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LEARNING DESIGN WITH DISCOVERY LEARNING MODEL FOR MATEMATICAL COMPUTATIONAL THINKING ABILITY

Aulia Kartika Syari,[1] Tian Abdul Aziz[2]
[1,2] Mathematics Education Master Program, State University of Jakarta
Jl. Rawamangun Muka, Rawamangun, Pulo Gadung, East Jakarta.
e-mail: [1]kartikasyaulia@gmail.com, [2]tian_aziz@unj.ac.id

Abstract

Designing instruction in a structured manner is essential to ensure that the learning process is effective, focused, and aligned with the needs of the learners.. This article aims to develop a learning design on the topic of SPLDV to improve computational thinking skills in junior high school students in East Jakarta City. This research is part of the instructional design of the ADDIE model which consists of Analysis, Design, Development, Implementation, and Evaluation. Based on the ADDIE development model, this research is limited to the design stage. The previous steps were developed through an instructional design that carried out a needs analysis in which classroom observations and needs interviews were conducted. The needs analysis was conducted on a class VIII in a junior high school in East Jakarta City with a total of 30 participants. Apart from the needs analysis to the learners, an interview was also conducted with one mathematics teacher at the school. Through the process of analyzing the needs obtained, a learning design has been formed and will be applied to further learning. The results of the discussion have been obtained to improve the process of computational thinking ability on SPLDV material can use the discovery learning model.

Keywords : ***Discovery Learning; Learning Design; two-variable linear equation system.***

1. INTRODUCTION

The Merdeka Curriculum has specific objectives in mathematics learning, one of which is 'problem solving problems which include the ability to understand problems, design mathematical models, solve models or interpret the solutions obtained (mathematical problem solving) [1]. Kemendikbudristek has planned that computational thinking skills should be included in the Indonesian curriculum. The Indonesian state realizes that computational

thinking will greatly help Indonesian children in dealing with complex problems [2]

According to PISA 2022, computational thinking skills include pattern recognition, designing and using abstracts, problem decomposition and determining algorithms in analyzing problem solving as part of a detailed solution. The combination of mathematics and computational thinking is not only important but effective to support students' mathematical conceptual development and understanding. Indirectly students are given a more realistic view of how mathematics can be practiced used in the real world and can be practiced professionally [3].

The results of PISA in 2022 showed that the mathematical ability of Indonesian students ranked 63 out of 81 countries with an average score of 366 math study results below the average score of the OECD of 472. In line with the research of Lestari dan Roesdiana (2023), the results of the computational thinking ability of students who were given test instruments, showed 43% of students were in the sufficient category and 26% of students were in the low category [4]. Reinforced by research, students solve the problems given, the steps of solving such as there are indicators of computational thinking skills that are incomplete and not systematic and logical. This error makes students unable to achieve algorithm indicators in computational thinking ability[5].

Computational thinking ability or commonly referred to as CT ability. CT ability is a cognitive approach that allows students to identify patterns, solve complex problems into small steps, organize a series of steps to solve problems in the form of algorithms like how computers work [6]–[8]. CT is considered as the ability of students to solve problems that can be represented to be simpler and more effective like a computer program. Problems encountered not only in everyday life can even be current circumstances [9], [10].

Research on SPLDV is quite a concern because currently many students have difficulty in solving SPLDV problems. In line with the research of Anisa et al (2023), there are errors that students have in solving SPLDV problems, one of which is problem transformation errors [11]. Students have difficulty in performing incomplete decomposition and can recognize the pattern of SPLDV problems but are wrong in making mathematical models which have an impact on the next step of solving [12]. So that another learning model is needed to improve mathematical computational thinking skills.

Based on the difficulties found, computational thinking skills are currently not fully developed in students. To develop mathematical computational thinking skills in students can be done through various approaches such as the use of learning models that can guide students to find contextual problem solving in everyday life in learning to make it easier for students to solve problems and understand the concepts independently on the material studied. One of the models that can be used is by using Discovery Learning model. Discovery learning is a learning process that provides opportunities for students to explore their own abilities and knowledge [13]. In this Discovery Learning model, it will be facilitated by worksheets and teacher supervision and make teachers more creative and make students active and fun when learning [14], [15]. By using Discovery Learning, students are helped in solving problems independently.

