Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6, 2427-2440
2024
Publisher: Learning Gate
DOI: 10.55214/25768484.v8i6.2493

Fostering students' potential understanding in mathematics learning: Use of teacher questions in small-group discussion

Harfin Lanya[1], Susiswo[2*], Erry Hidayanto[3], Swasono Rahardjo[4]
[1,2,3,4]Universitas Negeri Malang, Jl. Semarang 5, Malang, jawa Timur, Indonesia; harfin.lanya.2103119@students.um.ac.id (H.L.) susiswo.fmipa@um.ac.id (S.) erry.hidayanto.fmipa@um.ac.id (E.H.) swasono.rahardjo.fmipa@um.ac.id (S.R.)

Abstract: Teacher questions in mathematics learning can foster student understanding, especially teacher questions in small group discussions. Through the small group discussion method, teachers can specifically provide assistance to students more intensively in understanding learning materials by giving questions. There are 4 types of teacher questions in group learning, including convergent questions, divergent questions, probing and follow-up questions and evaluation questions. Based on the results of the study whose data were obtained from the analysis of learning videos conducted by a group of mathematics teachers consisting of 3 junior high school mathematics teachers and special interviews with teachers about the impact of teacher questions on fostering students' potential understanding, it was found that probing and follow-up questions were asked by teachers to help students solve problems in small group discussions. These questions direct students to understand the learning material and can be used as a reference in order to improve student potential.

Keywords: *Fostering, Mathemathics learning, Small-group discussion, Students' potential understanding.*

1. Introduction

Questioning by teachers in mathematics learning plays a crucial role in exploring and enriching students' understanding of mathematical concepts. Through strategically designed questions, teachers can stimulate critical thinking, invite students to actively participate, and encourage students to build their own understanding through a process of discovery. Effective questioning can connect prior knowledge with the knowledge being learnt, facilitate the development of problem-solving skills, and strengthen connectivity between concepts in mathematics. Thus, teachers' ability to ask questions is important to improve students' understanding of learning materials.

Probing and follow-up questions is important for the teachers to strengthen students' confidence in learning [1-3], promote students' critical thinking, ensure students' understanding of learning material, and to find out students' thinking processes [2, 4-7]. Probing and follow-up questions can be used by the teacher both as a teacher's response to students and also as an assessment of answers to the concepts being studied [1,4,6,8]. Thus, the types of probing and follow-up questions that the teacher asks can determine students' understanding of the concepts being studied.

Many ways are done by the teacher in order to understand the concept, one of them is asking questions. Asking questions is an activity that must be carried out by teachers in learning [6, 8, 9]. By making questions, the teacher will know the ability of their students [6, 10, 11]. Through asking questions, teachers can maximize learning outcomes [12].

In addition to asking questions, the teacher can ask students to collaborate with colleagues to understand concepts, for example the teacher uses the group discussion learning method [14-15]. Through group discussions, students can exchange ideas and discuss especially in problem solving.

* Correspondence: susiswo.fmipa@um.ac.id

Steps in problem solving include understanding the problem, planning, implementing the plan and re-checking [15-17]. In carrying out this step the role of the teacher is very necessary.

Learning mathematics is an activity carried out between teachers, students and the learning environment related to mathematics material. Mathematics teachers are advised to design student-centered authentic and interdisciplinary learning activities in order to fulfill 21st century skills [18]. Communication in class is generally dominated by the teacher [19]. Communication is an important instrument for the implementation of learning so that a teacher must have good communication skills. In relation to teacher communication especially in terms of teacher questions, this study focused on communication activities that can occur in mathematics learning, namely asking teacher questions.

Several studies have focused on the use of questions in the mathematics learning process [6, 20, 21]. Questions as an instructional tool are mostly used in learning [20]. Further, teacher guidance through analysis of questions asked and responses from students in mathematical discourse, can identify effective and ineffective question and answer strategies [6]. Moreover, teachers should need to create situations where questions relate to the questions asked, and identify situations that require the development of questioning skills [21].

The role of 3 mathematics Junior High School teachers in group discussion activities is the teacher asking various types of questions in small group discussions. The three teachers selected the types of probing and follow-up questions for each small group. The choice of question words and the depth of the teacher's questions are adjusted to the responses given by students in each group. By submitting teacher questions, students are able to solve problems contained and understand the material being studied. Therefore, it is important to examine more deeply about the technique of in group discussions and the reasons for selecting the types of questions in learning, especially probing and follow-up questions. Techniques of asking in group discussions and choosing the right types of questions can improve the quality of learning [22-27].

