JURNAL PENDIDIKAN MATEMATIKA DAN IPA

Vol. 17, No. 2 (2026) h. 331-343

http://jurnal.untan.ac.id/index.php/PMP

IDENTIFICATION OF FACTORS CONTRIBUTING TO STUDENTS' DIFFICULTIES IN SOLVING CONTEXTUAL PROBLEMS ON CIRCLE TOPICS USING THE FISHBONE DIAGRAM METHOD

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DOI: https://doi.org/10.26418/jpmipa.v17i2.92759

Abstract

Mathematical problem solving ability is an important skill for students to face real-world challenges. One material that is closely related to everyday life is circles. However, in practice, many learners have difficulty linking the concept of circles with contextual situations, resulting in their low problem-solving ability. This gap shows the importance of in-depth analysis of the factors that cause these difficulties. This study aims to systematically identify the factors that cause students' difficulties in solving contextual problems of circle material using the Fishbone Diagram method. The type of research is descriptive with a qualitative approach involving 23 students of class XI.11 SMA Negeri 7 Cirebon City who were selected through purposive sampling. Data were collected through observation, interviews, and literature studies. The data analysis technique used the Miles and Huberman model and the Fishbone Diagram method. The results grouped the difficulty factors into five main categories, namely: Man (understanding of problems and formulas, lack of confidence, difficulty connecting concepts, lack of initiative to ask, and limited teacher guidance), Method (dominant lecture method, minimal contextual exercises, lack of group discussions), Material (learning resources do not contain contextual problems, lack of interactive media assistance, examples of problems are less varied), Environment (less conducive classroom environment), and Measurement (exam questions are more difficult than exercises and lack of exam time). These results show that learners' difficulties are influenced by internal and external factors simultaneously.

Keywords: *Circle, Contextual Problem, Fishbone Diagram, Problem Solving.*

Received : **2024-11-14**
Revised : **2026-01-29**
Accepted : **2026-03-03**

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INTRODUCTION

Mathematics, as a fundamental discipline for the development of science, holds a significant position and makes an essential contribution to the development of human thought patterns [1]. Mathematics plays an important role in enhancing students' critical thinking and problem-solving abilities [2]. As stated by the National Council of Teachers of Mathematics (NCTM), students need to possess essential competencies referred to as mathematical skills [3]. The National Council of Teachers of Mathematics further emphasizes that one of the key mathematical skills that students must acquire is problem-solving ability [4].

Problem solving is interpreted as a skill that students must possess in order to organize information systematically and resolve problems to achieve the objectives of mathematics learning [5]. The urgency of mathematical problem-solving has become a significant concern at the international level. Based on a comparative study conducted by [6] in South Korea, valuable insights are provided into the relationship between problem-solving ability and overall academic achievement. The findings reveal that students who excel in problem-solving tend to demonstrate higher performance, both in mathematics and in other subjects that require analytical and systematic thinking. Furthermore, this skill is recognized as one of the essential competencies required in the 21st century [7]. In addition, problem-solving ability contributes significantly to various aspects of daily life, as almost every activity is closely related to mathematical concepts [8][5].

The urgency described above indicates that problem solving is a crucial skill that students need to possess, particularly in the teaching of circle topics in mathematics, as this material is frequently applied in various real-life situations [9]. However, in practice, many students still encounter difficulties in solving contextual problems related to circle concepts, which ultimately affects their low level of mathematical problem-solving ability. This is evidenced by a study conducted by [10], which revealed that students' mathematical problem-solving ability in solving problems on circle topics is relatively low. Furthermore, research by [11] found that 60% of students still demonstrate low performance in solving mathematical problems related to circle material.

Students' difficulties in solving contextual problems on circle topics are reflected in the weak connection between mathematical concepts and real-life situations [12][13]. This issue arises because, in the teaching process, teachers often focus on explaining concepts, formulas, and practice questions that can be solved directly by applying formulas, without incorporating contextual problems related to everyday life [14][15]. These findings are consistent with the results of observations conducted by the researcher in class XI.11 at SMA Negeri 7 Cirebon City, where the majority of students experienced difficulties in solving contextual problem-solving questions on circle topics. Some of them reported difficulties in understanding the information presented in the problems, particularly in relating it to the mathematical concepts they had

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learned. In addition, students also encountered difficulties in determining appropriate solution strategies, which led to confusion in organizing the steps required to solve the problems. Therefore, it is necessary to identify the factors influencing these difficulties in order to develop more effective learning solutions.

