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STUDENTS' COMPETENCY IN MATHEMATICAL MODELING OF REAL LIFE PROBLEMS ORIENTED BY *TRI HITA KARANA*

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ABSTRACT

Various research results show that students' abilities in solving real life problems are still lacking. The weak abilities of students can be caused by students not being accustomed to solving real life problems. One of the key aspects in solving real life problems is mathematical modeling based on situation models. Differences in assumptions have an impact on differences in modeling and differences in modeling have implications for differences in solving. The purpose of this study was to determine the description of mathematical modeling competence of real life problems oriented to *Tri Hita Karana* (THK). The subjects of this study were students and teachers of class VII Laboratory of Universitas Pendidikan Ganesha (Undiksha). The instruments used were tests and interview guidelines, while the data collection techniques used tests and interviews. The data analysis used was descriptive qualitative. The results of the study showed that: students' mathematical modeling for problem 1 with a very good category was 71.05%, good was 15.79%, sufficient was 2.63%, and very bad was 10.53%. For problem 2, students who had mathematical modeling competencies in the very bad category were 100%. For problem 3, students who had mathematical modeling competencies in the very good category were 11.84%, not good were 32.89%, and very bad were 55.27%.

Keywords: real life problems, *Tri Hita Karana*, mathematical modeling, competency.

INTRODUCTION

Problem solving is the core of learning mathematics. The results of the study showed that students are still weak in solving real life problems and providing realistic reasons (Suharta, 2016; Parwati and Suharta, 2020; Suharta and Parwati, 2020; Suharta and Suarjana, 2018). Weak student abilities can be caused by students not being accustomed to solving real-life problems. One key aspect in solving real-life problems is mathematical modeling based on situation models. Differences in assumptions impact differences in modeling and differences in modeling have implications for differences in solutions. According to Julia M. Aguirre, *et al.,* (2023) two major challenges in mathematics teacher education are developing teachers' understanding of (a) culturally responsive mathematics pedagogy, oriented towards social justice and (b) mathematical modeling as a standard for mathematical content and practice. Suharta and Ardana (2023) found that prospective elementary school teachers can perform mathematical modeling of real-life problems oriented towards social justice and can provide logical and realistic reasons. The mathematical modeling of prospective elementary school teachers who are male is better than female, the mathematical modeling abilities of those with high mathematical abilities are better than those with medium and low abilities, The results of the study by Suharta, Suparta, and Parwati (2020) showed that learning trajectory of geometric transformation related to ethnomathematics of traditional Balinese houses using phenomena, patterns, images led to better problem-solving abilities and mathematical literacy of students. Other research by Darma Atmaja, Suharta, Sariyasa, Suweken (2023) found that ethnomathematics in the concept of logic oriented to *Tri Hita Karana* (THK). The results of Suharta and Parwati's (2022) research are the use of THK-oriented cultural aspects such as the *mecaru* ceremony, *tumpekwariga*, *odalan*, *ngayah*. as a source of learning fractions can improve procedural and conceptual knowledge. Therefore, the description of the competency of mathematical modeling of real-life problems oriented to THK as a source of learning provides a new direction for learning mathematics in an effort to improve the ability to model and solve mathematical problems. The problem of this research is how is the description of junior high school students' competencies in mathematical modeling of real-life problems oriented to THK

The German education system makes mathematical modeling a competency in mathematics education at all levels including higher education (Gilbert Greefrath and Katrin Vorhölter, 2016). Increasing mathematical modeling competency has an impact on increasing mathematical problem-solving abilities. Real-life problems are generally in the form of story problems. Real-life problems are very important to be given to students because most real situations are expressed in words and so that students can see the benefits of mathematics in real life. Real-life problems can be used as a source of inspiration for the formation and construction of mathematical concepts or developing mathematical concepts (Suharta, Puja Astawa, Parwati, 2023). Problem solving involves organizing knowledge, previous experiences, intuition, attitudes, beliefs and cognitive abilities (Mi Kyung Cho, Min Kyeong Kim, 2020; Reys, at all, 2020). Real-life mathematical problems are mathematical problems in the form of stories with a real-life context, and in solving them require arguments or considerations according to real life. The term modeling describes the process of developing a model based on an application problem and using it to solve the problem. Therefore, mathematical modeling always starts from real-life problems, which are then explained with mathematical models and solved using the models. This whole process is then called modeling. The relationship between real life and mathematics is very close. Mathematics is used in real life and mathematics develops to solve problems in real life. Mathematical modeling is a mental process to transform real-life problems into mathematical statements. Gilbert Greefrath and Katrin

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Vorhölter (2016) describe mathematical modeling as a cycle. Competencies and indicators of mathematical modeling according to (Gilbert Greefrath and Katrin Vorhölter, 2016; Maaß, K. , 2006; Schmidt, B., 2011) are shown in the following table.

Table 01: Mathematical Modeling Competencies and Indicators

Competencies	Indicators
Simplifying problem situations	Identifying relevant and irrelevant information to real problems, formulating an understanding of the problem, making assumptions needed in the problem
Situation modeling	Determining mathematical concepts used in problem solving
Mathematical modeling	Translating specific and simplified real situations into mathematical sentences (e.g., terms, equations, images, diagrams, and functions)
Problem solving	Determining results
Interpretation	Connecting the results obtained with real situations

RESEARCH METHOD

1. Research Design

This study aims to reveal in depth about the competence of mathematical problem solving modeling. Therefore, the type of research used is qualitative (Ugwu, Chinyere. N. and Eze Val, H. U, 2023). The subjects of this study were students of class VII of SMP Laboratorium Undiksha. The number of research subjects was 78 people, but only 76 people were present during data collection.