One study revealed that students showed difficulties in all stages of CT, so that students were unable to solve problems correctly and structured [16]. In applying the concept of CT, students are able to solve mathematical problems in complex daily life more effectively and deeply, allowing them to understand the concept of SPLDV more thoroughly and applicatively [16]. Thus, with this instructional design design, SPLDV material has the hope to be a source of reference for the process of developing what

students focus on in the problem solving process. Based on the explanation above, the researcher will conduct a study entitled 'Instructional Design to Improve Students' Computational Thinking Ability on the Material of the System of Linear Equations of Two Variables'.

2. RESEARCH METHODS

This research is part of development research (Research and Development) using the ADDIE model, which includes five stages, namely: Analysis, Design, Development, Implementation, and Evaluation. The development carried out in the study has limitations of only two stages, namely analysis and design. This research was conducted at one of the public junior high schools in East Jakarta in the odd semester of the 2024/2025 school year. The subjects of this study were 30 students in class VIII. The instruments used include computational thinking test instruments, observation sheets, and interview guides. These instruments were used to identify learning needs in the material of the system of linear equations of two variables and the development of computational thinking skills. The data obtained were analyzed descriptively qualitatively through the stages of data reduction, data presentation, and conclusion drawing to produce a learning design that is in accordance with student needs.

3. RESULTS AND DISCUSSION

Based on the ADDIE development model, this research is limited to the design stage.

a. Analyze Stage

At this stage, a needs analysis is carried out in the learning process to determine the existence of problems and definite solutions in determining student competencies, at this stage including:

1. Curriculum Analysis

   Curriculum Analysis is carried out in order to analyze the Merdeka Curriculum at the junior high school level to focus on Learning Outcomes (CP) and Learning Objectives (TP) SPLDV material. The following are CP and TP on SPLDV material: Learning Outcomes: At the end of phase D, students can recognize, predict and generalize patterns in the form of an arrangement of objects and numbers. They can express a situation into algebraic form. They can use the properties of operations (commutative, associative and distributive) to produce equivalent algebraic forms. Learners can understand relations and functions (domain, codomain, range) and present them as arrow diagrams, tables, sets of ordered pairs, and graphs. They can distinguish some nonlinear functions from linear functions graphically. They can solve linear equations and inequalities of one variable. They can present, analyze and solve problems using relations, functions and linear equations. They can solve systems of linear equations of two variables through several ways for problem solving.

   Learning Objectives:

   1. Learners can explain the concept of a system of linear equations of two variables using their own language appropriately.
   2. Learners can solve problems by using methods correctly
   3. Learners can solve problems by combining the use of methods correctly
   4. Learners can determine the solution set using the method correctly.

This research is to provide instructions for implementing mathematics learning using computational thinking on SPLDV material. This ability can solve math problems from contextual or complex problems. However, learning by using the stages of computational thinking in solving problems has not been well implemented.

2. Analysis of Student Characteristics

Analysis of students' characteristics was conducted to identify students' characteristics. This can be seen from the initial skills, learning styles, and students' readiness to receive learning by solving contextual problems with structured according to students' computational thinking abilities.

3. Problem Analysis

Problem analysis was conducted by conducting observations and written tests related to SPLDV in accordance with the indicators of mathematical computational thinking ability. The test was done by 30 students of class VIII. Students' computational thinking ability was expressed by scores through the scoring rubric adapted to the needs of (Damayanti & Kartini, 2022) . Furthermore, the results of students' computational thinking ability were calculated by the formula:

$$N = \frac{score\ obtained}{total\ score} \times 100$$

The success of mathematical computational thinking in this study was determined by two criteria, namely: (1) the average score of the mathematical computational thinking test reached the minimum completion limit of 70 and (2) at least 70% of the total students in the study reached the completion limit. The assessment was conducted through a test designed based on the indicators of mathematical

computational thinking ability on the material of System of Linear Equations of Two Variables (SPLDV).