Research on the effectiveness of teacher questioning in group discussions has been conducted before [28-31]. Research on probing and follow-up questions has also been carried out previously by [2, 4, 6, 7, 9, 32]. However, specific research has not been carried out on how mathematics teacher techniques in asking probing and follow-up questions in group discussion learning.

This article will provide a theoretical contribution on the types of teacher questions in group discussions and their impact on students. Thus, it is expected that it can expand the repertoire of knowledge for the reader and does not rule out the possibility that the reader can imitate the activities carried out by the teacher in classroom learning for the same purpose.

2. Literature Review

Questions are the most powerful learning tool used by teachers to advance learning and increase student potential/understanding [9, 27, 33-35]. The following literature review provides context for the discussion about the purpose of asking questions in learning, the types of questions and the impact on students. We consider teacher questions in small group discussion lessons and types of teacher questions. Through the following literature review, we developed indicators detailing the teacher's questioning in learning activities, the definition of the types of questions asked by the teacher in learning and the frequency of the types of questions that the teacher used in learning so that it had an impact on students.

2.1. Questioning as a Formative Strategy

The purpose of asking questions to students is to help students clearly identify students' thoughts about the problem at hand, not to direct students to a solution. The teacher's questions will help students to see the relationship between ideas in understanding mathematical concepts [11, 36]. Questions related to ideas and learning objectives will arouse students' curiosity, help them think critically, reflect and help students build their own meaning in the material being studied. In addition, student responses will help teachers assess what students know and the next instructional steps [37].

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2427-2440, 2024
DOI: 10.55214/25768484.v8i6.2493

Some of the purposes of asking questions include questions to see students' thoughts, adapted to learning objectives, high-level questions according to student understanding, positioning questions that open responses to include other people, and the need to provide time in answering questions [37].

Wong KY [38] stated that questions help students to connect what is learned and what is already known. Findings from a study show that teachers mostly ask questions to attract interest and attention (26.3%) and to promote higher level thinking (14.8%) and to evoke the expression of feelings (14.1%). In addition, teachers use questions to manage students (4.8%) [69]. Therefore, well-constructed questions reflect higher order thinking and can promote knowledge acquisition [39].

2.2. Questioning as a Problem-Solving Strategy

There are many types of questions that can be used by teachers in the process of asking questions to students [6, 24, 40-41]. Classification of questions into 4 categories: (1) probing and follow-up, these types of questions are used to investigate further the answers given by students; (2) leading questions, main questions that direct students' answers through scaffolding; (3) Checklisting, the teacher gives questions from one question to the next with little attention to student responses; and (4) student-specific questioning, specific questions given by the teacher about something [6]. Reproductive, closed, open, evaluative, and rhetorical questions [40]. Various strategies that can be carried out by asking questions [24]: (1) Checklisting, following the questions according to plan, the teacher gives one question to another with little help for students' answers (no follow-up questions); (2) teaching more than judging, the teacher gives main questions with the aim of directing student answers and stops asking questions to teach concepts without encouraging students to provide responses; (3) asking questions and providing follow-up, the teacher uses various types of questions to find out more about student responses and other relevant questions, so that in the end students respond and are still open for discussion; question types include only asking wrong answers; non-specific questions (when the teacher follows up on student answers but with questions that indicate a lack of specificity); and competent questioning, (when the teacher listens to student answers and uses them to gather information about student reasoning). Types of questions include: open questions, closed questions, main questions, process questions and rhetorical questions [42]. From the discussion, it can be stated that one of the goals of asking questions is to solve problems in the learning that is carried out.

2.3. Related Research

Jiang, Y [43] used questioning as a form of formative assessment strategy by examining the practice of teachers of English as a Foreign Language in Chinese universities. The focus in this study was to investigate how teachers deploy questions to stimulate students' thinking, reveal students' current learning levels, and enable responses to inform pedagogical decisions [43] Research on types of probing and follow-up questions [2, 4, 6, 7, 9] submitted by teachers in learning.

