METACOGNITIVE LEARNING MODEL ORIENTED BY HOTS TO INCREASE STUDENT MATHEMATICAL LITERATION

Sitti Inaya Masrura[1], Nenny Indrawati[2] and Andi Alim Syahri[3]

[1,2]Mathematics Education Department, Universitas Sulawesi Barat
[3]Mathematics Education Department, Universitas Muhammadiyah Makassar

[1]sittiinayamasrura@unsulbar.ac.id
[2]nennyindrawati@unsulbar.ac.id
[3]andialims@unismuh.ac.id

Abstract
This study aims to develop a lesson plan and student activity sheets metacognitive model oriented by HOTS which is valid. Lesson plan and student activity sheets developed as effort to improve students' mathematical literation ability in comparative subject. The research method used in this study was Research and Development approach. The design of this study consisted of 2 (two) steps, i.e., doing Front-End Analysis and Prototype step. Prototype step consisted of design lesson plan and student activity sheets metacognitive models and validity it oriented by HOTS. The data were analyzed using qualitative descriptive technique. The results showed that the prototype were valid, both in content and construct with lesson plan score was 3.78 and student activity sheets score were 3.79.

Keywords: Metacognitive, HOTS, Mathematical literacy, Lesson Plan, Student Activity Sheet

1. Introduction

The Education has important role in the generation of people who are competent and competitive according to the development of science and technology. Mathematics is the basic in the development of science and technology. Therefore, mathematics and understanding are needed holistically, were someone not only understands mathematics but also applies it in the life. This ability is known as mathematical literacy. Literacy or mathematical understanding is defined as the ability of an individual to formulate, use, and interpret mathematics in various contexts.It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to explain and predict phenomena. Thus mathematical literacy helps a person to recognize the role of mathematics in the world and make judgments and decisions needed as citizens(OECD, 2013).

The achievement of mathematical literacy can be seen from the results of Indonesia's participation in several international comparative studies, such as Trends in the International Mathematics and Science Study (TIMMS) and the Program for International Student Assessment (PISA). The results of the TIMSS which aim to determine the development of mathematics and natural sciences of 13-year-old students, have not shown satisfactory performance. Indonesian students in mathematics ability in 1999 were only able get 34th rank out of 38 countries. In 2003, the mathematical abilities of Indonesian students ranked were 35th out of 46 countries. Furthermore, in 2007 the achievements of Indonesian students did not show significant increase, mathematical ability was ranked 36th out of 49 countries (Pupendik, 2012). The latest TIMSS results in 2011 also did not much different, mathematics ability was still ranked 38th out of 42 countries(Kemdikbud, 2013).In PISA 2012 the achievement of Indonesian student’s mathematical literacy getting worse, which was only ranked 64th out of 65 countries. These results indicate that students' mathematical literacy in Indonesia based on international studies is still not satisfactory. The low mathematical literacy is indicated by the instruments used to measure high-order thinking skills (HOTS) that have not been able to be mastered by students well. Therfore, improving HOTS has become one of the priorities in learning school mathematics.

Metacognitive ability is cognitive ability that are seen as relevant to high-level ability, because metacognitive ability is second-degree thinking ability that require knowledge of their own knowledge and knowledge of others, so that they are expected to improve their mathematical literacy ability. The facts also showed that students’metacognitive ability is still low, so it is important and urgent problem to be solved(Siagian, Saragih, & Sinaga, 2019). Based on the description above, the researcher considers that it is needed to develop lesson planand student activities sheet metacognitive learning model oriented by HOTS to increase student mathematical literation.

2. Review of Literature

2.1. Metacognitve learning model

Flavell reveal that metacognitive activity actually activity "thinking about thinking", is the activity of consciously controlling the cognitive process it self (Livingston, 2003). Ridley said metacognitive activity includes thinking activity to plan, monitor, and reflect how to solve a problem(Livingston, 2003). Metacognitive knowledge is about learning in yourself.

Metacognitive refers to higher thinking patterns that involve active supervision to cognitive processes in learning.

