

# Integrating Ethnomathematics in Mathematical Learning Design for Elementary Schools

Erni Puji Astuti <sup>1,a)</sup> and Riawan Yudi Purwoko <sup>2, b)</sup>

<sup>1</sup>(*Muhammadiyah University Of Purworejo, Indonesia*)

<sup>2</sup>(*Muhammadiyah University Of Purworejo, Indonesia*)

<sup>a)</sup>erni\_umpwr@mail.com

<sup>b)</sup>riawanyudi.umpwr@gmail.com

**Abstract.** The innovation of mathematics learning in elementary school is urgently required since a culture crisis is getting worse. Mathematics teaching learning is still centered on teachers and gives less attention to the role of local culture as great values and learning source especially in Purworejo district. The specific objective of this research is to produce mathematics learning design which focuses on ethno-mathematics-based teaching-learning instruments with local culture setting. The research method employed is design research in which each cycle consists of research preparation stages, implementation of the design, analysis of data obtained from previous stage. Steps taken in research preparation stage are analyzing literatures, discussing with teachers, designing Mathematics learning instrument with local culture and analyzing preliminary design. The initial product of this research is learning instruments realized in learning books which consist of teacher books, student books, and student work sheets on the subject of the plane. The average score of practicality score is 4,07 with very good level of practicality and student's response to learning is very positive with the percentage of students' learning mastery level of 86.11%, so that the instrument is effective.

**Keyword:** Ethnomathematics, Mathematics, Learning, Instruments

## I. INTRODUCTION

Philosophically, education is the process of humanizing human beings, that is, as a good individual of self and surrounding environment. In Ki Hajar Dewantara's concept, education is a process of humanizing. That is, in daily life, every individual should have the attitude and behavior that upholds the values contained in the surrounding environment. It is the thing that will reflect the essence of education because education is essentially a cultural forming process.

Cultural messages can be customized through classroom practice so as to be able to prepare an intelligent human being, in the sense of humans who can be society members that educate, know, appreciate, and understand their own culture. The orientation of education on cultural values is expected to shape the behavior of individuals as members of a civilized society who appreciate their own culture. If education aimed at strengthening the cultural values, the educational programs held in schools should always be integrated with the development of local cultural values, including through learning programs in all subjects including mathematics learning.

NCTM (2011) mentions that an effective math teaching requires an understanding of what students have known previously and need to learn and then challenge and support them to learn it well. Especially in elementary, the students are between 7-13 years old. According to Piaget they are in the concrete operational phase (Ibrahim &Suparni, 2012: 79). Based on this phase, teaching learning math in elementary school should begin with something concrete and tangible as well as close to life, knowledge and experience of students. In addition, Freudenthal (1991) stated that mathematics is a human activity and must be correlated with reality. Freudenthal regards mathematics not as a finished product that we provide to students, but rather a process that is constructed by the students. In mathematics learning model in accordance with the above philosophy is realistic mathematics education model.

Then to link the cultural values with teaching learning mathematics, realistic mathematics that is culture oriented is designed in the form of the teaching-learning instrument termed ethno-mathematics.

From this issue, we need a proper teaching learning instrument to support the teaching learning process of mathematics in elementary schools in Purworejo in order to provide an atmosphere of local wisdom in the development of reasoning power, to enhance the activity, creativity of students and instill an appreciation of local culture of Purworejo. Based on the background of the above problems, the researchers propose the design of an ethno-based mathematics teaching instrument by taking the local cultural setting in the Purworejo district.

## II. THEORETICAL REVIEW

### Culture and Mathematics

The popular definition of culture is the result of human's creativity, sense, and initiative. Hofstede & Hofstede (2005: 3-4) mention "Culture is a catchword for all those patterns of thinking, feeling, and acting referred to in the previous paragraphs. Not only activities supposed to refine the mind are included, but also the ordinary and menial things in life". The opinion understands that culture is the slogan for all forms or ways of thinking, feeling, and acting in various things. Culture is not something that only supports a good way of thinking, but includes everything that is ordinary or extraordinary in life.

Those elements are cultural initiatives that enable the development of human civilization. In this context, education is not only a transfer of knowledge and skills, but also includes the transmission of cultural values and social norms. It can be stated that each community as culture bearer is concerned to maintain the entanglement between the various educational efforts with the struggles of developing culture. The continuity of living in community is also influenced by the ongoing transfer of cultural values and social norms from one generation to the next. This continuity made possible by the orientation of the same cultural values and behavior conformism based on the social applicable.

Mathematics is seen as a cultural product developed through various activities, such as counting, placing, measuring, designing, playing and explaining. Everyone everyday conscious or not performs these activities, further it can be said that mathematics is closer to daily life. Those activities are common ones performed by any person. Thus mathematics as cultural knowledge is derived from these activities in a certain way (posture) consciously and continuously.