Friedman analyzed the questions asked by the teacher in learning. In his research, he explained how the strategies were used to obtain better learning outcomes with the subject of 13 teachers, especially in learning geometry [44]. In research conducted by [45], it was found that the submission of open-ended questions given by the teacher in class interaction resulted in an unfavorable response, so that as a form of response to student answers the teacher gave follow-up questions [45].

In research conducted by [46], it was found that the pedagogical style used in many mathematics classes was still (traditional). The teacher should explain how, when, and what types of questions to ask students. Then the teacher also needs to ascertain whether the questions asked are in accordance with the conditions of the students [47-48]. Research on teacher questions in group learning [28, 29, 30, 49] has also been conducted.

2.4. Purpose of the Study

This study aims to determine the types of questions asked by the teacher in group discussions and the impact of the types of questions asked by the teacher on students. Thus, the questions in this study

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2427-2440, 2024
DOI: 10.55214/25768484.v8i6.2493

were what types of questions were asked by the teacher in group learning, which types of questions were asked the most by the teacher in group discussions and what was the impact on students?

3. Method

The purpose of this study was to determine the types of questions asked by teachers in mathematics learning to foster students' potential understanding in small group discussions. This study is a descriptive qualitative study with a case study [50] that explores cases about the types of teacher questions that fostering students' potential understanding in mathematics learning. The subjects of this study were three junior high school mathematics teachers who used the small group discussion method.

3.1. Participants

This research approach is qualitative research with a case study type. The cases explored by the researchers are questions asked by teachers to increase student understanding or students' ability to solve problems. This research was carried out at State Junior High Schools throughout Pamekasan Regency with a total of 26 mathematics teachers spread across 8 junior high schools. Of the eight junior high schools, there were 8 mathematics teachers who were used as potential subjects in the research. Each school was represented by 1 teacher. The 8 mathematics teachers were selected because they had the potential to become prospective research subjects who were selected based on the following criteria; (1) teaching mathematics material; and (2) willingness to become a potential research subject. Subjects were taken by observing learning carried out on eight state junior high school mathematics teachers for 3 weeks, twice in each meeting. Based on the results of observations made by researchers, there were 3 teachers who met the criteria as research subjects. The subject criteria in this research are (1) teaching mathematics material; (2) using group discussion learning methods; (3) asking questions in the learning process; (4) willing to become a research subject.

Table 1.
Determination of research subject selection based on criteria.

No	Initial	Home school	Research subject criteria				Decisions
			Teaching mathematics material	Group discussion method	Asking questions in the learning process	Willing to be a research subject	
1	NS	A	V	V	V	V	Research subject
2	IL	B	V	V	V	V	Research subject
3	AL	C	V	-	-	V	-
4	IY	D	V	V	V	V	Research subject
5	FC	E	V	-	V	V	-
6	DH	F	V	-	-	V	-
7	FE	G	V	-	V	V	-
8	EG	H	V	-	V	V	-

Based on Table 1 above, there are 8 mathematics teachers who have the potential to be research subjects. However, only 3 teachers meet the 4 criteria determined by the researcher, namely teaching mathematics material, using group discussion method, asking questions in the learning process and being willing to be research subjects. Thus, the researcher decided to choose NS, IL, and IY as research subjects.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2427-2440, 2024
DOI: 10.55214/25768484.v8i6.2493

3.2. Data Collection Tools

Observations of the learning process were carried out to obtain information related to the learning done by the research subjects. Learning observations were carried out on subjects NS, IY and IL during 2 meetings with a time allocation of 70 minutes for each meeting. Observations were done by using auxiliary instruments in the form of observation sheets which were filled in directly by the researcher during the learning process. Observation sheets are used to record all teacher activities during the learning process. These learning activities include preliminary activities, core activities and closing activities [51]. However, in this study the researcher observed the focus of subject questions in the core learning activities. Video recording equipment (handycam) and image recording (camera) are used for documenting the results of learning videos and images that researchers cannot capture directly during the learning process. So, the observation sheet has been filled in directly by the researcher.

The focus of this research is to find out the types of questions that are mostly asked by research subjects in group discussions, especially during core learning activities. So, the observation sheet is specifically designed to find out the types of questions asked by teachers in delivering material, student involvement and carrying out assessments. As shown in Table 2.

Table 2.
Observation sheet.

