysis with characters from students, production sources, dispersion plans that relates to media traits.

3) *Format selection*
This step is related to previous media selection. The term instructional format itself refers to a combination of media, teaching strategies, and usage techniques. For example: visual format, audiovisual format, non-verbal format, etc. The assessment of the appropriate format depends on the number of factors being discussed.

4) *Initial design*
Providing the basic things of learning through appropriate media and in the appropriate sequence. This step also includes composing various learning activities such as reading books, interviewing specific students, and applying different skills to pay attention each student.

c. *Develop*
The purpose of this step is to modify the learning materials in the initial draft. The results of the design stage should be considered as an early version so modifications are required to obtain an effective final version. There are two steps in this stage:

1) *Expert appraisal*
Is a technique for obtaining suggestions for improving materials. A number of experts are asked to evaluate the material from the point of view of learning and technique. Based on feedback from experts the first draft was modified.

2) *Developmental testing*
Testing the material on students to define sections that require revision. Based on responses, reactions and students' comments, the material can be modified. The test cycle, revise and test is done until the material obtained is consistent and effective.

d. Disseminate
The final draft of the learning material is obtained if the developmental testing stage shows consistent results and the expert gives positive comments. At this stage three steps are known; validation testing, packaging, diffusion and adopting. In the validation testing step, the material is used on artificial conditions, to demonstrate who is learning, what to learn, on what conditions and how much time is spent.

III. RESULT AND DISCUSSION

1. Development of Learning Tools Based on Realistic Mathematics Education of Valid, Practical, and Effective Ethnomatematics Nuances Education-Based Learning Tools Realistic Mathematics Valid, Practical and Effective Etnomatematic Nuances

Learning tools which is developed based on realistic mathematics education of ethnomatematic nuances are in line with the tools developed by Maulydia (2017) namely Lesson Plans (RPP), Students' Book, Teachers' Book, LKS and learning outcomes [12]. However, there are differences in the devices developed in this study with Maulydia. This difference is caused of undeveloped of teacher's guide book in this research, while the research of Maulydia developed the device. Another difference is that Maulydia compiled the tests in accordance with the indicators of problem-solving abilities, whereas in this study the tests were composed of students' ability tests based on indicators of mathematical communication skills.

In accordance with the opinion of Nieeven (1997) a learning model is said to be good if the model (1) is valid, (2) practical, and (3) effective [13]. Learning tools that have been prepared through the *define* and *design* stage in the form of draft I are tested in advance by submitting all components of instructional tools developed such as lesson plans (RPP), students' book, students' activity sheet, and communication skill test to experts. The following validation results from the validator.

Tools development in this research is validation process by validator and validation of statistic in field to fulfill enough requirement to be good device. The fulfillment of the validity aspect is in line with the opinion of Akker (1999: 10) which states that validity refers to the extent to which the design of

the device is based on the latest state of technology, art, or science ('content validity') and the various components of the device consistently related to each other ('construct validity') [14].

Table 1. Total Average Validation Results of Validator

No	Learning Tools	Validation Results (Total Average)
1	Students' Book	4,33
2	Lesson Plans	4,18
3	Students' Activity Sheet	4,28
4	Test of Students' Mathematical Communication Skills	Without Validation

From the validation results for each learning tools component developed by using realistic mathematics education based education ethnomatematics nuances is in "valid" category. But even though the learning tools components developed have met the criteria of validity, there are some components that need to be fixed appropriate with the notes provided by the expert team covering the use of language, writing or typing and animation display that must be appropriate with the material conditions. So based on the results of records from experts that the learning tools have met the criteria of validity with the category "valid" with a note must be revised.

Besides validity, it is also required effectiveness as a good tool requirements. This is in line with the opinion of Nieveen (1997) which states that effectiveness refers to the way students do curriculum experience and student achievement results in accordance with the goals set by the developer [15].

Table 2. Completeness of Students Learning Clasically

No	**Explanations**	**Value**	
		Experiment I	**Experiment II**
1	Highest Score	3,60	3,90
2	Lowest Score	2,10	2,30
3	Average	3,02	3,22
4	Percentage of Classical Completeness	83,33%	86,66%

Tabel 3. Completeness of Learning Goals

No	Learning Goals	Experiment I		Experiment II	
		% Completness of Learning goals	Explanations	% Completness of Learning goals	Explanations
1	Students are able to write what they know and what is being asked	96%	Achieved	97%	Achieved
2	Students are able to make planning of problems	90%	Achieved	94%	Achieved
3	Students are able to do the calculations with the planning that has been made	69%	Not achieved	83%	Achieved
4	Students are able to make concluson from the result of resolving the problemsthat have been done	46%	Not achieved	75%	Achieved

Based on the results of student observations during the learning and analysis of data that has been stated previously that students' activity on experiment II is within the limits of tolerance set and the completeness obtained during test I conducted in class VII-4 SMP Negeri 2 Percut Sei Tuan, from 30 the average students of classical completeness of mathematical communication skills is 83,33%. After obtaining the result of experiment I, revision was made to correct the deficiencies in experiment I, then the learning device was tested again in experiment II with the average of classical completeness of mathematical communication skills is 86,66%.

