HYPOTHETICAL LEARNING TRAJECTORY ON THE NUMBER PATTERN IN ELEMENTARY SCHOOL

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Abstract

The background of this research is by the findings in field about the difficulties of students in 1 grade in completing mathematics problem on number pattern. The finding informed the low ability of students in order number rightly. Based on that findings, then analysis is held to find the ideal way on number pattern material. The analysis result to that material will produce a Hypothetical Learning Trajectory (HLT) so it can minimalize the learning obstacle. This article will discuss about what is meant by HLT and how to set a HLT on number pattern material. The research method used is qualitative method. The subjects of this research are 24 students in grade 1 elementary school. Instrument used in this research is lesson design, test and non test. Test Instrument is constructed by number pattern material which have been studied, non test instrument is the structured interview to students and teacher. Data collected are analyzed descriptively to decide the ideal learning. The result of this research are material and learning trajectory which given positive interaction description of students toward HLT which have been developed, so it can be concluded that by HLT, it is expected to minimalize students learning obstacles.

Keywords: Hypothetical Learning Trajectory, Learning Obstacle, Number Pattern

INTRODUCTION

The Mathematics’ learning in 1 grade elementary school is differ to the others grades. It is for the first time is taught to them formally so it’s need a special strategy to make students happy because happiness is important till next grades. Based on 2015 Programme for International Student Assessment (PISA) rank of mathematics ability in age 15, Indonesia is in 64 ranks (OECD, 2016). This position is increasing, previously in 2012, Indonesia is in 71 of 72 countries ranks (OECD, 2012). Therefore, mathematics learning in primary grade need a special attention such as cultivation of the right concept, because the primary problem in mathematics education is disability to teach the basic concept (Ozkan & Ozkan, 2012).

Learning observation in class was on October 2016, showed that teacher was monotonous to text book and give short explanation to students. When the teacher asked, some students had difficulties in mentioning numbers order from 20 to 1 and determining image pattern order. It is contrast to students’ understanding level which according to Piaget they are in operational concrete. Means in the presenting order or number pattern it is better combined with concrete things. Based on that findings, so it needs material design and learning trajectory.

Lesson plan development depends on teacher in adapting the material to students’ ability, situation and class condition. Those are done in order all objectives learning components include cognitive, attitude, and skill aspects can work optimally. If the third aspects can be well measured, then students’ improvement ability data completely get (Nurbudiyan, 2013).

Permendikbud learning principles (2016) i.e., from students being told to students finding out, from the learning emphasizes single answer to multi dimensional answer, from
verbalized learning to aplicative skill. So, developing lesson plan which fulfill learning principles criteria, is needed. Before planning and setting learning devices, students’ learning obstacle data are needed. Data are analyzed to produce a material and learning trajectory as the step of structured learning.

LEARNING OBSTACLE
In learning sometimes teacher knows some students have learning obstacle by positive (such as happiness rising, passion to study) and negative responses (such as students feel restless, nervous, shaking and disable to answer the question given).

According to Brousseau (2002) learning obstacle happen because:

1. Obstacle of ontogenic origin is mismatching between learning and design given to students’ thinking readiness.
2. Obstacle of didactical origin happens because of learning taught by teacher who makes mistake in transferring core learning, this is teacher’s fatal mistake.
3. Obstacle of epistemological origin is someone knowledge is limited to certain context.

In this case, students’ vision toward one concept to another is disconnect and incomprehensive.

Hypothetical Learning Trajectory
Hypothetical learning trajectory (HLT) is a term stated by Simon (1955) to show how a teacher set a learning design. Learning trajectory is not absolute, word “Hypothetical” means a teacher can change and adapt aspects of lesson plan according to teacher observation in students’ understanding and learning obstacle based on their tasks.

Teacher’s task in creating right learning situation, should consider ideal order like learning trajectory which will be faced by students so learning objective can be achieved. The lesson plan usually less considering the students’ variety responses on develop didactic situation, so series didactic situation that developed for the next will not suitable with the learning trajectory variety of each students (Suryadi & Turmodi, 2011).

Needs to consider in planning and setting HLT according to Simon and Tzur (2004) are;
1. HLT is based on cognitive understanding of students who involved.
2. HLT is media to plan the certain mathematics learning concept.
3. Provide tools to support certain mathematics learning emphasized on concepts and procedures.
4. Teacher is involved in modifying HLT aspects.

In teaching number patterns, students must be comfort in creating and expanding patterns which can be build using simple materials i.e., buttons, colored blocks, cubes, toothpicks, geometric shapes, or other objects that are easily obtained (Van de Walle, 2008). A research on using lego to teach number patterns to XI grade students in Junior High School showed that the activities helped students to understand number patterns (Handayani, et al., 2015).

RESEARCH OBJECTIVES
The research objectives is developing learning material and learning trajectory of mathematics in 1 grade on number pattern. Learning trajectory is constructed based on learning obstacle and interview result of teacher and students.
POPULATION AND SAMPLE

The setting of research is in one of Bandung City elementary school. The subjects are students in first grade amount 24 students; 10 males, 14 females. The research is held in even semester academic year 2016/2017.