Huitt said that metacognitive thinking enables students to benefit from instruction and influences the use and maintenance of cognitive strategies. While there are several approaches to metacognitive instruction, the most effective involve providing students with both the knowledge of cognitive processes and strategies, and experience or practice in using both cognitive and metacognitive strategies while evaluating the outcomes of their efforts. Simply providing knowledge without experience, or vice versa, does not seem to be sufficient for the development of metacognitive control(Hargrove, 2013). The phases of the metacognitive learning model are as follows. (1) Preliminary. In this phase, students explore the prior knowledge related to the material to be discussed. (2) Development of cognitive ability. At this stage, students are given chance to solve cognitive problems. (3) Development of metacognitive abilities. Before metacognitive ability is developed, initally, students are given mathematics problem based on metacognitve, then countinues to next phase. (a) Planning, the teacher guides students in planning and implementing the completion procedure, the cognitive strategy used, and prior knowledge which is relevan in solving the problem. (b) Monitoring, the teacher guides students in monitoring completion procedures, relevant prior knowledge and cognitive strategies used. (c) Reflection, the teacher guides students to reflect the process of understanding concepts that have been done in activity to solve mathematical problem based on metacognitive. It is done by comparing the results obtained by students and the reason which are given, so that in this case there will be a process of controlling and reflection on cognitive activity that has been carried out. (4) Closing, at this stage, students are guided in making conclusion from the learning that has been done(Listiani, Wiarta, & Darsana, 2014).

Based on several opinions stated above, it can be concluded that the metacognitive learning model is a learning model designed to increase awareness about the thinking process in learning so that, when this awareness is realized, students can guard their mind by designing, monitoring, and evaluating what they learn.

2.2. *Highorder thinking skill (hots)*

In cognitive domain, HOTS is at the level of analysis, synthesis, and evaluation. While after HOTS was revised at the level of Analyzing, Evaluating, and Creating(Anderson et al., 2001). Resnick defines high order thinking as not routine or not fully known in advance, complex, multiple solution or view points, involves uncertainty, involves process of making meaning, is effortfull requirts in mental work(Yen & Halili, 2015). Ernawati reveals that high-level thinking or higher order thinking skills (HOTS) is a way of thinking that no longer verbally memorizes but also means the essence contained among them, in order to be able to interpret the meanings, integralistic thinking is needed with analysis, synthesis, association to draw conclusions towards creation of creative and productive ideas(Aningsih, 2018). Based on arguments above, it can be concluded that higher order thinking skills (HOTS) is a high-level thinking by analyzing, synthesizing, and evaluating information so the students can interpret and make decisions on certain conditions and create new something.

2.3. Mathematical literacy

In PISA, mathematical literacy is a person's ability to formulate, apply, and interpret mathematics into many contexts, include mathematical reasoning and using concepts,

procedures, facts and tools to explain, describe, and predict phenomena. Mathematical literacy helps someone to understand the role and usefulness of mathematics in everyday life besides using it to make the right decisions as citizens who build, care, and think(Sari, 2015).

Mathematical literacy is the capacity of students to formulate, apply, and interpret mathematics in various contexts, including mathematical reasoning and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena(OECD, 2013). Other argues that mathematical literacy is knowledge to know and use the basic of mathematics in daily life(Ojose, 2011). Based on arguments above, it can be concluded that mathematical literacy is abiltty to formulate, interpret mathematics in various contexts, and apply it in daily life.

3. Research Method

This study was research and development approach. The development research approach was used to design and develop lesson plan and student activity sheet metacogniteve learning model oriented by HOTS which was valid. The design of this study was consisted of 2 (two) steps, i.e., doing Front-End analysis and prototype stages. Development of prototype consisted of designing lesson plan and student activity sheet metacogniteve learning model oriented by HOTS which was valid. The data were analyzed by qualitative descriptive techniques. The procedure of this study which was adapted, can be seen in figure 1 below (Yenti, Afriyani, & Herawati, 2012).