2. Instruments and techniques for data collection and analysis.

The instruments used were tests, questionnaires and interview guidelines, while data collection techniques used tests, questionnaires and interviews. The test used to collect data is related to mathematical modeling skills. The form of the test is a description with questions that cover real situations, situation modeling, mathematical modeling, problem solving, and interpretation. The test material is related to numbers, ratios, and linear equation systems.

The data analysis used is descriptive qualitative. Competency descriptions are categorized as very good (SB), good (B), sufficient (C), not good (TB), and very bad (STB), with the following descriptions.

Table 02: Competency descriptions

Competency	SB	B	C	TB	STB
Simplification of the problem situation	Simplifying and making assumptions very well	Simplifying and making assumptions well	Simplifying and making assumptions moderately	Simplifying or making assumptions, but not quite right	Simplifying or making assumptions, but not quite right or making nothing (blank)
Situation modeling	Create a situation model and very appropriate	Create a situation model and appropriate	Create a situation model and quite appropriate	Create a situation model and not appropriate	Does not create a situation model
Mathematical modeling	Making mathematical models and very appropriate	Making a mathematical model and it fits	Making a mathematical model and it fits quite well	Making a mathematical model and it doesn't fit	Not making a mathematical model
Problem solving	Problem solving is very logical and correct	Logical and correct problem solving	Problem solving is not logical and correct	Problem solving is very illogical	Not doing any problem solving
Interpretation	Very appropriate to real situations	According to the real situation	Quite according to the real situation	Not according to the real situation	Does not carry out interpretation (blank)

3. Research Procedure

The research procedure is as follows.

a. Giving students a test related to real-life mathematical problems and asking them to determine their mathematical model.
b. Analyzing the competencies shown in mathematical modeling.
c. Classifying students' mathematical modeling competencies.

RESEARCH RESULTS AND DISCUSSION

Using the data collection method as described previously, the following is a description of students' mathematical modeling competencies.

Problem 1

Table 01: Competency descriptions of problem 1.

Competency	Competency descriptions(%)				
	SB	B	C	TB	STB
Simplification of the problem situation	60.53	25.00	7.89	0.00	6.58
Situation modeling	63.16	19.74	6.58	0.00	10.53
Mathematical modeling	71.05	15.79	2,63	0.00	10.53
Problem solving	71.05	15.79	0.00	0.00	13.16
Interpretation	0.00	81.58	0.00	0.00	18.42

For problem number 1, students who have the competence of simplifying problem situations in the very good category are 60.53%, good is 25%, sufficient is 7.89%, and very bad is 6.58%. Students who have the competence of modeling situations in the very good category are 63.16%, good is 19.74%, sufficient is 6.58%, and very bad is 10.53%. Students who have the competence of mathematical modeling in the very good category are 71.05%, good is 15.79%, sufficient is 2.63%, and very bad is 10.53%. Students who have the competence of problem solving in the very good category are 71.05%, good is 15.79%, and very bad is 13.16%. Students who have the competence of interpretation in the good category are 81.53%, and very bad is 18.42%.

Problem 2

Table 02: Competency descriptions of Problem 2

Competency	Competency descriptions(%)				
	SB	B	C	TB	STB
Simplification of the problem situation	0.00	0.00	0.00	82.89	17.11
Situation modeling	0.00	0.00	0.00	82.89	17.11
Mathematical modeling	0.00	0.00	0.00	0.00	100.00
Problem solving	0.00	0.00	0.00	0.00	100.00
Interpretation	0.00	0.00	0.00	0.00	100.00

For problem number 2, students who have the competence of simplifying problem situations in the category of not good are 82.89%, and very bad is 17.11%. Students who have the competence of modeling situations in the category of not good are 82.89%, and very bad is 17.11%. Students who have the competence of mathematical modeling in the category of very bad are 100%. Students who have the competence of problem solving in the category of very bad are 100%. Students who have the competence of interpretation in the category of very bad are 100%.

Problem 3

Table 03: Competency descriptions of Problem 3

Competency	Competency descriptions(%)				
	SB	B	C	TB	STB
Simplification of the problem situation	0.00	11.84	0.00	48.68	39.48
Situation modeling	11.84	0.00	0.00	32.89	55.27
Mathematical modeling	11.84	0.00	0.00	32.89	55.27
Problem solving	11.84	0.00	0.00	32.89	55.27
Interpretation	0.00	11.84	0.00	32.89	55.27

For problem number 3, students who have good category of problem situation simplification competence are 11.84%, not good is 32.89%, and very bad is 55.27%. Students who have situation modeling competence with very good category are 11.84%, not good is 32.89%, and very bad is 55.27%. Students who have mathematical modeling competence with very good category are 11.84%, not good is 32.89%, and very bad is 55.27%.. Students who have problem solving competence with very good category are 11.84%, not good is 32.89%, and very bad is 55.27%.. Students who have interpretation competence with good category are 11.84%, not good is 32.89%, and very bad is 55.27%.

CONCLUSION AND SUGGESTIONS

Students' mathematical modeling for problem 1 with the very good category is 71.05%, good is 15.79%, sufficient is 2.63%, and very bad is 10.53%. For problem 2, students who have mathematical modeling competence with the very bad category are 100%. For problem 3, students who have mathematical modeling competence with the very good category are 11.84%, not good is 32.89%, and very bad is 55.27%.

Based on these conclusions, it is suggested to teachers that mathematical modeling gets more attention in learning. In addition, the Undiksha Study Program is suggested to study more deeply and broadly related to mathematical modeling as a key aspect in the school mathematics curriculum, both at the elementary and secondary education levels.

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