Further, (Ernest, 1991: 42) states that:

*"The grounds for describing mathematical knowledge as a social construction and for adopting this name are threefold: (i) The basis of mathematical knowledge is linguistic knowledge, conventions and rules, and language is a social construction, (ii) Interpersonal social processes are required to turn an individual's subjective mathematical knowledge, after publication, into accepted objective mathematical knowledge, (iii) Objectivity itself will be understood to be social".*

The opinion gives an overview that the social constructivist views mathematics as a result of social construction. To describe the mathematics as a social construction, it should be understood that the basis of mathematical knowledge is linguistic knowledge, conventions and rules, and language as a social construction. It requires interpersonal social process to give the knowledge of mathematics, although it is still subjective for a moment. When it has already been published into knowledge then objectivity will be accepted on the condition of objectivity itself must be understood socially.

In mathematics teaching-learning in the classroom, teachers often use a concept that applies to the social context to understand mathematical concepts. Vigotsky states that "in classroom life, the meaning of mathematical concepts and the validity of mathematical statements are socially accomplished" (Stefe et al, 1996: 25). Sometimes the mathematical meaning or statement would be understood by students if they are supported by the terms heard every day. In example, when we teach a deduction, often a teacher explains using the terms of taken, missing, and the others. Thus, students will understand the concept of deduction and its benefits in everyday life.

When referring to the result of the 10<sup>th</sup> International Congress of Mathematics Education, there are several objectives of the discussion on the issue of ethno-mathematics, namely:

1. What is the relationship between ethno-mathematics, mathematics and anthropology, and politic of mathematics education.

2. How to prove further that the school program successfully achieved the goal of combining the ethno-mathematics idea.
3. What are the implications of the ethno-mathematics research for mathematics and mathematics education.
4. What is the relationship of differences in language or cultural features in generating the mathematical concept (Favilli, 2001: 3)

So if the culture and mathematics combined in the context of learning then can bring local culture that has not always got a place in the learning process in school. In a culture-based learning, the learning environment will turn into a fun environment for teachers and students, enabling teachers and students to participate actively based on familiar cultures, to maximize results. Teachers play a role in guiding and directing students' potential to explore the various cultures that are known. Furthermore, the interaction of teachers and students will accommodate the process of creating the meaning of science that is processed in the subjects of mathematics in schools.

### **Ethnomathematic**

Ethnomathematics is mathematics growing and developing in a particular culture (Yusuf et al, 2010). Culture in this case deals with set of norms or general rules that apply in society, beliefs, and values recognized in the communities living in tribes or groups of the same race (Hammond, 2000).

Ethnography is a description and analysis of a social groups based on the field research as the data. Ethnography represents the data that is essential for all research in cultural anthropology. Therefore, for a comparative study or a comparison of community samples from around the world, it takes ethnographic data about each sample to study (Pinasti: 2007). There are seven ethnographic framework which are ingredients of studying the cultural unity of ethnic groups in a community as follows: (1) language, (2) technology, (3) economic system, (4) social organization, (5) knowledge, (6) art, and (7) religious system. Due to those elements are universal and we can identify every social group, ethnique, and nations using those frameworks, therefore all human activities can be classified into one of them (Pinasti, 2007).

Then, "mathema" here means to explain, understand, and manage real things specifically by calculating, measuring, classifying, sorting, and modeling a pattern that appears on an environment. The suffix "tics" means the art of engineering.

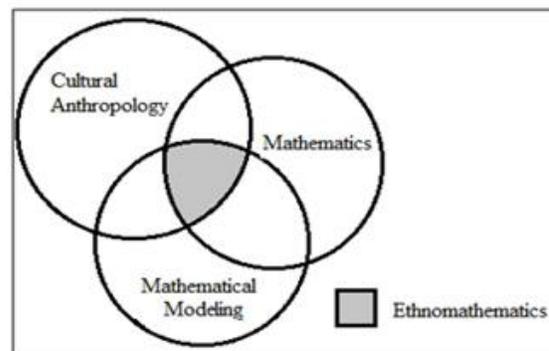


Figure 1. Ethnomathematics (taken from Rosa & Orey:2013)

Because of growing and developing from culture, ethno-mathematics existence is often not realized by the user community. This is due to ethno-mathematics often looks more "modest" than a formal mathematics form found in school. The local community accustomed using ethno-mathematics may feel not being confident with the legacy of their ancestors, because the mathematics in this culture is not utilized with definitions, theorems and formulas such as are commonly encountered in academic mathematics.

### **Integrating Ethnomathematics in Mathematical Learning**

Teaching-learning instrument is an instrument used as a guide in planning the teaching-learning in the classroom or that in good tutorials. The instrument is part of the teaching-learning model. "The term of teaching models refers to a particular approach to instruction that includes its goals, syntax, environment, and management system" (Arends, 1997: 7). The statement means the term of teaching-learning model is concerned with applied

teaching-learning approach, including teaching objectives, the stages in the teaching-learning activities, teaching-learning environment, and classroom management.