INSTRUMENTS

The research instruments are lesson design, test, and non test. The test is written test to measure students’ ability in completing number pattern test, whereas non test instrument are teacher and students’ interview.

METHODOLOGY

This research is using a qualitative approach. It is the study to investigate quality of relations, activities, situations, or materials which emphasized on holistic description which explains all details occured during certain activities situations instead of comparing certain manipulations effects (Fraenkel, et.al., 2012). This is in line with Moleong (2014) who stated that qualitative research aims to understand phenomenon experienced by the subject. So, the data presented in this paper is the description during the research.

DISCUSSION

After observing learning obstacle by some students’ answer orally and writtenly, the information conclude as follow, the students have difficulty in using simple concrete things to find the number pattern, students are not able finding simple image pattern which show number pattern, students are not able to prove the number pattern answer which they get and students difficult to complete number pattern till 20.

Based on that analysis, learning material and learning trajectory is designed to minimalized the learning obstacle. The learning material should be considered by teacher in design learning, a learning material must be able to help students in building their knowledge. Learning trajectory must be theoretically validated by three reviewers, among 2 mathematics experts and 1 low grade classroom teacher. The validation process are assessment, suggestion, comment.

Below is learning trajectory which constructs based on number pattern material in 1 grade elementary school:

Picture 1. Learning Trajectory Structural
The steps in developing material and learning trajectory are:
1. Designing the learning series based on learning trajectory which are the material development and activities that will be done based on the identifying of learning obstacle, produces draft.
2. Draft 1 design, then being content and language validated by the validator. Revision is done based on the validation result so it produces the draft 2 design.
3. Draft 2 design is bringing back to validator. This step is doing till producing n-draft (the best draft). Next, after the draft is available, then it consulted to teacher before the try out is held.
4. If the teacher approved to practice in classroom, then for the next step is the learning trajectory is tried out in 1 grade.

Below is mathematics lesson design in grade 1 on number pattern:

Objectives:
1. Making number pattern 1 till 20 by using concrete things
2. Completing number pattern sequences 1 till 20
3. Describing number pattern sequences 1 till 20

<table>
<thead>
<tr>
<th>Didactical Situation</th>
<th>Expected Students’ Response</th>
<th>Teacher’s Role/ Guide</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>CLASSICAL ACTIVITY</strong></td>
<td>Students are expected to be able to get number pattern basic knowledge</td>
<td>Explains that concrete things can show numbers sequences.</td>
</tr>
<tr>
<td>Teacher provides carton ready to stick and max 30plastic glass lids to order the shape that show number pattern</td>
<td>Students are expected to be able to continue the next shape.</td>
<td>Provides concrete things that are clearly visible to all students such as glass lid</td>
</tr>
<tr>
<td>Students give attention to teacher while order first and second shapes from the lids</td>
<td>This activity will stimulate students to guess or estimate the answer and solution to the question given.</td>
<td>Keep conclusive situation before starting to order concrete things.</td>
</tr>
<tr>
<td>Students give task to complete third and fourth shapes</td>
<td>Students use their reasoning to complete shape 3 and shape 4</td>
<td>Directs students on the process to get the next shape</td>
</tr>
<tr>
<td>Students determine third and fourth shape</td>
<td>At first, students might have problems so teacher directed.</td>
<td>Be students’ facilitator</td>
</tr>
<tr>
<td>Students explain the way to get third and fourth shape</td>
<td>If don’t get third shape, teacher will direct.</td>
<td>Make effort in students to answer correctly</td>
</tr>
<tr>
<td>Students explain the way to get fifth shape and so on</td>
<td>Students are able to mention the additional two lids on each shapes.</td>
<td>Directs students to discover that sequence of concrete things represents sequence of number pattern</td>
</tr>
<tr>
<td>Students can mention number pattern which formed</td>
<td>Students can mention number pattern of 1, 3, 5, 7 and so on</td>
<td></td>
</tr>
</tbody>
</table>

...
Example the written test after the classical learning:

1. Complete the sequence of back numbers on these football jerseys!

2. Complete the date in this calendar below!

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
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<tbody>
<tr>
<td>13</td>
<td>14</td>
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Indonesia’s independence day

3. Draw the correct flower on the fourth image in this line!

After lesson design have been tried out in grade 1 by observing and interview the teacher and students, it is proven that students more simple to understand number pattern by using concrete things and students feel happy in learning based on learning trajectory which set.

**SUGGESTION**

Planning and set the learning by making learning materials and learning trajectory is recommended according to students’ need. That is essential to do in order the essence of material which transfered by teacher can be received optimally for students. So the objectives in learning principles can be achieved. To design the the learning, it needs various data such as learning obstacle and interview, that usable as guideline in construct a HLT. The HLT result is expected can be applied by teacher in first grade, especially in number pattern.

**BIBLIOGRAPHY**


