Did the Teacher Ask the Right Questions? An Analysis of Teacher Asking Ability in Stimulating Students' Mathematical Literacy

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This study was conducted to identify the structure of the questions asked by teachers to stimulate students' mathematical literacy and to compare the questioning skills of PMRI workshop participants and non-participants. This study used a qualitative approach. The teachers were asked to conduct and record the lesson in this study. The teacher's questions were coded according to their cognitive level, question structure, and activity type. The results obtained showed that teacher A mostly asked at the level of cognitive knowledge (74.3%) and closed questions (90%). In contrast, Teacher B asked relatively evenly distributed questions at the level of cognitive knowledge, understanding, application, analysis, synthesis, and evaluation (24.9%, 20.2%, 18.3%, 15.4%, 11.6%, and 9.6%). The results showed that Teacher A emphasized more on the closed question structure (90%) while Teacher B was more varied (45% closed questions & 55% open questions). From the interview results, teacher B stated that he was used to applying coaching techniques when conducting learning. So, teacher B was accustomed to asking questions to stimulate children's thinking.

Keywords: questioning skill, stimulation, mathematical literacy, numeracy

INTRODUCTION

Questioning skill is essential to be mastered by the teacher to improve the quality of learning. This questioning skill determines students' success in understanding a material (MacNaughton & Williams, 2004; Halim et al., 2018). In addition, the questions given by the teacher can increase participation and

interaction between students and teachers and encourage students to provide feedback on the learning (Wood & Anderson, 2001; Massey et al., 2008). The results also show that questioning is excellent in stimulating students' critical thinking (Gall,1984; Morgan & Saxton, 1991; Ozden, 1999; Acıkgoz, 2006; Taspınar, 2009). Moreover, asking questions can also improve students' language literacy skills (Wasik1&1Bond, 2001; MacNaughton1&1Williams, 2004; Walsh1& Blewitt,12006;1Wasik, et1al, 2006; Massey,1et1al,12008). Therefore, teachers' stimulation through questions can increase students' practical thoughts in learning (Gall, 1984; Duster, 1997; MacNaughton & Williams, 2004; Daglıoglu & Cakir, 2007; Zucker et al., 2009).

Self-questioning is a learning strategy to facilitate and develop thinking skills to solve problems, activate student participation, foster interest, and motivate students to acquire new knowledge (Shi-Ying, 2011; Yang, 2017; Halim et al., 2018). This strategy, of course, depends on the teachers' skills in asking questions so that the questions given can stimulate students.

Based on observations on learning by mathematics teachers at SMP Negeri 2 Tondano in offline learning, it was found that in asking questions, the teacher was only limited to giving closed questions with "yes" or "no" answers. The teacher has attended PMRI workshops and Basic Teaching Training related to learning oriented to students' daily lives and has worked for more than 20 years. This learning impacts the interactions that occur in the classroom to be not participative and monotonous. At the same time, such closed questions can limit students' development of their ideas (MacKay, 1997; Goodwin et al., 1983; Wilen, 1991). Agreeing with them, Carin et al. (2005) stated that questions that focus on the level of knowledge of C1 in Bloom's taxonomy will only limit children's cognitive processes. This situation shows that the teacher needs to gain mastery of how to ask questions that can stimulate students.

In addition, the problem of the ability to ask teachers at this school needs to be explored further. Teachers have had a relatively long working period (more than ten years). They have attended PMRI workshops even though the research results show that the experience of attending workshops and a long working period positively influence teachers' teaching ability (Ismanto, 2007; Hasan, 2015; Sugito et al., 2019).

Different results were shown by young teachers who were observed in other classes. Young teachers who have worked for less than five years and have not attended PMRI workshops show considerable questioning skills. From observations, it is shown that the teacher provides context related to students' daily lives as a starting point for learning. The instructor then posed pertinent questions, such as "what data did you obtain? Why is this so? Anyone with a contrary viewpoint? and so forth." It is exciting and implements learning in the classroom, interactive and integrative. This result contradicts several research results, which show that the workshop experience and long working period positively influence teachers' teaching ability (Ismanto, 2007; Hasan, 2015; Sugito et al., 2019).

