Development of Learner Activity Sheets (LKPD) Based on Cognitive Structure and Metacognition Ability

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Abstract

This research was conducted to develop learner activity sheets (LKPD) based on cognitive structures and metacognition skills. The LKPD is aimed at Class XI students of MA Walisongo Pontianak which is a boarding school. LKPD is prepared to improve the cognitive structure ability of students in the aspects of comparative thinking structure, symbolic representation structure, and logical reasoning structure and metacognition ability of students in the aspects of planning, monitoring, reflection. LKPD material is adjusted to the competency standards, namely applying the laws of static fluid, designing and conducting experiments that utilise the properties of static fluid. The stages of this development research are up to the analysis and design stages which are part of the ADDIE design research design.

INTRODUCTION

Science is developing rapidly, affecting all aspects of human life, including education. Thus a teacher must learn to switch functions from being the centre of learning to becoming a facilitator. Teachers are required to always innovate in creating a learning process that functions to develop the potential of students with the character of Pancasila, independent, knowledgeable and critical reasoning and produce outcomes that are able to compete globally.

Learning is no longer teacher-centred and emphasises results, where students only copy the steps taken by the teacher. However, every learning process becomes a concern and evaluation for teachers to determine the next learning strategy. One of the skills that must be mastered by learners contained in the 2013 curriculum is metacognition [1].

The awareness that a person has to find solutions independently to the problems faced and get his cognitive through the stages of designing, monitoring and evaluating every action taken is called metacognition [2-3]. In addition, metacognition ability is related to the way learners think about their own thinking and their ability to choose the right strategy to solve problems [4]. In addition to metacognition ability, cognitive structure is needed in problem solving. Cognitive structure can be developed by linking the metacognition ability stored in the memory of learners [5].

The development of cognitive structures will affect one's success. Cognitive structure is built based on the understanding and experience experienced by learners [6] so that it will give birth to skills in self-adjustment, solving problems starting with the simplest to complex solutions [7].

Learner worksheets are one of the ways that teachers can use to meet the standards of the National Education System Law Number 20 of 2003 concerning preparing teaching materials that suit the needs and environment [8]. Metacognition-orientated LKPDs are effective and can be used [9] but have not been integrated into cognition structures. Therefore, the research aims to design LKPD based on cognition structure and metacognition. This research is in line with the field of excellence on the topic of innovative education and learning in the fields of Mathematics, Technology, Social, and Humanities contained in the research strategy plan (Renstra) of IKIP PGRI Pontianak 2021-2025. In the focus of learning media development with basic studies and development of learning media based on the field of study [10].

RESEARCH METHODS

This research aims to design LKPD based on cognitive structure and metacognition ability. The method used in this research is Research and Development (R&D) with the research design of the ADDIE development model (analysis, design, development, implementation, and evaluation). LKPD is prepared referring to the competency standards of physics subjects in class XII, namely applying the laws of static fluid in everyday life.

The source data used in this study are the syllabus of Class XI high school physics subject and textbooks. The research scheme can briefly be seen in Figure.1
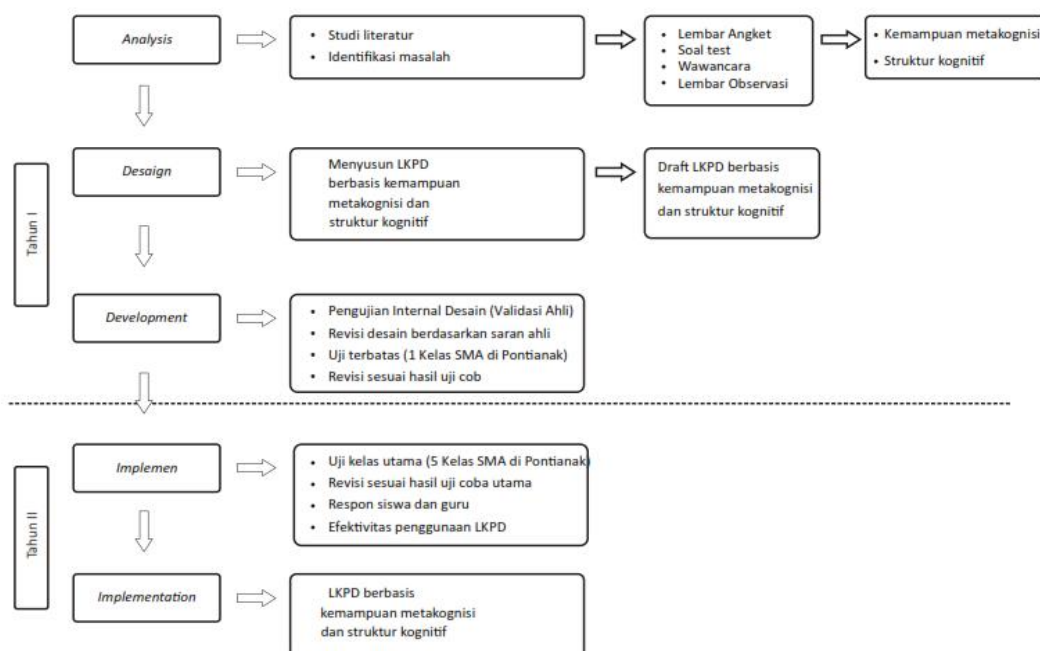

