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Exploration of College Student's Representations in Solve The Problem of Numeric Methods

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***Abstract*—A qualitative study aims to explore students' representations in solving problems of numerical methods. Participants in this study are two female college students. Data were collected by assigning the problem of interpolation method and task-based interviews. The findings of this study showed the student S1 employs multiple representations (symbolic and visual representations) in solving the problem of interpolation methods. Student S2 uses symbolic and visual representations but doesn't arrive at the solution of the problem of the interpolation method.**

Keywords*— *Representations; College Student; Problem; Numeric Methods

I. INTRODUCTION

The advancement of science and technology today produces global challenges that cannot be avoided for everyone. These advances also penetrated the world of education. Students must be equipped with 21st-century skills to face global challenges. Students are required to play a role as citizens and international citizens in a world without borders. These skills include critical thinking skills, creative thinking skills, communication skills, and collaboration skills.

Because the importance of these four skills is mastered by learners, the Indonesian ministry of education and culture emphasizes graduate competency standards that students must have namely creative, productive, critical, independent, collaborative and communicative [1]. The contemporer mathematics learning should be used to familiarize these four skills. Moreover, Nur et. al [2] emphazised learning mathematics according to the demands of the 2013 curriculum is student-oriented learning with contextual learning scenarios, creating a collaborative learning atmosphere, and developing 21st-century skills.

One of the interesting researchers is communication skills. Communication skills include exchanging ideas, asking questions, listening actively, analyzing problem situations, talking, choosing communication media, reading, writing, evaluating messages, and using technology. Someone is said to communicate effectively if the person can communicate his ideas in various forms and contexts.

Mathematics is a science that contains abstract ideas. The idea can be understood and communicated only through representations [3]. Representations is a configuration of objects or characteristics to represent, describe, and replace other objects [4]. There five representations typed used in mathematics education: representation of real-world objects, concrete representations, arithmetic symbol representations, representation of oral or verbal languages, and representation of images or graphics. Meanwhile, Yee and Bostic [5] categorized representations into symbolic and non-symbolic representations. The symbolic representation includes formulas, equations, and mathematical inequalities. Non-symbolic representations include images, sketches, graphs, tables, and words, phrases, or sentences used to illustrate mathematical ideas.

Representation has been studied and showed a very significant representation in mathematics learning [3], [6]–[8]. Representation allows students to reduce the level of abstractness in mathematical ideas. Furthermore, study conducted by Selling [3] explores how students learn to make, discuss, and reason with representations to solve problems. This finding has implications for the importance of giving all students access to mathematics through representation. Representation is seen as the practice of mathematical science and the practice of mathematical learning. A study by Wilkie scrutinized [6] current views on when and how children can or ought to learn about variables and multiple representations may need adjustment in mathematics education curricula. Moreover, a study in proportional logic emphasized the importance of various forms of multiple representations in mathematics learning and assessment [7]. Mielicki and Wiley [8] also pointed out successful algebraic problem solving entails adaptability of solution methods using different representations.

Representation in this study is an expression of mathematical ideas displayed by students in solving the problem of interpolation methods. Interpolation methods is one of methods to determine intermediate values that are not in the data. Therefore, the present study aims to explore college student's representations in solving problems of numerical methods, especially interpolation methods.

II. RESEARCH METHODS

This study is qualitative that produces descriptive data. The subjects of the study consisted of two female students majoring in mathematics education at Musamus University who participated in the numerical method even semester 2018/2019 academic year. The data described is in the form of student representation in solving the problem of interpolation methods in the course of numerical methods. Data was collected giving problems about interpolation methods and interview transcripts. The data is then analyzed by the researchers by reducing data, presenting data, and drawing conclusions.

III. RESULTS AND DISCUSSION

The problem of the interpolation method given to the two college students can be described below.

> Hitunglah $\int_0^1 \frac{1}{1+x}dx$ dengan menggunakan kaidah Simpson 1/3. Gunakan jarak antar titik $h = 0{,}125$