Improving students' mathematical literacy skills is also essential currently. It is because mathematical literacy skills are critical in helping students face challenges and problem-solving in everyday life (Stacey & Turner, 2015; Masjaya & Wardono, 2018; Janah et al., 2019). Mathematical literacy is the capacity to formulate, apply, and interpret mathematics in a variety of contexts, including the use of mathematical reasoning, concepts, procedures, and facts, in describing, explaining, and predicting phenomena. (OECD, 2003; Mangelep, 2013). So that students who have mathematical literacy skills will easily understand and manage known mathematical concepts to solve mathematical problems related to everyday life (Hanum et al., 2020).

Using stimulation in the form of questions can stimulate students' mathematical literacy. This is based on Jacques et al. (2020)'s research results, where a questioning approach can improve higher-order thinking skills and students' understanding of content and problem-solving. This is in line with the ability measured in students' mathematical literacy (OECD, 2019) because there is a connectivity between critical thinking, higher-order thinking, and mathematical literacy skills (Maharani & Abadi, 2019).

Several studies related to the integration of the ability to ask questions in learning have been conducted (Chappella, 2008; Ermasari et al., 2014; Bay & Hartman, 2015; Walsh & Hodge, 2018; Deshmukh, 2019; Jacques, 2020), but this research still focuses on the identification, profiling, and integration of critical thinking skills. This study focuses on identifying the structure of the questions asked by teachers in the

context of daily life to stimulate students' mathematical literacy and comparing the questioning skills of PMRI workshop participants and non-participants. This research is essential for comprehending how teachers pose questions in particular contexts. This study also identifies which activities stimulate mathematical literacy skills. Therefore, this study helps us comprehend the process of teacher stimulation using questions so that it can be beneficial and contribute to mathematics learning.

METHOD

This study involved two junior high school mathematics teachers who had attended the PMRI workshop (Teacher A) and who had not attended the PMRI workshop (Teacher B). Both were second-grade students of SMP Negeri 2 Tondano, consisting of forty students. Data were collected by observation and interviews. In classroom lessons, we observe how teachers ask questions, what questions they ask, and what students answer. During the observation, all interactions between the teacher and students in the classroom were recorded, then transcribed into notes, and six random samples of student work were collected. The audio was transcribed and based on the research objectives and issues identified in the observations, the researcher needed to formulate and clarify interview questions. The teacher and six students clarified and analyzed the students' mathematical creativity during the interview process. Additionally, these interviews were recorded and transcribed.

RESULTS AND DISCUSSION

Observation Result

In this section, the activities of the two teachers in learning are described. Descriptions are used to understand the focus of this study in more depth.

Teacher A's Activities

TABLE 1
TEACHER A'S QUESTIONING ACTIVITIES

Questioning Activity	Description
T: From the given problem, are the size of parts A and B same?	Open, Problem Posing
Gabriel: Not same, ma'am	Answer 1
T: What do you think, Andrea?	Prompting question
Andrea: Each side of the base is different, ma'am	Answer 2
T: Anything else?	Probing question
T: What flat shape is this?	Compliance question
Students: Triangle, ma'am	Answer 3
T: The area of the triangle is?	Compliance question
Students: ½ base x height, ma'am	Answer 4
T: OK, if we use numbers for each side, suppose that the length is 80 and the width is 40. Thus, what is the area?	Prompt question
S: If you use the triangle formula, the base is 80, the height is 20, ma'am. So, the area is (½)(80)(20) which is 800 square meters.	Answer 5
G: In the same way, what is the area of the other triangle? The base is 40 and the height is 40.	Prompting question
S: The area is the same, ma'am, which is 800 square meters	Answer 6
G: Then the area of triangles 1 and 2 is the same, right?	Compliance question
S: Same, ma'am	Answer 7

Teacher B's Activities

In learning, the teacher uses the context of everyday life as a starting point. The context is a mathematical problem in the form of story questions that can promote mathematical literacy among students. Following is a brief transcript excerpt displaying the teacher's questions and the students' responses.