Various previous studies have examined students' difficulties in mathematical problem solving; however, none have specifically identified the factors of difficulty in circle topics using a systematic approach. For instance, the study conducted by [12] entitled "Students' Difficulties and Contributing Factors in the Circumference and Area of a Circle" and the research by [16] entitled "Analysis of Students' Difficulties in Learning Geometric Shapes and Their Properties". The findings of these studies indicate that the novelty lies mainly in the research objects being investigated, while the interpreted results and discussions have not demonstrated significant differences across studies. Considering this gap in previous research, the researcher is motivated to introduce an innovation through a more systematic research approach. One method employed in this study to identify the factors causing difficulties in solving contextual problems on circle topics is the Fishbone Diagram, which is capable of categorizing various factors into specific groups. Therefore, this study aims to fill the gap in the existing literature by analyzing students' difficulties in solving contextual circle problems using this method.

The Fishbone Diagram method facilitates a systematic analysis of the various factors contributing to the problems faced by students. This method helps identify the main factors influencing an issue and analyze the detailed aspects associated with those factors [17]. Through this approach, teachers or educators can classify the factors of difficulty into specific categories, such as man, machine, material, method, environment, and measurement [18][19]. In this study, however, the researcher focuses on five main factors, namely man, material, method, environment, and measurement. The selection of these factors is adjusted to the needs of the study in order to obtain a more focused and relevant analysis.

Considering the problems described above, this study is important to conduct in order to assist teachers or educators in understanding the difficulties experienced by students, so that they can design more effective learning strategies [20]. By systematically identifying the factors of difficulty, teachers can develop more appropriate instructional methods to improve students' understanding and their problem-solving abilities in circle topics. Therefore, this study seeks to fill the gap in previous research by identifying the factors contributing to students' difficulties in solving contextual problem-solving questions on circle material using the Fishbone Diagram method. This research is expected to provide new insights for teachers or educators in designing more effective teaching methods to enhance students' understanding of circle topics and their ability to solve contextual problems.

METHOD

This study is classified as descriptive research employing a

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qualitative approach. A qualitative descriptive design is used to provide a comprehensive and straightforward description of a phenomenon based on participants' experiences and contextual data obtained through observations, interviews, and documentation, enabling researchers to present findings in a clear and contextual manner [21]. This approach aims to present an accurate account of events or conditions as they naturally occur and focuses on describing phenomena within their real-life context without relying on numerical analysis [22]. Through this approach, researchers can explore and interpret social phenomena in depth while capturing participants' perspectives and experiences in a natural setting [23].

It was conducted in class XI.11 at SMA Negeri 7 Cirebon City, involving 23 students as research subjects selected through purposive sampling. Purposive sampling is a non-probability sampling technique in which participants are deliberately selected based on specific criteria relevant to the research objectives, allowing researchers to obtain meaningful information from individuals who have direct experience with the phenomenon being studied [24]. The selection was based on specific criteria, such as students who experienced difficulties in solving contextual problem-solving questions, were actively involved in the learning process, and were able to provide in-depth information regarding the difficulties they encountered. The selection of these subjects aimed to obtain more detailed information about the factors influencing students' difficulties.

The data collection techniques were carried out through observation, interviews, and literature review. Observation was conducted by directly examining how students encountered difficulties in solving contextual problems related to circle topics. Interviews were conducted with the research subjects to obtain information regarding the factors contributing to difficulties in solving contextual problems on circle material. Meanwhile, the literature review was used as a theoretical basis for understanding the factors influencing students' difficulties.