Fig. 1. The Interpolation Method Problem

A. Description of Representation of College Student 1 (S1) in Solving Problems of Interpolation Methods

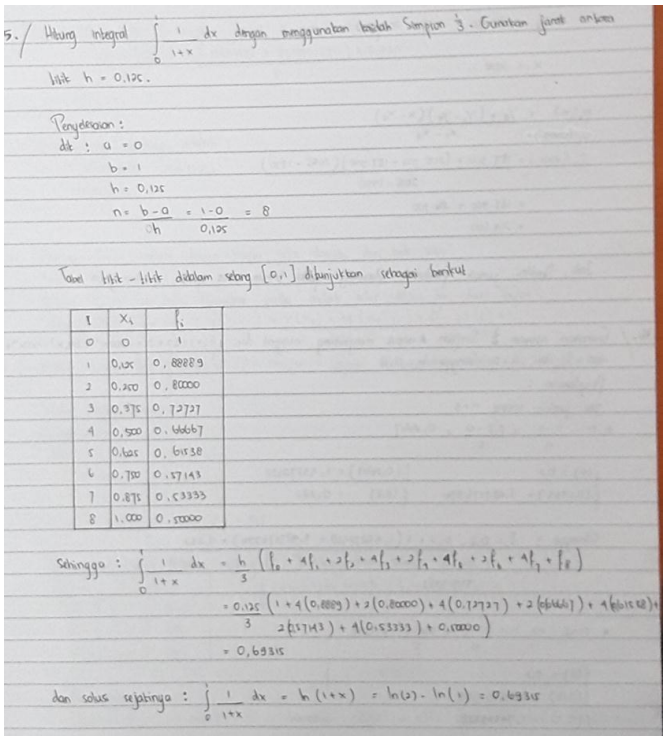

Fig. 2. Representations of Student 1.

Student 1 (S1) understand the problem by writing what is known by using symbolic representations. Student uses symbol a as the representation of the lower bound and b as the integral upper limit. This is align with Stylianou [9] representations as a means to understand the information provided in the problem situation and set goals. At the stage devising a plan, the students make a solution plan by determining the value of the partition $n = \frac{b-a}{h}$. Students get a value of $n = 8$. Furthermore, students create a table to present partitions namely $i = 1,...,8.$ which are then used to determine the values of x_i and $f(x_i)$. Then student 1 (S1) carries out the plan using the Simpson's rule $\frac{1}{3}$. At the looking back stage, student S1 check the correctness of the solution by comparing Simpson's rule $\frac{1}{3}$ with a real solution using integrals. Student S1's solution show she has succeeded in solving the problem of interpolation methods by using symbolic and visual representations.

B. Description of Representation of College Student 2 (S2) in Solving Problems of Interpolation Methods

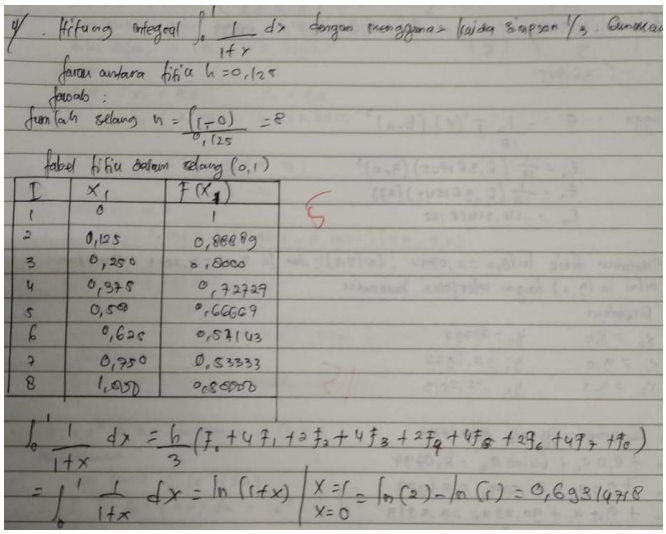

Fig. 3. Representation of Student 2

Student S2 understands the problem without restating what is known and asked about the problem. Student (S2) makes solution plan by determining the partition value $n = \frac{b-a}{h}$. Furthermore, student S2 creates tables to present partitions namely $i = 1,...,8$ which are then used to determine the values of x_i and $f(x_i)$. This corroborate study by [10] which pointed out pictures are often created during the initial stage of problem text understanding, and tables are sometimes created during computation of the solution. Student S2 made an error when $i = 5.$ Student gets the value of $f(x_5) = 0{,}66667$ which should be the value

of $f(x_5) = 0{,}615538$. Next, the student carries out the plan using the Simpson's rule $\frac{1}{3}$ but are incomplete. Student only writes the Simpson's rule $\frac{1}{3}$ without changing the value of $f(x_i)$. Student S2 carries out the plan using integrals. This is not following the order on the problem. At the looking back stage, student S2 doesn't check the correctness of the solution that has been obtained. The student S2 solution shows she uses symbolic and visual representation but does not succeed in solving the problem of the interpolation method. In other words student S2 cann't monitor her progress in problem solving.

IV. CONCLUSIONS

Student S1 use multiple representations (symbolic and visual representations) in solving the problem of interpolation methods. S2 students use symbolic and visual representations but doesn't arrive at the solution of the problem of the interpolation method. This study implies that first, the lecturer who handle the numerical method course should pay attention to the representation as the centre of classroom learning. Second, students in solving problems are required to be able to use the suitable representations so that they succeed in arriving at the correct solution.

V. ACKNOWLEGMENT

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