TABLE 2
TEACHER B' QUESTIONING ACTIVITIES

Questioning Activity	Description
T: From the given problems, can anyone answer?	Open, Problem Posing
Lovely: I can, ma'am. I agree with Stanly. The division is not the same, because the division crosses so that the base is different. So, if the base and height are different, then the area is different, and the distribution is uneven	Answer 1
T: So, to make them same, what is Lovely looking at?	Prompting question
T: Shapes that have the same area can be seen from their shapes or what?	Prompting question
Lovely: Judging from the shape, Ma'am	Answer 2
T: So, if the shapes are different, the areas are different, right?	Probing question
Lovely: Yes, ma'am	Answer 3
T: How about the others? Any other opinions?	Compliance question
Clarisa: I am	Answer 4
G: Yes, Clarisa, what do you think?	Compliance question
Clarisa: The area is different, Ma'am. There are 2 that are the same, and there are 2 that are different	Answer 5
T: Does that mean Clarisa agrees with Lovely's answer?	Prompting question
Clarisa: Yes, ma'am. Yet, I have different picture	Answer 6
T: Anyone have another opinion?	Compliance question
Cheryl: it can be counted if there is a size, ma'am?	Answer 7
T: Okay, if you give me the length and width, can you find the area?	Probing question
Lovely: yes, I assume the length is 10 and the width is 5.	Answer 8
T: Yes, what can Lovely conclude from that result?	Prompting question
Cheryl: The conclusion is "Same," Ma'am, because if it is divided by any number (using the formula for the area of a triangle), the result is the same. So, the division of the area is same.	Answer 9
T: Any other opinions?	Compliance question
Clarisa: Same, ma'am, because they use the same area formula.	Answer 10

Types of Teacher's Questions That Stimulate Mathematical Literacy

Based on the teacher's questioning activity above, Teacher B asks various questions to stimulate students' mathematical thinking. The teacher generates additional questions based on the responses of students in order to explore their ideas and engage other students in finding suitable responses. Through this process, students share the given contextual problem-solving strategies.

This demonstrates that the instructor asks both closed and open questions throughout the lesson. The results of teacher interviews indicate that teachers ask questions based on the problem's objectives. In addition, teachers want to improve their students' mathematical abilities. When students answer, "yes or no," the teacher asks closed questions. However, teachers ask open-ended questions to stimulate students to think carefully and encourage them to associate mathematical concepts with many other ideas. When asking closed questions, the teacher encourages students to analyze the question's meaning. The teacher then asked the students about the problem. Here, the teacher instructs students to formulate questions based

on the provided statements. The teacher lists the answers from different students to this open-ended question. In addition, the teacher encourages students to analyze the mistakes of other friends by asking, "Really?" This makes students learn to find the truth in their answers. In addition, the teacher improves communication and reasoning skills by asking, "why is this," "how," "where did the answer come from," and so on.

TABLE 3
SOME OF THE QUESTIONS ASKED BY THE TEACHER

Closed Question	***Open-ended Question***
From the given problems, can anyone answer?	What do you think?
So, to make them same, what is Lovely looking at?	So, if the shapes are different, the areas are different, right?
The area of the triangle is	What can be concluded from the results obtained?

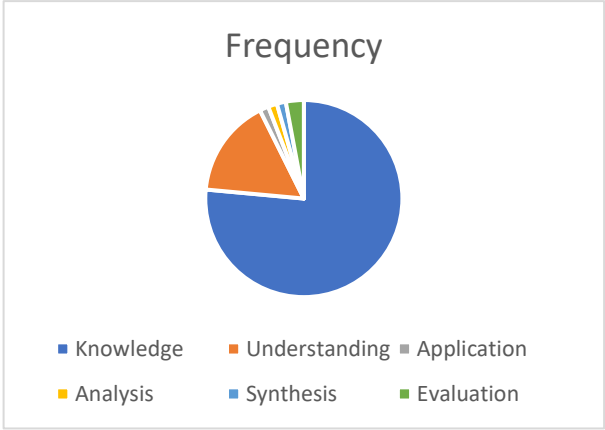
From the results of the interview with teacher B, teacher B stated that he was accustomed to using coaching techniques in learning. The experience of participating in coaching training mainly helps Teacher B in creating stimulation in learning. Here the teacher acts as a coach by providing appropriate and in-depth questions to reveal the answers that students will raise (Coachee) (Jerusalem, MA, 2011; Fitrihana et al., 2014).

Cognitive Level of Teachers' Questions

In comparison to the cognitive level of the instructor's questions, these questions demonstrate a superior level of knowledge. The cognitive level of Teacher A's questions is displayed in Table 4.