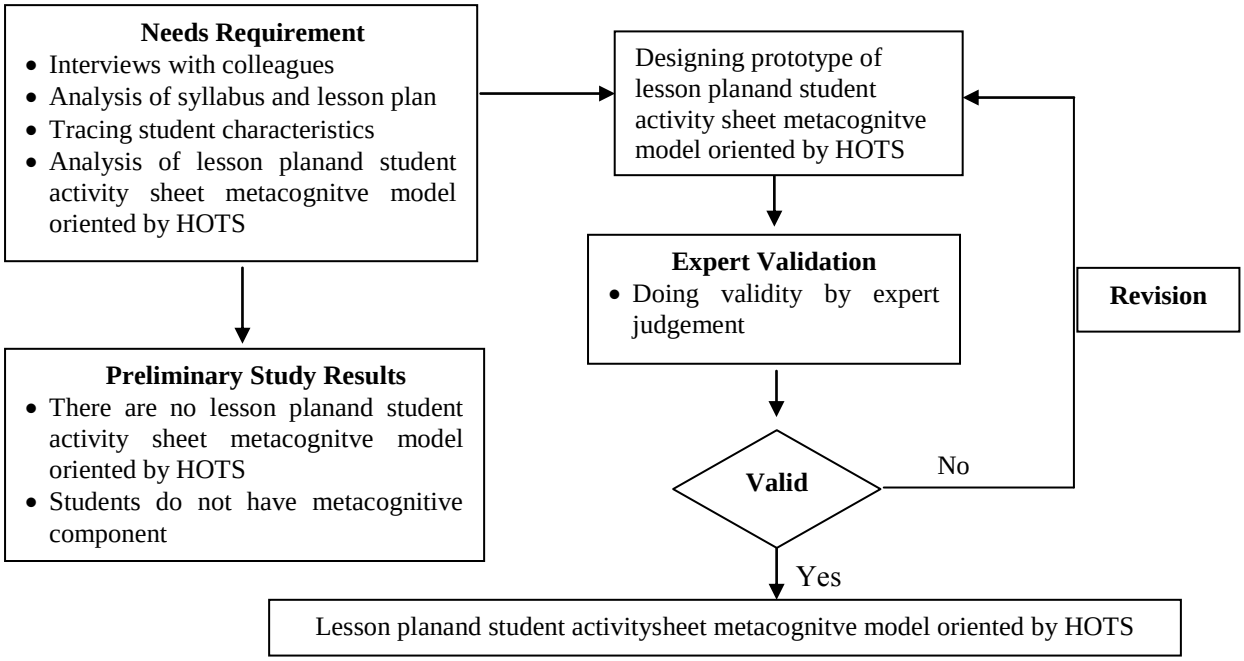

Figure 1.Research Prosedure

Validation of lesson plan and student activity sheet metacognitive model oriented by HOTS observed in contents and constructs, the questions posed in the validation sheet are in table 1 below.

Table 1. **Validation of Lesson Plan and Student Activity Sheet Metacognitive Model oriented by HOTS**

Validated Aspects	Method of Collecting Data	Instrument
1. Lesson Plan *Format:* Suitability of lesson planformat with curriculum 2013 Completeness of lesson plancomponents Suitability of letters, type, and font sizes *Language* The use of language is reviewed from the use of Indonesia language Simplicity of sentence structure, clear, and easy to understand *Content* or *LearningActivities* Suitability of graduate learning achievement, with content standard Expected final ability clarity Suitability of the syntax of learning activities with metacognitive learning model Learning activities have provided opportunities for students to realize and control their knowledge Learning activities have provided opportunities for students to make conclusions, considerations, and correct decisions The accuracy of the assessment form Suitability of learning activities by relating to aspects of mathematical literacy ability 2. Student Activity Sheet *Format* Clarity of material distribution It has a clear appeal and numbering system Conformity between text and illustrations Suitability of the layout space, type, and font size *Language* The use of language is viewed from the Indonesian language rules Clarity of instructions / directions and comments Simplicity of sentence structure The language used is commutative *Illustration*	Discussion with mathematics education experts	Validation sheet

Validated Aspects	Method of Collecting Data	Instrument
Illustration support to clarify concepts It has a clear and easy to understand appearance *Content* Explanation of cognitive strategies Willingness of space for students to apply cognitive strategies Subject matter is grouped in logical parts Determination of basic competencies and indicators Suitability of problems with indicators Integration of the metacognitive model and mathematical literacy ability Mathematics problems oriented HOTS		

The analysis of validity test can be seen on table 2 below

Table 2. Validity Criteria

Interval	Level of Validity	Conclusion
$3,5 \leq M \leq 4,0$	very valid	no revision
$2,5 \leq M \leq 3,5$	Valid	small revision
$1,5 \leq M \leq 3,5$	less valid	large revision
$M \leq 1,5$	Invalid	can't applied

M= Average all aspects of all validators. Table of validity criteria was adopted from (Murtafiah, Masrura, Indrawati, Arsyad, & Awi, 2018).