After the data were collected, the analysis process was conducted using the Miles and Huberman model, which consists of several stages, namely data reduction, data display, and conclusion drawing [25]. Data reduction was carried out by selecting and categorizing information relevant to the factors contributing to students' difficulties in solving contextual problems on circle topics. Irrelevant data were reduced and separated from the appropriate data. Data display was presented in the form of figures or descriptive explanations illustrating the results of identifying the factors of students' difficulties in solving contextual problems on circle material. Meanwhile, conclusion drawing was conducted by identifying the factors that contribute to students' difficulties and formulating recommendations based on the research findings.

In addition, the researcher employed the Fishbone Diagram method to systematically analyze the data and identify the factors contributing to students' difficulties in solving contextual problems on circle topics. The Fishbone Diagram is

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widely used as a visual analytical tool to organize possible causes of a problem into structured categories and to support systematic root cause analysis in research and educational problem solving [26][27]. The diagram illustrates the relationship between a problem and its contributing factors, where the "head" represents the main problem and the "bones" represent categories of potential causes that influence the issue [26]. In this study, the analysis began by defining the main problem, namely students' difficulties in solving contextual problems related to circle material. Subsequently, potential causal factors were identified from observation and interview data and grouped into several categories such as learning process, students' conceptual understanding, problem-solving skills, and learning environment. These factors were then mapped into a Fishbone Diagram to visualize the relationship between the main problem and its contributing factors. The diagram was further interpreted to determine the dominant causes of students' difficulties, which were then used as the basis for drawing conclusions and formulating recommendations for improving the learning process [28].

The validity of the data was tested using triangulation techniques.

Triangulation is a strategy used in qualitative research to enhance the credibility and validity of findings by comparing data obtained from multiple sources, methods, or times of data collection [29]. In this study, the researcher employed source triangulation and time triangulation. Source triangulation was conducted by comparing data obtained from interviews with the research subjects, while time triangulation was applied by collecting data at different times during observations and interviews to ensure the consistency and validity of the research findings.

RESULT AND DISCUSSION

Result

Based on the results of observations and interviews with students of class XI.11 at SMA Negeri 7 Cirebon City, which were analyzed using the Fishbone Diagram method, various factors were identified as causes of students' difficulties in solving contextual problems on circle topics. These problems were categorized into five main groups, namely Man (students and teachers), Method (instructional methods), Material (learning resources), Environment (learning environment), and Measurement (evaluation/assessment).

Based on Figure 1, in the **Man category**, most students experience confusion in understanding circle formulas and encounter difficulties in comprehending problem statements and relating mathematical concepts to real-life contexts. In addition, low self-confidence when solving problems becomes a significant obstacle, as students tend to be afraid of making mistakes and are reluctant to attempt answers. Their reluctance to ask questions to the teacher further hinders them from obtaining adequate guidance, preventing them from overcoming their difficulties optimally. Moreover, a lack of initiative to seek clarification from the teacher also contributes to this issue. Some students also stated that the guidance provided by the teacher is still perceived as limited.

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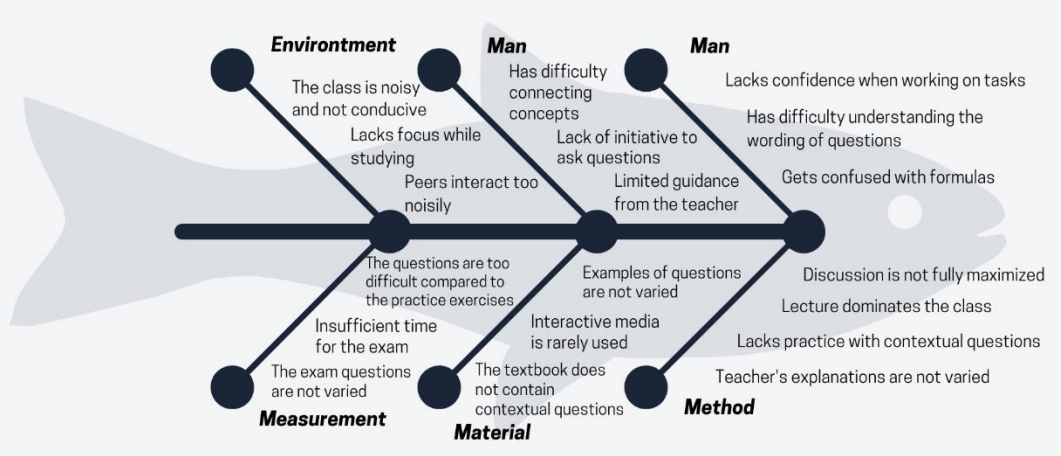