In experiment I, the students' response analysis related to students' feelings toward the learning component of students' opinions on the material, student's books and the way the teacher perceived the students was above 80%. The percentage of learning atmosphere aspect is lower than other aspect of device that is 72,73%. Based on comments and interviews made to two students who responded negatively, the reason they expressed was the dislike of group learning that made the class atmosphere even more fussed.

Furthermore, the analysis of students' responses related to the tools components of both the student's book, the LAS and how the teacher taught has reached 80%, but the learning atmosphere has not reached 80% that is only 66.67%. This happens because students are already accustomed to study in groups at the school. To improve this aspect, there is little revision in the students' book and LAS.

From the enthusiastic aspect of the students follow the learning, students give positive response above 90%, it means that the students are interested to continue next learning activity. Aspects of language clarity used in students' books and LAS has also reached 80%, but the words, sentences and instructions that students ask during the learning as a reference language improvement. Incomprehensible words or phrases added explanations or replaced with simpler and problem solving in student's books added important conclusions or concepts that students must understand. Student's interest in books and LAS has also reached 80%.

With the improvements made, then in the second experiment, the aspects of students' response both in terms of students' sense of the tools, the novelty of the tool components and language clarity in the students' book and LAS increased. While from the enthusiastic aspect to follow the learning and interest in books of students and LAS did not experience significant changes. Thus the final tools produced has been responded well by the students. This is in line with Hidayanto's (2013) research, also found that RME-based teaching materials offer students more interest in learning [16]. In addition, students' responses were obtained in accordance with Fredrick (2008), who said that ethnomatematics create a class atmosphere that respects and cares for different cultures and traditions [17].

2. Improving Mathematical Communication Skills Using Educational-Based Learning Tools Realistic Mathematics Ethnomatematic Nuances

After the tools are developed to a good quality includes validity, practically and effectiveness, it will be seen how much improvement of students' mathematical communication skills using learning tools developed based on realistic mathematics education ethnomatematics nuances. The result of the development research obtained by Syahputra (2017) is a significant improvement in students' problem solving abilities [21]. Enhancement will be seen through N-Gain from the pre-test results and post-test of students' mathematical communication skills on experiment 2. The N-Gain results of students' mathematical communication skills are presented in Table 4.

Tabel 4. Result of *N-Gain* Students' Mathematical Communication Skills

N-Gain	Interpretation	Number of Students
g ≥ 0,7	High	10
0,3 ≤ g < 0,7	Medium	20
g < 0,3	Low	0

Based on the table, it can be seen that 10 students got a Gain score in the range (0.7 or increased "High" category communication skills.) For students experiencing the "Medium" category improvement or Gain score at 0.3 (g <0, 7 amounted to 20 and none of the students experienced an increase in "Low" category communication skills. The result of Gain for improvement of communication skills per indicator can be seen in the following table.

Tabel 5. N Value Gain Per Indicator

No	Indicator	Value
1	1	0,77
2	2	0,48
3	3	0,4
4	4	0,37

The total pretest score of students 'mathematical communication skills is 1813 from a maximum score of 2400. While the total post-test score of students' mathematical communication skills is 2127. Based on that value, we can see large N-Gain communication skills as follows:

$$\text{gain ternormalisasi } (g) = \frac{Posttest\ Score - Pretest\ Score}{Maximum\ Score - Pretest\ Score} = \frac{2127 - 1813}{2400 - 1813} = \frac{414}{587} = 0{,}53$$

N-Gain value of 0.53 if interpreted into the classification described in Chapter III, then the total increase in communication skills obtained are in the "Medium" category. This means that learning tools developed based on realistic mathematics education ethnomatematics nuances has improved the ability of mathematical communication with a large increase in the category "Medium" ie with the value of 0.53 Gain.

The improvement of students' mathematical communication skills from learning tools developed based on realistic mathematics education ethnomatematic nuances in accordance with Bruner's theory. Bruner emphasized the influence of culture on one's behavior. He emphasized that the learning process would work well and creatively if the teacher gave students the opportunity to discover a concept, theory, rule, or understanding through the examples encountered in their lives.

The Gain values of communication ability performances were 0.37, 0.4, 0.48, and 0.77, respectively, and all in the medium and high improvement categories.

IV CONCLUSIONS

From the results of research that has been obtained can be described the following conclusions.

1. The validity of the learning tools product based on the realistic mathematics education of the developed ethnomatematic nuances has fulfilled the validity criteria and valid categories with little revision.
2. The practicality of the learning device product based on the realistic mathematics education of the developed ethnomatematic nuances has fulfilled the good category.
3. The effectiveness of product of learning tools based on realistic mathematic education of ethnomatematic nuances developed, obtained by the average of classical completeness of mathematical communication skills in experiment I 47% and 86,7% for second try, so the learning tools is effective.
4. Improving students' mathematical communication skills using the tools that have been developed based on realistic mathematics education of ethnomatematic nuances seen from the value of N-Gain 0.53 means being in the medium category.

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