PROBLEM POSING: CREATIVE THINKING ABILITY BASED THEORY WALLAS FROM HABITS OF MIND

Febria Dewi Pratiwi[1],
Mardiyana[2],
Ikrar Pramudya[3]
[1,2,3]Magister of Mathematics Education,
Faculty of Teacher Training and Education,
Universitas Sebelas Maret
febriadewi@student.uns.ac.id

ABSTRACT

This qualitative research aimed to analyze and delineate the stages of creative thinking as per Wallas' theory, observed through students' problem-posing abilities categorized by habits of mind. The research employed questionnaires, problem posing tasks, and interviews to explore how students in developing and proficient habits of mind categories demonstrate creative thinking in problem-posing. The instruments included a questionnaire on thinking habits and assessments of problem-posing skills. Subjects were purposively selected based on their classification into three habits of mind categories. Data analysis involved techniques of data reduction, presentation, and concluding. The findings revealed distinct behaviors: students with developing habits of mind tend to propose new problems under familiar conditions without error correction. In contrast, those classified with proficient habits of mind propose new problems under varied conditions and effectively address errors. Other subjects exhibit behaviors intermediate between these categories, problem-posing similarly and rectifying errors as necessary.

Keywords: Analysis, Problem-Posing, Creative Thinking, Habits of mind.

INTRODUCTION

Students' thinking skills can be developed through active learning processes that encourage them to actively seek solutions to presented problems (Fahmi & Subhan, 2021). Such skills, particularly in the context of seeking solutions, are often referred to as creative thinking skills. These skills involve the ability of students to generate and develop ideas for problems and alternative solutions. Once new

ideas or concepts are generated, students process them through various stages of creative thinking.

Sadler-Smith (2015) elucidates the stages of the creative thinking process as proposed by Wallas, which consist of four stages: 1) the preparation stage, where students carefully observe information and instructions from the Problem Submission Task (TPM), comprehend what is initially known, and accurately list known and questioned elements of the TPM; 2) the incubation stage, where students contemplate the meaning of the TPM questions and develop a plan for problem submission; 3) the illumination stage, where students verbally articulate the mathematics problem, document the problem on an answer sheet, and rectify any errors; and 4) the verification stage, where students explain the procedures for solving the mathematics problem and solve the problem on the answer sheet.

Thinking, as a cognitive activity, is associated with thinking habits, or habits of mind. These habits have significant benefits (Isfiani, 2016). Nurmala et al. (2019) state that consistent mathematical thinking habits through contextual problem exploration activities support students' achievement in mastering mathematical concepts. Hence, good mathematical thinking habits positively impact other mathematical abilities. Furthermore, problem submission tasks help students apply their mastery of mathematical concepts to encountered problems.

Ghasempour et al. (2003) reveal that problem submission can enhance creative thinking and develop students' knowledge and understanding of mathematics. Johnson (2002) also notes that problem submission in mathematics fosters creative thinking skills. Additionally, solving mathematical tasks helps form individuals who are capable, creative, confident, responsible for their actions, and able to work independently and collaboratively, which are facilitated by habits of mind (Sugandi, Maya, & Hutajulu, 2019). These habits are essential for solving complex problems and generating new understanding and thinking (Aringga, Shodiqin, & Albab, 2019).

Costa and Kallick, (2008) highlight that learning that incorporates habits of mind can influence student behaviour in answering questions accurately. Students with developed thinking habits can find and solve problems rationally (Arifin & Susanti, 2022). Costa and Kallick (2009) categorize habits of mind into five levels: 1) The beginner category (no concept) refers to students who provide minimal responses; 2) The limited category refers to students who provide limited responses; 3) The developing category refers to students who provide good responses (almost meeting 16 indicators);

4) The proficient category refers to students who provide good responses; and 5) The distinguished category refers to students who provide excellent responses. This research aims to delineate the creative thinking process of students in problem-posing, viewed through the lens of thinking habits. By examining students' thinking habits, the research seeks to ensure that students can logically and correctly present problems.