TABLE 4
COGNITIVE LEVEL OF TEACHER A'S QUESTIONS

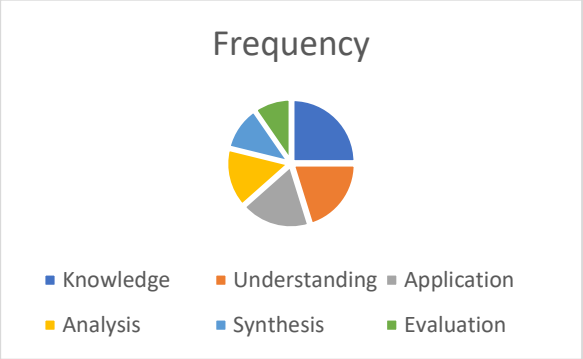
Level	**Frequency**
Knowledge	52
Understanding	11
Application	1
Analysis	1
Synthesis	1
Evaluation	2
Total	**70**



Teacher A poses questions at all cognitive levels, although the majority are knowledge-based (C1). This table reveals that the instructor posed 70 questions regarding the students' level of knowledge (C1). In addition, the questions at the cognitive levels of application, analysis, and synthesis are asked the least. Table 5 depicts the cognitive level of Teacher B's questions.

TABLE 5
COGNITIVE LEVEL OF TEACHER B'S QUESTIONS

Level	Frequency
Knowledge	26
Understanding	21
Application	19
Analysis	16
Synthesis	12
Evaluation	10
Total	**105**



Discussion

This study was conducted by comparing the questions of mathematics teachers who attended the PMRI workshop with those of those who did not. In this study, the cognitive level (knowledge, understanding, application, analysis, synthesis, and evaluation) and question structure of teacher questions were coded (closed, open). The results showed that teacher A mostly asked at the cognitive level of knowledge (74.3%) and closed questions (90%). In contrast, Teacher B asked questions at the level of knowledge which was relatively evenly distributed at the cognitive level of knowledge, understanding, application, analysis, synthesis, and evaluation (24.9%, 20.2%, 18.3%, 15.4%, 11.6%, 9.6%). The search results also show that Teacher A emphasizes the structure of closed questions (90%) while Teacher B is more varied (45% closed questions & 55% open questions).

Additionally, research indicates that teachers spend most of their time learning through verbal questioning. Teachers ask practical questions by posing both closed and open-ended inquiries. Closed questions require correct or incorrect responses because they have a single correct answer. On the other hand, teachers use open-ended questions to assess the accuracy of students' responses and to cultivate communication, reasoning, mathematical concepts, reasoning, and problem-solving skills (Kwon et al., 2006). The teacher's use of open-ended questions can foster mathematical creativity and critical thinking among students (Kwon et al., 2006).

The free-form questions also encourage students to provide multiple answers and challenge the teacher to respond quickly to unexpected responses from students. Especially if students misunderstand a given problem, you may need to ask additional questions to encourage the teacher to reflect on the answer. From the results of interviews with students, students needed clarification about dividing the trapezoidal shape (Unit 4) into four equal parts. Also, in unit 2 questions, students think that the area will automatically be the same if the shapes are the same.

Teacher A posed 74.3 percent of knowledge-level questions, compared to Teacher B's 24.9 percent. Knowledge-level questions are typically employed to identify, recall, and acquire knowledge (Duster, 1997; Storey, 2004). Knowledge-level questions are designed to evaluate students' knowledge, not their reasoning (Filiz, 2007). In contrast, hot-level questions (analysis, integration, evaluation) can improve a child's cognitive abilities (Walsh & Blewitt, 2006; Chappella et al., 2018).

The findings of this study indicate that teachers must improve their questioning abilities. Participation in PMRI workshops does not guarantee to increase in the teacher's ability to ask questions. This is presumably because the PMRI workshop focused on developing contextual material in learning, not on the

teacher's questioning skills. On the other hand, the coaching technique used by teacher B showed significant results on the teacher's ability to ask questions. This aligns with Helmy's research (2019), where coaching techniques can direct students to obtain the best achievements through stimulation, powerful questions, and creative dialogue.

CONCLUSION

This study identifies two areas for teacher questions: cognitive level and the structure of questions asked to students. According to the findings of the study, teacher A posed more knowledge-level and closed questions, while teacher B posed a wider variety of questions. From the interview results, teacher B stated that he was used to applying coaching techniques when conducting learning. So, teacher B is accustomed to asking questions to stimulate children's thinking.

The results of this study can be used as the basis for developing questions that help children's learning, thinking, and interactions. Effective teaching is primarily dependent on the teacher's question-asking skills. The structure and distribution of questions should be considered prior to planning how to ask questions to facilitate the proper development of children. Teachers must know the standard terms for each level of Bloom's Taxonomy to determine what kinds of questions can be asked. In this way, it is easier for teachers to generate questions that correspond to each taxonomic level.

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