Figure 1. Research scheme

RESULTS AND DISCUSSION

This research is a development research with ADDIE method. The research is limited to the stages of product analysis and design. In the early stages of the research, product design was carried out which resulted in an LKPD that was expected to improve the cognitive structure ability and metacognition ability of students.

At the analysis stage, the data obtained that at Walisongo High School students use learning resources from Student Worksheets which contain a summary of teaching materials and a collection of questions and there is no Physics LKPD based on cognitive structures and metacognition skills. The LKPD does not provide opportunities for students to develop abilities in observing, planning, identifying, and other skills. The content of the existing LKPD is still oriented towards memorising concepts and answering questions.

Based on the results of the analysis stage, the initial product design will be developed. This development refers to the competency standards of the 2013 curriculum (Figure.2).

Figure 2. Static Fluid Competency Standards

A teacher must try to create a learning atmosphere that is not only classically result-oriented but also pays attention to the process of each individual by paying attention to the relationship with the surrounding environment. Every child has a cognitive structure that is very fast to capture and remember something real [7]. Therefore, this student worksheet (LKPD) is arranged in such a way that it is expected to explore the cognitive structure and metacognition abilities of students. Aspects that are expected to develop include observation, representation, reasoning skills, and collaboration.

Therefore, before compiling the learning objectives to be produced in the learning process in using LKPD based on cognitive structure and metacognition ability, first compiled indicators of cognitive structure and metacognition ability. Cognitive structure developed following Garner [5], has 3 aspects and described in indicators of cognitive structure (Table.1).

Table 1. Cognitive Structure Indicators

Aspects	Indicators
Comparative Thinking Structure	Processing information by identifying how data is similar and different, such as by recognition, memorisation, classification.
Symbolic Representation Structure	Transforming information into culturally acceptable coding systems, such as into pictorial, verbal and nonverbal, and mathematical forms.
Logical Reasoning Structure	Use systematic thinking strategies in processing and generating information with deductive and inductive reasoning, analogical thinking and can make hypotheticals, determine cause and effect relationships, analyse, synthesise, evaluate the processes that have been carried out, classify problems, and problem solving so as to conclude.

In metacognition ability, it consists of 3 aspects that will be developed referring to [11]. The 3 aspects are described in the indicators of metacognition skills as in Table.2

Table 2: Indicators of Metacognition Ability

Aspects	Indicators
Planning	Includes activities of estimating the results (hypothesis), estimating problem solving strategies, estimating tools and materials and estimating the steps that must be taken in solving a problem.
Monitoring	Includes testing activities, correcting things that are wrong and can hinder, rescheduling strategies that are carried out
Reflection	Conclude concepts based on experimental results and in accordance with learning objectives

After determining the indicators of cognitive structure and metacognition ability, then arranged the learning objectives to be achieved. Learning objectives are arranged operationally so that it is easier to determine the measurement of the success rate of the objectives to be achieved (Figure.3).

Tujuan Pembelajaran

1. Menjelasakan hukum-hukum fluida statisk
2. Mengidentifikasi variabel-variabel dalam hukum-hukum hukum hidrostatis
3. Merepresentasi dalam bentuk gambar, verbal dan matematis
4. Merancang percobaan yang memanfaatkan sifat-sifat hukum hidrostatis
5. Melakukan percobaan yang memanfaatkan sifat-sifat hukum hidrostatis
6. Menganalisis fenomena pada hukum hidrostatis
7. Menyimpulkan hasil pembelajaan pada hukum hidrostatis

Figure 3. Static Fluid Learning Objectives

After the stage of determining learning objectives, learning steps are then designed in the LKPD which contains indicators that must be owned by students based on cognitive structures and metacognition abilities as in Table.3.