4. Result

The design of lesson plan and student activity sheet prototypes were based on Front-End analysis through interviews with peers, syllabus and lesson plan analysis, tracing students' characters, analysis of lesson plan and student activity sheet literature and metacognitive aspects. The results of the analysis are then used as reference in designing lesson plan and student activity sheet metacognitive learning model oriented by HOTS as an effort to improve students' mathematical literacy ability.

The characteristics of the lesson plan that had been designed and developed were mentioned as follows: (1) Subject identity contains: education units, subjects, time allocation and semester; (2) Core competencies: basic competencies and indicators of achievement competencies taken from mathematics syllabus in accordance with the comparison subject; (3) Learning goal; (4) Learning resources: contains learning resources that become a reference in learning activities; (5) The learning model used was metacognitive model oriented by HOTS that was integrated with the scientific approach that characterizes the 2013 curriculum. Metacognitive learning model given activities that can activate the metacognition component with student activity sheets which contained problem oriented by HOTS, so they could stimulate student literacy; The phases: (a) Introduction; (b) Development of cognitive ability; (c) Core activities: Development of metacognitive ability consisted of Planning, monitoring,

evaluation and reflection; (d) Closing; (6) Learning activities contained teacher and student activities during learning. Each meeting the learning activities were adjusted to the metacognitive model so that learning activities could stimulate student metacognition processes, which were then expected to become accustomed to monitoring, regulating, evaluating and reflecting on what he thought about his own learning process; (7) Assessment: it's about assessment and instruments to measure indicator achievement. The syntax lesson plans are listed in table 3below.

Table 3. Examples of Learning Activities in Lesson Plan Metacognitive Model oriented by HOTS as Effort to Improve Literacy Ability

The Syntax of the Learning Model	Teacher activity	Student Activity
Introduction (Problem Orientation: Exploring students' initial knowledge regarding Comparative matter)	Greetings, attendance Delivering main Competencies, Basic Competencies, Indicators of Competency achievement and Learning objectives CSASsify students in groups Connect learning activities to the experiences of students. Example: The teacher asks how many people live in your house. Try to compare between the number of men and women!	Answering greetings, pray Listening to Teacher's delivery Make study group Notice to the example given by the teacher Thinking about solving problems submitted by the teacher
Cognitive Ability Development (Submission of Cognitive type problems)	Asking Questions that have relevance to the matter understands the comparison of two quantities. Suppose that from 30 students, 20 students like Mathematics and 10 others like physics. How do you compare the choices of students who like mathematics by liking physics?	Thinking about the possibility of solving the problem submitted by the teacher Answering Teacher's questions
Main activities (Development of metacognitive abilities) Submission of metacognitive type problems)	- Ask students to discuss Matter Chapter 5 about comparison	- Discuss in groups
Stage 1. PLANNING	- Ask students to observe pictures on books / worksheets, other interactive media related to understanding and determining the ratio of two quantities - Provide material related to understanding and determining the ratio of two quantities - Provide opportunities for students to identify as many questions as possible related to images that lead to the concept of two quantities comparisons - The teacher responds to students'	-Observe pictures on books / worksheets, other interactive media presented by the teacher - Listen to the matter presented by the teacher -Listen to the teacher's