4. Student Needs Analysis

Based on the problem analysis above, students have difficulty in converting from the form of contextual problems in the problem into mathematical models and solving problems according to existing algorithms. This happens because the problem exercises are only fixated with the monotonous form of the problem only numbers and symbols do not use contextual problems. It was found that students were only able to know the problem in question.

b. Design Stage

Activities at the design stage consist of determining the specific competencies of teaching material methods, and learning steps in line with the Merdeka Curriculum. After the analysis process is carried out, the next stage carried out by researchers is the planning stage (Design) to develop a learning design to be made. This learning design on SPLDV material is carried out through a number of stages, namely:

1. Setting learning objectives
2. Developing Discovery Learning syntax
3. Developing SPLDV questions

In the planning stage by referring to learning design planning based on the results of the needs analysis stage, it is known what kind of learning will be designed, namely the development of learning design using the discovery learning model. The learning design at this stage is the development of learning syntax using discovery learning in accordance with the indicators of computational thinking skills. At this stage, the learning design planning that researchers design consists of making SPLDV teaching modules and preparing SPLDV questions for evaluation.

Making teaching modules is done by looking at CP and TP in SPLDV material which is expected that students are able to solve the

system of linear equations of two variables using various methods to solve problems In designing learning designs, teachers use learning outcomes and objectives as a reference in determining changes in performance, behavior, or knowledge achieved. Meanwhile, learning objectives serve as structured steps that lead to more significant results. Because basic competencies need to be repeated in their application, learning objectives are also called performance objectives [17]. The learning objectives in the discussion of SPLDV are that students can explain, solve SPLDV problems using various methods and determine the solution set.

The application of the Discovery Learning Model with SPLDV learning objectives is expected to improve computational thinking skills through solving cases in the context of daily life. According to research Afifah et al., (2024) that Discovery Learning is proven to be effective in learning mathematics with SPLDV material which involves questions oriented to high order thinking skills. The use of this model can improve student learning outcomes. In the Hasibuan et al., (2021), Discovery Learning consists 6 steps, namely: formulating questions or problems, designing initial conjectures (hypotheses), developing experimental plans, conducting discussions to obtain information, collecting and analyzing data, and drawing conclusions. The selection of questions and problems used in everyday life around students such as buying and selling stationery.

After conducting learning according to the Discovery Learning syntax, learning evaluation is carried out, namely through formative assessment. Formative assessment aims to provide feedback that can be used by teachers as managers of learning activities in order to strengthen student involvement in the learning process through adjustments to cognitive structures, characteristics of the material being studied, and approaches or

learning strategies applied [20]. The choice of formative assessment is because researchers want to see whether using Discovery Learning can improve the ability to understand concepts in SPLDV material which is indicated by learning outcomes ≥ 70 . The following is a lattice of SPLDV questions.

No	Learning Objective	Problem Indicator	Problem No.
1	Learners can explain the concept of a system of linear equations of two variables using their own language appropriately.	Students are able to identify and decompose SPLDV problems into the required information.	1a,2a
2		Students are able to find the important parts needed create representation to a or model in solving SPLDV problems	1b, 2b
3	Students are able to solve problems using the correct method Learners can solve problems by combining the use of methods correctly	Students are able to determine the steps of problem solving logically and systematically SPLDV problems.	1c, 2c
4.	Learners can solve problems by combining the use of methods appropriately 4.	Students are able to solve similar problems using SPLDV models or solutions that have been found previous in problem solving.	1d, 2d

Public 1. SPLDV Formative Problem Grid Table

The study of students' answers was conducted using the scoring rubric adapted to the needs of [21]. Furthermore, the results of students' computational thinking ability were calculated by the formula:

$$N = \frac{skor\ obtained}{total\ score} \times 100$$

The success in mathematical computational thinking ability in this study was determined based on two criteria, namely: (1) the

average score of the mathematical computational thinking test reached or exceeded the minimum completeness limit of 70, and (2) at least 75% of the total students in the study were declared complete.

4. CONCLUSIONS AND SUGGESTIONS

Based on the results of the research and analysis that has been done, it can be concluded that the instructional design based on the Discovery Learning learning model on the material of the System of Linear Equations of Two Variables (SPLDV) is designed to improve the mathematical computational thinking skills of grade VIII students. This research focused on the first two stages in the ADDIE model, namely analysis and design, which showed that students still had difficulty in understanding contextual problems, making mathematical models, and compiling solution steps logically and systematically. The needs analysis showed that previous learning did not involve contextual problems and did not support the development of computational thinking skills optimally. Therefore, by designing Discovery Learning-oriented learning, equipped with questions that match the indicators of computational thinking ability and teaching modules that are aligned with the Merdeka Curriculum, it is hoped that students can be more active, independent, and systematic in solving mathematical problems, and able to achieve targeted learning completeness.

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