Figure 1. Research results presented using a fishbone diagram

In the **Method category**, the dominant lecture method results in students participating less in the teaching process. This condition leads to minimal interaction and creativity among students during learning. Moreover, group discussions are not fully utilized, even though they are considered helpful. A lack of practice with contextual questions is also problematic, as most practice exercises consist only of routine calculations without connection to real-life situations. Furthermore, the teacher's explanations are not varied enough, making it difficult for some students, especially those with a visual learning style, to follow the material.

In the **Material category**, the learning resources used do not optimally support understanding of contextual questions. The textbooks tend to contain only routine exercises and standard multiple-choice questions. In addition, the variety of examples provided by the teacher is still limited, making it difficult for students when faced with different types of questions. Interactive learning media is also rarely used in the teaching process, even though some students stated that they are more engaged and understand the material better with the help of visual media or applications.

In the **Environment category**, a less conducive learning environment also affects students' focus and concentration. Noisy classrooms and overly active peer interactions often disrupt the learning atmosphere. In addition, classroom facilities are considered insufficient, such as the lack of fans.

In the **Measurement category**, students feel that the exam questions are more difficult compared to the practice exercises previously provided. The practice given before the exam is also insufficient, leaving many students feeling unprepared. The time allocated for the exam is considered too short. Furthermore, the limited variety of question types makes it difficult for students to adjust during the exam.

Based on the analysis using the Fishbone Diagram, it can be concluded that students' difficulties in solving contextual questions on the topic of circles are caused by internal factors, namely the students and the teacher, as

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well as external factors, including the teaching method, learning resources, learning environment, and evaluation/assessment. The Man and Method factors are the most dominant, having the greatest influence on these difficulties. To address this issue, it is recommended that the teacher increase the variety of teaching methods, such as incorporating more interactive media and implementing group discussion methods. In addition, the teacher should provide more varied examples of contextual questions and exercises that develop problem-solving skills. The learning environment should be made more conducive, supported by adequate classroom facilities. Learning evaluations should also be designed with a balanced variety of questions, combining routine and contextual problems, with time allocations adjusted to students' abilities. On the other hand, students should be encouraged to ask questions more actively and build their self-confidence during the learning process to support their success in solving contextual questions.

Discussion

Based on the analysis using the Fishbone Diagram, it was found that in the **Man category**, the majority of students experience difficulties in understanding the wording of questions and in connecting mathematical concepts to real-life contexts. This issue is consistent with the findings of [30], who identified that the inability to comprehend the meaning of questions and determine the correct calculations is a primary factor in students' difficulties in learning mathematics. Difficulties in understanding question statements can hinder students' critical thinking processes in solving problems effectively. This finding is also supported by studies showing that the ability to solve mathematical word problems is influenced by reading comprehension skills. Students often experience difficulties in interpreting information presented in the problem text and translating it into appropriate mathematical operations. Research by [31] found a positive relationship between reading comprehension ability and students' ability to solve mathematical word problems. In addition, [32] found that students' errors in solving word problems are often caused by difficulties in understanding the relationships between information and the context presented in the problem text.

In addition, students' low self-confidence when solving problems also poses a significant obstacle. Negative attitudes toward mathematics, such as fear of making mistakes and reluctance to ask questions, are major barriers in the teaching process [33]. This reluctance to ask questions is further exacerbated by the teacher's limited ability to create a conducive classroom environment, as noted by [34], who emphasize that students' willingness to ask questions largely depends on their comfort and sense of acceptance within the learning environment. This finding is also supported by studies indicating that affective factors such as self-confidence and mathematics anxiety have a significant influence on students' mathematics learning ability. One study found that self-confidence has a strong positive correlation with mathematical problem-solving ability,

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with a correlation coefficient of r = 0.6923, contributing 47.22% to the variance in students' problem-solving abilities [35].