METHOD

This research employed descriptive qualitative research to elucidate the creative thinking process of students during problem-posing on the topic of Pythagoras. Qualitative research aims to explain and understand social phenomena from the participants' perspectives, focusing on natural settings where the presence of the researcher does not influence the dynamics of the subject being studied (Sutama, 2019). The participants in this research were eighth-grade students from SMP Negeri 1 Sukodono. The data included students' problem-posing activities based on Wallas' stages, categorized into developing, proficient, and other habits of mind.

The research instruments comprised tasks, questionnaires, and interviews. The primary task was a Problem Submission Task (TPM) related to the Pythagorean theorem, developed by the researcher. The interview guide contained targeted questions to delve into the subjects' creative thinking process during problem-posing and to ensure adherence to Wallas' stages. The instruments were validated by three experts, including two mathematicians and one educator, who provided feedback to enhance their quality. The validators offered suggestions on spelling, punctuation, and the use of standardized terms according to the Indonesian Dictionary (KBBI). The problem submission task was illustrated in Figure 1.

Figure 1:
Problem Submission Task Instrument

Pythagoras Problem Instrument
"During the Indonesian Independence Day celebration in August, it is customary for residents to put up flags in front of their homes. Mr. Roni is one of the residents who is very enthusiastic about putting up the red and white flag in front of his house by installing an iron pole that he made himself, with a height of 8 meters. To ensure that the pole stands upright on flat ground, Mr. Roni attaches a rope to the top of

the flagpole, which is then connected to a stake in the ground. If the distance between the stake and the bottom of the pole is 6 meters, how long does the rope need to be to keep the iron pole standing upright?"

Data collection techniques in this research included the Problem Submission Task (TPM), questionnaires, and interviews. Participants completed a habits of mind questionnaire, which was subsequently analyzed to categorize each student's thinking habits. The data analysis process followed the stages outlined by Milles and Hubberman (Sutama, 2019), namely data reduction, data presentation, and drawing conclusions. Data reduction involved summarizing, selecting key points, focusing on essential aspects, identifying themes and patterns, and discarding unnecessary data. Following reduction, the data in qualitative research was presented narratively and classified according to the main research issues. Conclusions were drawn by analyzing the results of the problem submission task and interviews with the students (subjects). The research concluded by analyzing the creative thinking process in problem-posing based on Wallas' stages, viewed through the lens of thinking habits.

FINDINGS AND DISCUSSION

The findings of this research indicated that students exhibit varying levels of creative thinking in *problem-posing* based on Wallas' stages, depending on their *habits of mind.* Specifically, Student 1 (S1), categorized as developing, Student 2 (S2), categorized as proficient, and Student 3 (S3), who lacks established thinking habits, demonstrate distinct differences in their approaches to *problem-posing*.

1. Problem Posing by S1 in the Developing Category

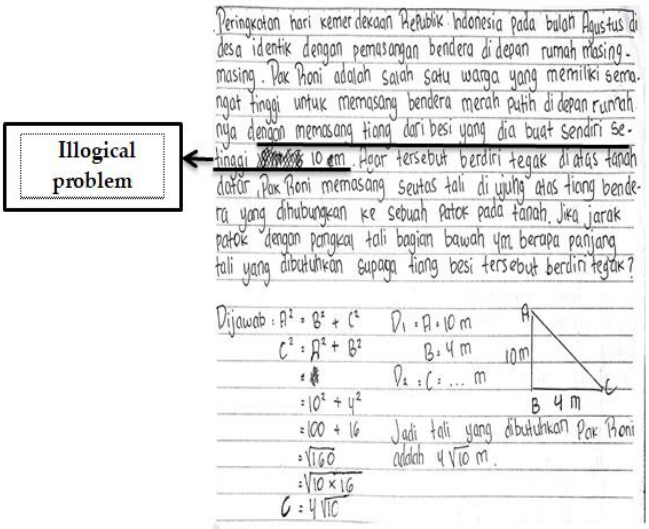
The creative thinking process of Student 1 (S1) in *problem-posing*, categorized under the developing *habits of mind*, can be delineated through Wallas' stages. In the preparation stage, S1 undertakes several activities, including reading the Problem Submission Task (TPM), observing the information and instructions provided in the TPM meticulously, and being able to accurately identify and articulate the known and unknown elements of the TPM as instructed. S1 also demonstrates a clear understanding of the related subject matter. During the incubation stage, S1 begins to reflect on the purpose of the

questions in the TPM, particularly those related to the Pythagorean theorem. Subsequently, S1 starts formulating a plan for submitting a mathematics problem, beginning with an explanation of the problem design that aligns with the given problem.

