How to develop higher-order thinking skills?

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Abstract. This research intends to produce a mathematical learning design based on Manggarai Local excellence in developing the higher-order thinking skills of students at extraordinary school. This research was a design research that went through three stages, namely initial research, implementation, and retrospective analysis. Data collection were done through post-test results, questionnaires, and observation. Data were analyzed descriptively. The result of the research is mathematics learning based Manggarai local excellence can develop higher-order thinking skills of students at extraordinary school. This result can be motivation for readers or teachers to integrating the local excellence in learning activities.

1. Introduction
Mathematics learning based on local excellence can bring students closer to everyday life and student residence. Many mathematics around us, so the teachers and students can get to know mathematics more closely. Teachers and students can take advantage of local superiority in areas related to mathematics because it can help facilitate students' understanding of mathematics [1]. Integrating local that mathematics learning based on local excellence can increase higher-order thinking skills (HOTS). HOTS is based on contextual problems, non-routine, and interesting stimulus [2].

Some research results of learning based on local excellence and HOTS, namely realistic mathematics learning in local excellence-based educational games, can build students' mathematical communication [3], computer Assessment Instrument which promotes students' HOT skills improvement and aids the assessment process for instructors [4], and the recommended coefficient of resolution of HOT skills development services and helpful tool of analysis of this process [5]. However, students have difficulty in learning mathematics when the mathematics material taught is not relevant to the way of life of the community/students. Mathematics was difficult to understand because there were two schemes obtained, namely the scheme obtained in the environment and the scheme obtained in school [6]. HOTS is a literacy problem in Indonesia [7].

In addition to these studies, researchers have the latest research. Researchers research mathematical learning design based on Manggarai local excellence to develop higher-order thinking skills. The design of realistic mathematical education (RME) based on Manggarai local excellence can improve HOTS because, with the use of contextual and non-routine problems, students can find certain material concepts using certain local excellence, and the problems presented are certainly interesting. Besides, students are accustomed to thinking critically, being able to solve problems well, argue, and make informed decisions. This study aimed to produce a mathematical learning design prototype based on Manggarai Local excellence in developing higher-order thinking skills.
The design of RME based on local excellence is to integrate some local excellence in Manggarai on realistic mathematics learning syntax so that the learning syntax can be described as follows:

1) Presenting contextual problems, in this case, we can take advantage of the Manggarai local excellence that students know. Students are asked to understand and resolve the problem according to the instructions given. Some local advantages used in this study, namely:

a. Lodok

![Figure 1](image1.jpg)

**Figure 1.** Figure 1 is one of the Manggarai local excellence and is often visited by tourists. The name of this place is Lodok. Lodok can be integrated into mathematics learning.

The teacher asks students to observe the picture then asks students about how the picture relates to mathematics. Is mathematics in the picture? Students are guided to find mathematics in the picture and students are expected to be able to build an understanding of mathematics from the picture. Lodok can embed the concepts of triangles, rectangles, and circles. Next, we guide students to find the width and circumference of the third flat shape based on the definition of circumference and area of awake. Thus, students get through the picture.

b. Mbaru Niang

![Figure 2](image2.jpg)

**Figure 2.** Figure 2 illustrates the model of the Manggarai traditional house which is commonly called mbaru niang. Mbaru niang in this picture is located in one of the tourist attractions which is often called Wae Rebo. Students can construct mathematical concepts through this picture.

The same thing is done for this figure, so students get the concept of cones from this picture.
c. Songke

![Songke Cloth Image]

Figure 3. Figure 3 shows the Manggarai woven cloth commonly called songke. Mathematics is also in songke.

The same thing was done on the songke cloth image, so students found the concept of rhombus from this picture.

2) Explain contextual problems
In this case, we help students provide solutions if they have difficulty understanding the problems given.

3) Resolve contextual problems
Students are divided into certain groups and are asked to solve problems that have a worksheet given. At this stage, students are expected to complete the questions given in their way and answers that are different from each group.

4) Compare and discuss problems
At this stage, each group compares the answers. Thus students are trained to be able to express opinions in front of friends and teachers.

5) Draw conclusions
The teacher directs students to conclude concepts, definitions or mathematical procedures related to contextual problems that have just been resolved. Then from the results of the conclusions obtained can be related to the actual conditions in life.