In the **Method category**, a teaching approach dominated by lectures tends to reduce students' active participation in the learning process. This is consistent with the findings of [36], who reported that lecture-based methods lead to low motivation and creativity among students and make learning monotonous. The limited use of group discussions, which could enhance communication skills, collaboration, and problem-solving abilities, is also a contributing factor to students' low conceptual understanding [37].

Furthermore, the lack of practice with contextual questions is also a critical issue. Research by [38] revealed that more than 80% of the questions in mathematics textbooks in Southeast Asia are still based on pure mathematics, without any connection to real-life contexts. This results in students' low proficiency in solving story problems that require the application of mathematical concepts to real-world situations. Additionally, the limited variation in the teacher's explanations further exacerbates learning difficulties, especially for students with a visual learning style. Students with a visual learning style tend to demonstrate superior learning outcomes compared to other learning styles [39].

In the **Material category**, the learning resources used in teaching are considered not yet optimal in supporting students' understanding of contextual questions. The mathematics textbooks used mostly contain routine exercises, as noted by [40], who found that 69.3% of the questions in Kurikulum Merdeka textbooks are not context-based. The lack of variety in the examples provided by the teacher also contributes to students' inability to handle different types of questions, whereas the use of varied teaching methods has been shown to significantly enhance motivation and mathematics learning outcomes [41]. This condition is also supported by the findings of [42], who reported that many students experience difficulties using teaching materials because the content is too brief, lacks clear explanations, and is not sufficiently contextual to support students' understanding in problem-solving activities.

In addition, the use of interactive learning media in the teaching and learning process is still rarely implemented. In fact, the use of interactive media can significantly enhance students' motivation and engagement, which ultimately has a positive impact on learning outcomes [43]. A variety of interactive learning media also allows students to be more active in the teaching process and to understand the material in a more engaging and effective way [44].

In the **Environment category**, an unconducive learning environment, such as noisy classrooms and limited supporting facilities, affects students' concentration and comfort while learning. This is consistent with the study by [45],which emphasizes the importance of creating a quiet, safe, and comfortable learning environment to support the optimization of students' potential. Therefore, improving facilities and better classroom management are highly necessary so

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that students can learn more effectively and maintain focus.

Finally, in the **Measurement category**, it was found that students perceive exam questions as more difficult compared to practice exercises, while the number of practice questions provided before the exam is considered insufficient. In addition, the time available for completing the exam is regarded as too short, which increases students' anxiety. This finding aligns with the study by [46], which revealed that insufficient practice and limited exam time significantly contribute to higher anxiety and lower mathematics achievement. The lack of variety in question types also poses a challenge, as emphasized by [41], who state that varied methods and question types are important to reduce boredom and enhance students' readiness for exams. Therefore, it is essential to provide more diverse practice exercises and allow adequate exam time to reduce anxiety and maximize students' preparedness.

CONCLUSION

Based on the results of observations and interviews analyzed using the Fishbone Diagram, it was found that students' difficulties in solving contextual questions on the topic of circles are caused by various factors grouped into five main categories: Man (students and teacher), Method (teaching methods), Material (learning resources), Environment (learning environment), and Measurement (evaluation/assessment). The primary factors influencing these difficulties include problems in understanding the wording of questions, low self-confidence, a lecture-dominated teaching method, and the lack of variety in questions and supportive learning resources. In addition, an unconducive learning environment and limited exam time also affect students' readiness.

To address these issues, it is recommended that teachers not only implement active and varied teaching methods, such as group discussions and the use of interactive learning media to enhance motivation and understanding, but also provide contextual questions that are more relevant to real-life situations. In addition, teachers should enrich the learning resources used, such as diverse textbooks and learning media that support various student learning styles. Teachers are also expected to create a conducive learning environment and improve the quality of guidance and attention given to students to help them overcome the difficulties they face.

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