The Syntax of the Learning Model	Teacher activity	Student Activity
Stage 2. MONITORING	questions and answers, by asking questions then directing them to the definition of comparison -The teacher makes students aware of the knowledge they already have ("Okay, until here you can understand the two-dimensional comparison definition, by asking students to name which examples and not comparative examples.") - The teacher asks students to ask themselves what they have and have not known about the matter - The teacher assures students about the knowledge they already have and uses it in solving problems that will be proposed in the SAS	explanation and issue ideas and related questions -answer teacher questions -Make research about examples and not examples of comparison -Students monitor their own idea by writing what they have and have not known into the available SAS
Stage 3. EVALUATION AND REFLECTION	- The teacher asks several students to present their answers in front of the cSASs - The teacher asks for the responses of other students by checking "Are there other alternative answers?" - The teacher asks students to discuss and check the verity	- students present their work - students respond to the results of their friends' presentations and submit other alternative answers - Students evaluate their answers and correct them if something goes wrong
Closing (Making conclusions about subject matter)	- The teacher provides strengthening to students about the definition of comparison and correct answers to the problems given by asking a few questions - The teacher asks students to make conclusions about the material - The teacher asks students to make notes about their learning experience today - The lecturer gave the Homework in the form of HOTS oriented questions	-students answer teacher questions -students make conclusions -student make daily note

The prototype of student activity sheet was not only designed by referring to the general role of the development of student activity sheets, but also refered to the development of metacognitive ability that contained questions about self-assessment. The specific characters from student activity sheet were as follows: In the student activity sheet, students fill in a number of questions that direct the extent of their understanding of the material between them: what do you think about this problem? "; "Can you solve this problem? "How do you solve this problem?" The problem and exercices were problem oriented HOTS or problem which was adopted from TIMMS and PISA. Result data of expert assessment to the lesson plan and student activity sheet were summarized in following table 4below.

Table 4. Description of The Results of Expert Assessment of Learning Devices

Devices	Indicator	Assessment	Conclusion
Lesson Plan	Format	4,00	
	Language	3,75	
	Content/Activity Learning	3,60	
	Average	3,78	Valid
Student Activity Sheet	Format	3,91	
	Language	3,87	
	Illustration	3,83	
	Content	3,58	
	Average	3,79	Valid

In the lesson plan validation sheet the experts suggest, i.e.: learning goal in the understanding aspect had to the stage of distinguishing between examples and non-example of the two measurement. The use of language needed to be observed so that the sentence structure is obvious, Assessment needs to be attached. Furthermore, in the student activity sheet validation sheet suggested, i.e.: Indicators need to be added, emphasis on questions that activated metacognitive ability and given problems that had hingh order thingking.

5. Discussion

The revision result and assessment by the validator could be concluded that validity of lesson plan and student activity sheets have been fulfilled. The results of expert judgment showed that learning devices with metacognitive model oriented by HOTS in of all aspects were valid, but there were still suggestions for improvements to be considered for the perfection of learning devices developed. The suggestions namely (1) Learning Objectives in the aspect of understanding shall up to the stage of distinguishing examples and non-example of the two measurement, this is in accordance with the opinion of Davis (Akib, 2001) mentioning four criteria someone is said to understand the concept, i.e.: (a) it can express its attributes, (b) it can provide examples of the concept, (c) it can provide non examples of concepts, and (d) it can give names and define them. (2) clarity in compiling sentences on learning devices developed so that they are easy to understand and do not cause multiple meanings. In student activity sheet, it was recommended to add HOTS problem to emphasize questions that activated metacognitive ability and gave examples of high-level thinking problems or HOTS. This is based on the opinion that "ability of high-level thinking includes thinking critically, logically, reflective, metacognitive, and creative. This ability can be activated when an individual encounters unfamiliar problems, uncertainties, questions, or doubts. Someone will be trained to think systematically, and use reason (logically), find various ways and solutions to problem solving (creative), make self-corrections naturally to what he thinks (metacognitive) to question and give the right argument (critical) and take lessons from every activity based on the knowledge and experience that is owned (reflective). The knowledge and experience possessed support the growth and development of ability of high-level thinking"(King, Goodson, & Rohani, 2004).

6. Conclusion

The results of validation by expert judgments shows that the prototype of lesson plan and student activity sheets have been fulfilled the criteria of content validity and construct validity

after revisions, with a score of 3.78 for lesson plan and a score of 3.79 for student actvity sheets. Lesson Plan and student activity sheets can be reference for other teachers or researchers and its are expected to develop metacognitive ability and improve mathematical literacy through HOTS. This research is still in the validation stage, therefore, it will be continued in the practicality test and the effectiveness of the learning device.

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