Table 3. cognitive structures and metacognition abilities

Aspects	Indicators
Observing	observe thde teacher's demonstration
Symbolic representation	draw phenomena that arise from observing the demonstration
Recognising	make questions from the phenomenon that the teacher demonstrates
Collaboration Clarification	Learners discuss and select the best question
Conjecture/hypothesise	make a hypothesis from the question
Approximate strategy	design activity steps to test hypotheses estimate the tools and materials required write down the things that affect the hypothesis testing process
Problem solving	write down corrective steps when making mistakes
conclude	summarise the concept of the learning that has been done
Observing	observe the teacher's demonstration
Symbolic representation	draw phenomena that arise from observing the demonstration

In the early stages of using LKPD based on cognitive structures and metacognition, the problem orientation stage. Learners are trained in the aspect of observing a phenomenon that the teacher demonstrates. Then from the existing phenomena, students are trained to represent the results of observations in the form of images and verbal (Figure.4), make questions (Figure.5) and discuss with group friends to choose the best question (collaboration aspect) (Figure.6), make hypotheses from the question (Figure.7).
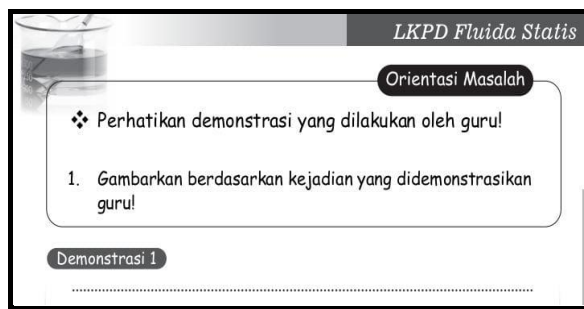
Figure 4. Orientation stage (Observing and representation aspects)

At the problem orientation stage, students are trained to have the ability to observe the phenomenon demonstrated by the teacher. The demonstration is when a vessel is filled with water and given two holes that are at different heights. Students are asked to observe, which of the two points of the hole has the farthest beam. After observing the demonstration conducted by the teacher, students are asked to describe based on the phenomenon that occurs.

This is to see the extent of students' concept understanding of hisdrostatic pressure. If students are wrong in presenting concepts into pictures, it can be said that students have not built concepts properly [12-13].
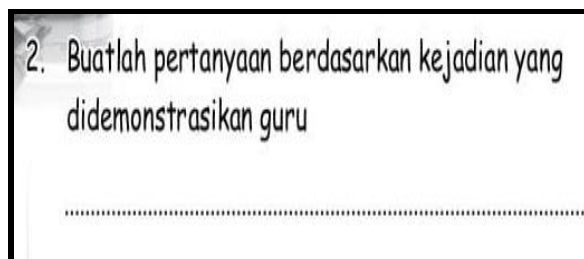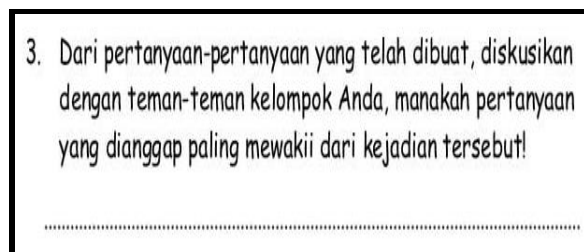

Figure 5: Ability to make questions

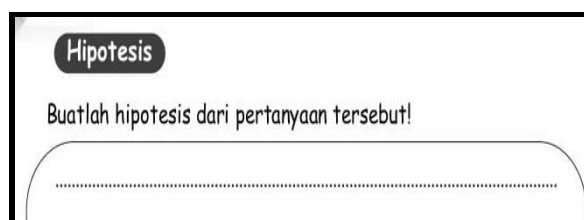**Figure 6.** Collaboration Ability Stage

Figure 7: Ability to make hypotheses

LKPD based on cognitive structure and metacognition ability is expected to stimulate learners actively in the problem solving process (Figure 8). Learners are given the freedom to determine the strategies and steps of problem solving. This is to avoid learners making the same decision as that delivered by the teacher [12].

The indicators of metacognition skills are arranged to actively involve and train students' thinking skills. In line with Amelia, et al [9] who stated that in metacognition ability, a person's thinking process is actively involved in the thinking process (active control).

CONCLUSIONS

This LKPD has been designed based on cognitive structures and metacognition skills. The ability of learners to be developed on LKPD is a cognitive structure, namely comparative thinking structure, symbolic representation structure, logical reasoning structure and on metacognition skills in planning, monitoring, reflection. The LKPD material is adjusted to the competency standards, namely applying the laws of static fluid, designing and conducting experiments that utilise the properties of the hydrostatic law. LKPD based on cognitive structure and metacognition ability still needs to be done feasibility study, effectiveness and practicality. Therefore, the research will be continued to the next stage.

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