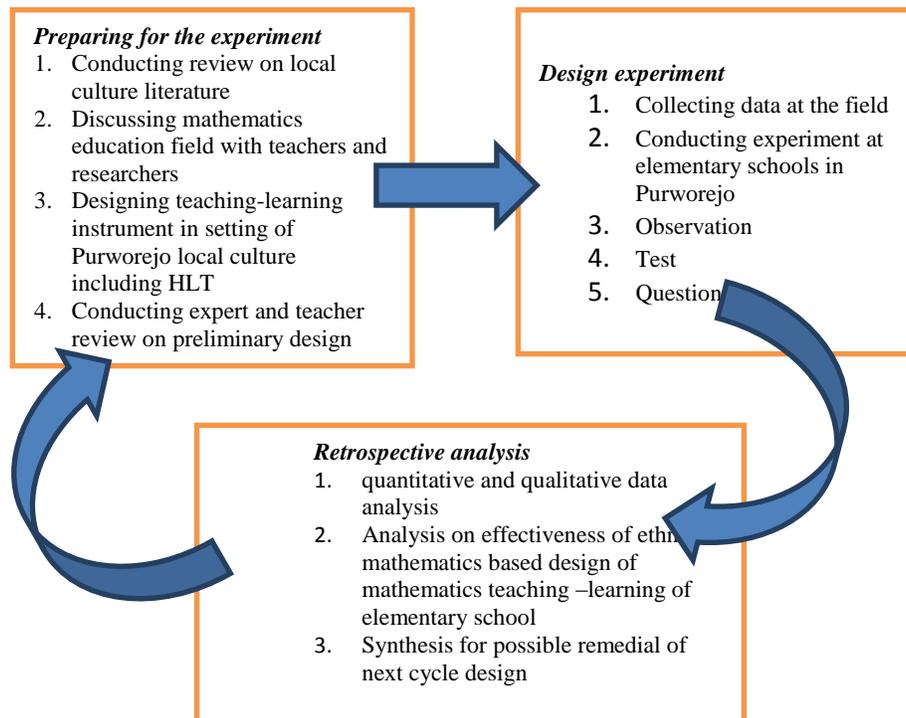
Teaching-learning instrument is a plan used as a guide in planning the classroom teaching-learning, so that the teaching-learning instrument is considered important in the teaching-learning process. In this case, it is mathematics teaching-learning instrument in mathematics at elementary school level-oriented on introduction to the culture in order to provide an understanding on mathematics concepts and instill positive values of culture, especially the culture in Purworejo area.

Based on several theories above, then the model of learning based on culture-based mathematics is based on constructivism learning theory, so that the required instrument of mathematics learning adapted to the theory. Learning instruments that are integrated with ethnomathematics emphasize the construction of mathematical knowledge by instilling positive cultural values.

## RESEARCH METHOD

This study uses design research method. The steps of the process of design research are like in the design process of education (educational design), in example, analysis, design, evaluation and revision which are as a cyclical process ended on the balance between ideal theory and the practice. According to Gravemeijer & Cobb (2006), the phases of the design research implementation are:

1. preparing for the experiment (preparatory research)
2. design experiment (the implementation of the experimental design), and
3. retrospective analysis (analysis of data obtained from the previous stage).



### III. RESULT AND DISCUSSION

#### Preparation for the experiment

At the stage of conducting an instructional analysis the researchers conducted an analysis of the learning that has been done in SD Negeri Sendangsari Purworejo. Where learning tends to be on the use of conventional learning models, students are accustomed to learning in groups. From the results of data collection in the form of literature review, discussion with teachers and researchers in the field of mathematics education then is applied in the design of learning instrument in local cultural settings Purworejo, continued by expert review conducted by experts of model and teachers of the initial design. From this preliminary activity, the product design was produced in the form of learning instrument consisting of teacher books, student book, student work sheet on the subject of the plane.

#### Design of the experiment

At the stage of designing and conducting formative evaluation, the researcher conducted product test to the students of SD Negeri Sendangsari as the subject of the research. From the results of these tests the obtained data are as follows: 1) the observation on the conducting of teaching learning model is good category; 2) the practicality of the learning model with an average score of 4,07 levels practicality is very good; 3) the student response to teaching learning model is in very positive category; 4) the test of evaluation of student learning outcomes reaches a complete percentage of students 86.11%.

#### Retrospective analysis

From the result of repetition of rectangular and triangular properties obtained at the designing and formative evaluation stage, the data are analyzed to see the effectiveness of the developed teaching learning model by taking into account the predefined effectiveness indicator. Based on the analysis of the replication results, the result of the classical class is 86.11%. In addition to see the effectiveness of teaching learning instruments the data analysis of student responses is conducted the result shows that the student response is in very positive category.

### IV. CONCLUSION

This study is a series of development research with an emphasis on products. The results of this preliminary study in the form of product design of teaching learning instrument are consisting of teacher books, student book, student work sheet, on the subject of the plane. The product of mathematics teaching learning instrument made is compatible according to the experts of model, teachers. Response with the average score of practicality 4,07 in good level practicality. Meanwhile student's response to learning is very positive with the percentage of students mastery level of 86.11%, According to the finding above the instrument is effective and can be used as reference and an alternative as a model of teaching learning oriented on the cultural settings that exist in Purworejo is exactly an effort to instill the positive cultural noble values.

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