In the illumination stage, S1 verbally expresses the posed mathematics problem fluently, articulating the problem in its entirety. A student in the developing category of *habits of mind* demonstrates a solid grasp of mathematical concepts, which facilitates the articulation of the posed problem. This observation is consistent with Qadarsih's (2017) research, which indicates that habits of mind significantly influence the mastery of mathematical concepts. However, when asked whether the posed problem is logical, S1 struggles to provide a satisfactory explanation. This difficulty arises because S1 is not accustomed to thinking in terms of everyday experiences and thus cannot distinguish between logical and illogical problems. Additionally, this challenge is compounded by a general lack of habitual mathematical thinking in learning (Indriani et al., 2018). Despite this, S1 proceeds to document the posed mathematics problem on the answer sheet.

In the verification stage, S1 begins to verify the proposed problem-solving process against reality by explaining the procedure for solving the posed mathematics problem, including the formulas used and the steps required to solve it using those formulas. Ultimately, S1 successfully solves the posed Pythagorean problem, as illustrated in Figure 2.

Figure 2:
Problem Posing by S1



2. Problem Posing by S2 in the Proficient Category

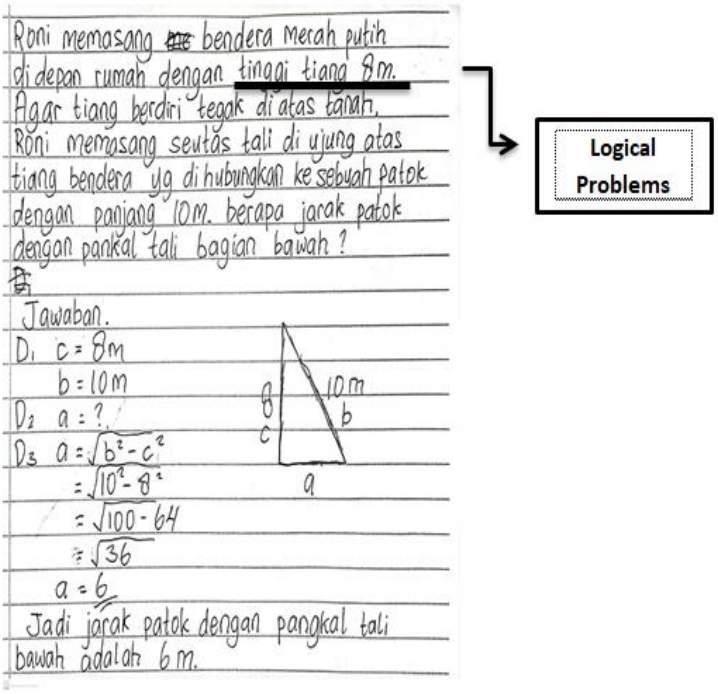
The creative thinking process of Student 2 (S2) in *problem-posing*, categorized under proficient habits of mind, follows Wallas' stages. In the preparation stage, S2 undertakes several activities, including reading the Problem Submission Task (TPM), meticulously observing the information and instructions provided in the TPM, and fluently identifying and articulating the known and unknown elements of the TPM as instructed.

During the incubation stage, S2 begins to reflect on the purpose of the questions in the TPM, particularly those related to the Pythagorean theorem. Subsequently, S2 starts formulating a plan for submitting a mathematics problem. This stage begins with S2 explaining the design of the problem to be posed, which differs from the given problem.

In the illumination stage, S2 begins to verbally express the posed mathematics problem fluently, articulating the problem in its entirety. Before writing down the posed mathematics problem, S2 is asked to verify whether the problem is logical. S2 is able to revise the initially posed problem to make it logical, drawing on real-life experiences. This ability to apply everyday experiences to *problem-posing* is indicative of S2's *habits of mind*. When students have well-developed thinking habits, they can solve various problems easily using their own methods (Astatin et al., 2020). S2 then writes down the posed mathematics problem on the answer sheet.