2. Methods
This research was design research and carried out at SLB / B Karya Murni Ruteng. The research subjects were adjusted to the research stages and the sampling technique was purposive sampling. Data were collected through tests, questionnaires, and observations. The instruments used were validation sheets, learning implementation feasibility sheets, students and teachers response questionnaires, and HOTS tests. The flow of the research design adopted the steps that Plomp presented, namely 1) we are preparing for the experiment at this stage hypothetical learning trajectory (HLT). At this stage, a preliminary design is needed to implement original idea obtained from the literature review before designing RME based on Manggarai local excellence. So at this stage, RME based on Manggarai local excellence prototypes were obtained; 2) experiment design (implementation of experimental design), at this stage the researcher collects data to answer the problem of research statements. Design prototypes that have been designed are tested or implemented in mathematics learning. The experiences that occur at this stage will be the basis for the redesign or modification of the HLT for subsequent learning processes,
and 3) retrospective analysis (analysis of data collected from the previous step). The step aims to analyze the data collected, both in the form of qualitative and quantitative. The results of the analysis are guidelines for answering research questions. The results of the study are effective indications and whether or not the prototypes of the RME based on Manggarai local excellence in developing HOTS.

3. Result and Discussion

3.1 The validity of the learning device
The average score of the results of the validation of the learning device, namely:

Table 1. Recapitulation of the validity of learning device

| Number | Learning device       | Average | Criteria |
|--------|-----------------------|---------|----------|
| 1      | Student’s book        | 2,7     | Valid    |
| 2      | Teacher’s manual      | 2,6     | Valid    |
| 3      | Plans for implementing| 2,7     | Valid    |

Table 1 informs that all learning devices fulfill the validity aspects.

3.2 Practicality of Learning Devices Data
Data on the practicality of learning devices is obtained based on observations by 2 observers of classroom learning activities and students' and teachers' response questionnaires. In this study, observer 1 was an SLB / B Karya Murni Ruteng math teacher and observer 2 was researchers. Data from observations were presented as follows:

Table 2. Data Recapitulation of Observation Results of Learning Devices

| Observation       | Observer 1 | Observer 2 | Total | Criteria   |
|-------------------|------------|------------|-------|------------|
| Limited trial     | 3,1        | 3,3        | 3,2   | Practical  |
| Field trial 1     | 2,8        | 2,8        | 2,8   | Practical  |
| Field trial 2     | 3,6        | 3,8        | 3,7   | Very practical |

Table 2 concludes that the criteria for learning devices developed in limited trials are the same as field trials 1, which are practical, while the learning device used during learning in field trials 2 is very practical, so the learning devices developed have met practicality criteria. We can see the questionnaire responses of students and teachers to learning devices in the following table:

Table 3. Recapitulation of Student Response Data on Learning Devices

| Observation       | Average | Criteria |
|-------------------|---------|----------|
| Limited trial     | 3,2     | Practical|
| Field trial 1     | 3,3     | Practical|
| Field trial 2     | 3,4     | Practical|

Table 3 shows that the learning devices used meet practical aspects

Table 4. Data Recapitulation of Teacher Responses

| Number | Observation  | Average | Criteria |
|--------|--------------|---------|----------|
| 1      | Limited trial| 2,8     | Practical|
| 2      | Field trial 1| 3,0     | Practical|
| 3      | Field trial 2| 3,4     | Practical|

Table 4 also shows that the learning devices used meet practical aspects.

3.3 Effectiveness of Learning Devices
The effectiveness of learning device data is obtained based on the test results done by students who are oriented to HOTS. The data can be seen in the following table:

| Number | Observation     | Interval | Student Score | Percentage |
|--------|-----------------|----------|---------------|------------|
| 1      | Limited trial   | X < 75   | 0             | 0%         |
|        |                 | X > 75   | 6             | 100%       |
| 2      | Field trial 1   | X < 75   | 0             | 0%         |
|        |                 | X > 75   | 30            | 100%       |
| 3      | Field trial 2   | X < 75   | 0             | 0%         |
|        |                 | X > 75   | 30            | 100%       |

If X <75, the criteria are not good. Whereas X> 75, the criteria are good. So based on the data in the table, it is concluded that the learning device used is effective because it can increase HOTS.

So, the results of the study show that the design of RME based on Manggarai local excellence is effective for increasing HOTS. Integrating local excellence of Manggarai in RME can develop HOTS students. The presentation of contextual problems in the form of local excellence of Manggarai greatly helps students to get closer to mathematics. Students can think that mathematics is identical to the things that are in our daily lives so students are motivated to be mathematical. Linking mathematical material to the local excellence of Manggarai is one form of interactive content. We must incorporate interactive content into the learning materials used by students, so students are more enthusiastic in learning [8]. At RME, students are guided to solve the problem given. Usually, the problem given is a non-routine problem, the questions given are also story questions. So that at this stage, students are led to solving the problem of story problems, interpret information with their language or use other languages /sentences, understand complex information, conceptual understanding, and think critically [9]. Students also compare the answers with the answers of other groups. Then students draw conclusions based on the results of discussions with other groups. So, the activities carried out in learning in this study illustrate that the learning carried out is student-centered learning, while the abilities that appear to students reflect the characteristics of HOTS.

4. Conclusion
Based on the previous descriptions, we conclude that RME based on Manggarai local excellence was effective in developing HOTS. The advice that can be given is that the teacher should be able to use this model as an alternative to classroom learning.

5. References
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