Local instruction theory on spherical geometry?

I Nuraida

Pendidikan Matematika, Universitas Galuh, Jl. R.E. Martadinata, Nomor 150. Ciamis

Ida.nuraidamath@gmail.com

Abstract. This research is motivated by the lack of understanding of students on the spherical geometry. The purpose of this study is to analysis Local Instruction Theory (LIT) developed from Hypothetical Learning Trajectory (HLT) on the spherical geometry. The Lessons that include LIT are Realistic Mathematics Education (RME) learning. The research method is design research that starts from preliminary design, touch experiment and retrospective analysis with two cycles. The population in this study is all students of group IX. There are three activities to produce LIT to spherical geometry. These activities are: Identify the elements in the spherical geometry including the tube, cone, and ball, the activity find the concept of area and volume of spherical geometry, the activity of solving the problem area and the volume of spherical geometry, and the activity of applying problems with daily life

1. Introduction

In addition to thinking of HLT teachers need to identify learning difficulties faced by students, so in making learning materials can be on target. According to [1] learning difficulties faced students there are three kinds of adversity are: 1) the difficulty or hindrance resulting mismatch with the demands of children's ability levels of thinking contained in the materials; 2) difficulties due to the limitations of context in understanding a concept; 3) difficulties caused confusion or weakness related teaching material design. The third type of difficulty is it considerations for designing learning materials or learning new material.

Related things that have been put forth, then learning math should preferably be given by encouraging students and give an opportunity to the students to try to find themselves through the help of the teacher, so that created Local Instruction Theory (LIT) [2]. The appropriate learning approach that is a learning approach to Realistic Mathematics Education (RME). Related learning RME, [1] holds that mathematics should not be seen as learning materials that must be transferred directly as math ready-made, but rather should be viewed as a human activity. Learning math is done by giving them freely to students opportunity to try to find out for yourself, which is known by the term guided reinvention.

[1] also argue that mathematics is a human activity that emphasizes the student's activity to search for, find, and build their own knowledge necessary so that learning becomes centered on students. [3] try formulation mathematical process, in the context of mathematics education, into two types namely, horizontal and vertical mathematical.

Learning Trajectory (LT) is called HLT because the design is still a guess or hypothesis. LT is used to describe the transformations resulting from the participation of activities in learning mathematics, also used for a series of learning or learning paths. HLT is used as part of what is called the cycle of teaching mathematics (mathematical learning cycle) for one or two lessons and even more [6]. HLT consists of three components: learning objectives, which define the direction (learning objectives),

learning activities, and learning process hypotheses to predict how the students' thoughts and understanding will develop in the context of learning activities.

LIT with respect to descriptions, and backgrounds, expected learning routes so as to relate to a set of intructional activities for a particular topic [7]. In the opinion of [8], (1) the learning path plan deals with a small number of instructional activities and local instruction theories that encompass the whole set, and (2) the desired learning path plan according to the particular classroom setting, while the LIT consists of a framework work, which informs the development of a learning path plan for a particular classroom.

[9] states that LIT is a theory about the learning process that describes the learning path on a particular topic with a set of activities that support it. Broadly speaking LIT is the final product of HLT which has been designed, implemented, and analyzed learning outcomes [11].

2. Experimental Method

This research uses design research [10] to design trajectory material under realistic approach (Realistic Mathematics Education). This design is appropriate to answer research questions and attain research purposes. This research design defines a systematic analysis that designing, developing, and evaluating the intervention toward education (program, strategy, learning material, product, and system) as a solution to solve the complicated problems in education [4]. The cyclic occurs in design research. It is a repetitive activity from thinking experiment to learning experiment in diagram illustrating the experiment idea [5].
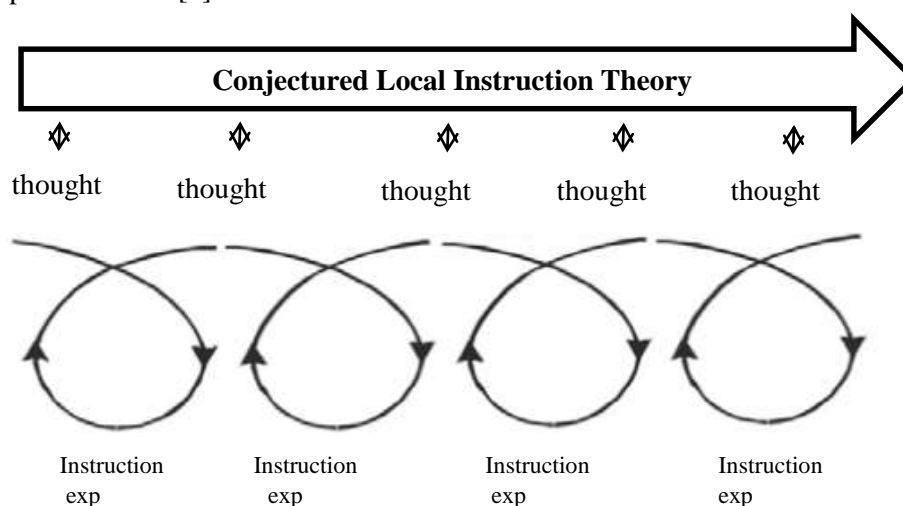
Figure 1. A cumulative cyclic process in design research [12]

According the picture that design research has the objective to develop a theory which is based on LIT that are based on the empirical basis of the experiment through collaboration between researchers and teachers aim to increase research relevance by having educational policies and practices. The method used in this research is the research design method (design research) to design the building of curved side space by using realistic approach (Realistics Mathematics Education). The design of this research is a suitable design to answer research questions and achieve research objectives. This study aims to design Hypothetical Learning Trajectory (HLT) and develop prototype Local Instruction Theory (LIT). So far, no one has been researching by designing HLT and developing LIT about building spherical geometry, that is why researchers take design research research.

3. Result and Discussion

At this stage the researcher analyzes the retrospective findings of the research objectives contributing to develop LIT [12] and answer the problem formulation. Learning with the RME approach is a learning that has three principles [9] namely; guided reinvention through progressive

mathematizing is a learning where students are given the opportunity to discover their own mathematical concepts by solving various contextual problems; didactical phenomenology is the principle whereby students are accustomed to free thinking and daring to argue; and self developed models is a principle that aims to bridge the knowledge of informal mathematics and formal mathematics of students. These principles are in accordance with RME's learning characteristics [7]. The main principle in RME learning is that students are given the opportunity to rediscover the mathematical concepts of the concept of finding the breadth and volume of the spherical geometry that includes tubes, cones and spheres.

Based on [13] about LIT by design research, phase 1: preparing for experiment or preliminary, this phase functions to implement initial ideas from literature analysis regarding learning of trajectory material, realistic mathematics education, curriculum, and design as the basic formulation of student' preliminary strategic hypothesis in learning spherical geometry. Phase 2: teaching experiment, the teacher ought to try predicting before students' mental activity occurs. Phase 3: retrospective analysis, in this phase to aim at developing LIT.

4. Conclusion

The result of HLT development into LT in this research is LIT using RME approach [11]. This LIT explains the steps that students should do by using RME learning related materials to construct spherical geometry in class 9. The steps that students do in learning RME are; the activity involves the concept of building up the curved side spaces associated with elements and identification; activity to discover the broad concept and the volume of spherical geometry; and activity to solve the problem of widespread area and volume of spherical geometry. Based on the matter related to spherical geometry, it can be concluded that LIT has its own uniqueness and uniqueness in the learning theory that is produced. This means that LIT only applies to one material itself.

5. Acknowledgments

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