In the verification stage, S2 begins to verify the proposed problem-solving process against reality by explaining the procedure for solving the posed mathematics problem, including the formulas used and the steps required to solve it using those formulas. Ultimately, S2 successfully solves the posed Pythagorean problem, as illustrated in Figure 3.

Figure 3:
Problem Posing by S2



3. Problem Posing by S3

The creative thinking process of Student 3 (S3) in *problem-posing* follows Wallas' stages. In the preparation stage, S3 undertakes several activities, including reading the Problem Submission Task (TPM), meticulously observing the information and instructions provided in the TPM, and fluently identifying and articulating the known and unknown elements of the TPM as instructed.

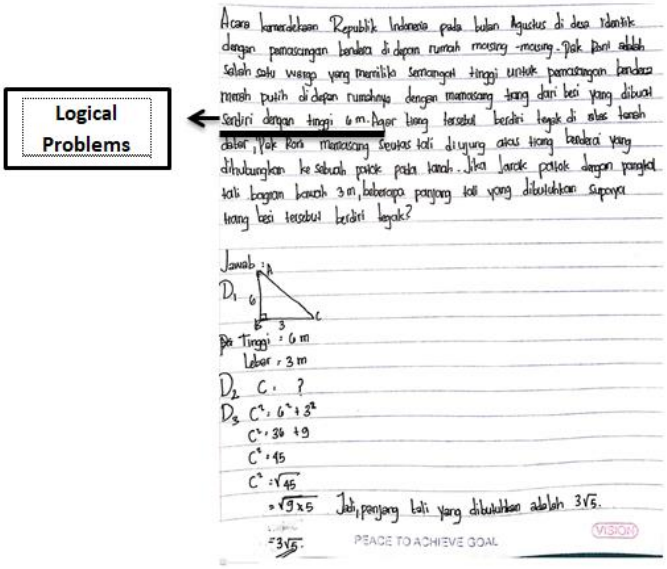
During the incubation stage, S3 begins to reflect on the purpose of the questions in the TPM, particularly those related to the Pythagorean theorem. Subsequently, S3 starts formulating a plan for submitting a mathematics problem. This stage begins with S3 explaining the design of the problem to be posed, which is similar to the given problem.

In the illumination stage, S3 begins to verbally express the posed mathematics problem fluently, articulating the problem in its entirety. Before writing down the posed mathematics problem, S3 is asked to verify whether the problem is logical. S3 is able to revise the initially posed problem to make it logical based on discussions with

the teacher. After this, S3 writes down the posed mathematics problem on the answer sheet.

In the verification stage, S3 begins to verify the proposed problem-solving process against reality by explaining the procedure for solving the posed mathematics problem, including the formulas used and the steps required to solve it using those formulas. Eventually, S3 successfully solves the posed Pythagorean problem, as illustrated in Figure 4.

Figure 4:
Results of Problem Posing by S3



Discussion

Based on the results of the analysis of the creative thinking process in problem posing Pythagoras problems. Students with habits of mind in the developing, proficient and other subject can collect information, look for new ideas, discover new ideas, and test and check the suitability of the problem solutions that have been created. This observation is consistent with Siswono (2004) researh, that students tend to think creatively and are able to carry out every step of the creative thinking process; can understand assignment instructions and requests well, students are able to imagine, students can express new ideas, and relate them to the mathematics material they have studied and their personal experiences. Beside that, students with habits of mind in developing, proficient categories and other students can pose problems according to their respective habits

of thinking. This observation is consistent with Watoni & Negara (2024) research, that students who have the habit of thinking in mathematics can think creatively according to their respective abilities.

CONCLUSION

Based on these results, it can be concluded that students with different habits of mind categories exhibit variations in *problem-posing* according to Wallas' stages. Students categorized as developing are able to propose new problems under similar conditions without revising the problem if errors occur. On the other hand, students categorized as proficient in *habits of mind* can propose new problems under different conditions and correct errors, drawing on their *habits of mind* to connect prior life experiences. Other students can propose the same problem based on the provided scenario and can correct errors by consulting with the teacher.

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