No	Aspects observed	Types of questions				Target of questions being asked	Comments
		CQ	DQ	PF	EQ	Personal / Small group / Big group	
1	Core activities						
	a. Explanation						
	b. Student involvement in learning						
	c. Implementation of learning assessment						

In addition to observation sheets, researchers conducted semi-structured interviews to research subjects. Interviews were conducted to confirm information that researchers did not obtain while observing learning directly, such as the reasons for choosing certain types of questions in group discussions, and the impact of the types of questions on students. The interview process was carried out using a cellphone as a voice recording tool to assist researchers in conducting data analysis.

3.3. Data Collection Process

The data collection process was carried out by observing the learning done by three research subjects for 2 consecutive meetings. Next, the learning video is transcribed into a learning transcript. Apart from learning transcript data, researchers also collected data in the form of recorded interviews with three research subjects, which were then transcribed into interview transcripts. The data collection process in the form of learning videos was carried out for 4 weeks, and 3 weeks for the interview process.

Research subjects' interview process requires a relatively long time to dig deeper into the types of questions asked by teachers in group discussions and the impact that occurs on students after the process of asking questions. The interview process is also carried out by playing back the learning video in minutes and seconds that the subject has done when asking questions to students.

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2427-2440, 2024
DOI: 10.55214/25768484.v8i6.2493

3.4. Data Analysis

The results of the observations which were in the form of learning transcripts were reduced and coded for each type of question asked by the research subjects in the group discussion process. Coding is carried out based on Table 3.

Table 3.
Coding types of questions in learning.

No	Types of questions	Code
1	Convergent	CQ
2	Divergent	DQ
3	Probing and follow up	PF
4	Evaluation	EQ

This question coding typology refers to research conducted by classification system [52,53]. Next, based on the coding analysis provisions in table 3, the researcher calculated the questions most frequently asked by the subjects. Reasons for choosing the types of questions that are often asked during interviews with subjects and the impact that occurs on students after asking questions by the subject. Based on the process, researchers can draw conclusions.

4. Results and Discussion

4.1. Teacher Questions in Small Group Discussion

Many probing and follow-up questions were asked by teachers in group discussions. This can be seen in the percentages of Table 2 below. Based on the results of interviews with the teacher, the teacher asks probing and follow-up questions to help students solving problems. The interrogative sentences used by the teacher in asking probing and follow-up questions depend on the responses given by students in learning.

Types of convergent questions are also asked by teachers in learning. The teacher asks these types of questions to determine students' ability to understand the problem. Students can answer the convergent questions asked by the teacher by doing 1 stage of calculation or thinking. Apart from that, there are several other types of questions, such as divergent and evaluation. Divergent questions are used by the teacher to find out students' understanding of the material being discussed and usually the teacher uses open ended questions. Evaluation questions are used by the teacher to evaluate or find out the extent of student understanding, checking student understanding. Frequently used interrogative sentences such as "how are the others, do you understand?". Explanation of each type of question will be presented in the table. 4 and the percentage for each type of question that the teacher used in group discussion is presented in Table 5.

Table 4 provides definitions and examples of the various types of questions that might appear in the lesson to give readers an idea of the types of questions. Table 3 shows the average number of questions asked by the teacher in group discussion activities.

Table 4.
Types of questions asked by the teacher.

Type	Definitions	Examples
Convergent question	Convergent questions, teachers sometimes ask students to make a specific response which in many cases can be obtained by a one-step thinking process [8]	" Is a triangle a two dimensional shape?" (IL-at the 11th minute and 21st second) "In what condition it give us advantages?" (IY-at the 20th minute 16 seconds) "What is the meaning of the

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2427-2440, 2024
DOI: 10.55214/25768484.v8i6.2493

		central angle?" (NS-at 2 min 24 sec)
Divergent question	Divergent questions have a non-limiting tendency, leaving respondents/students free to choose one of possible ways to answer, and in details. Questions are open questions [8]	"Circle elements, what are the elements of the circle?" (NS-at 1 minute 20 seconds) "Why do sellers make profits?" (IY-at the 7th minute 15 seconds) How do you determine the size of the central angle? (IL-at 5 minutes 25 seconds)
Probing and follow up question	Follow-up questions were asked by the teacher based on the responses given by students. The responses given can be a new tool for teachers to follow up on the objectives in question [8]	IY: "how do you know it is a profit?", "55,000" S: "multiplied by 10" IY: "what price does 10 times mean?"
Evaluative question	In this evaluative question, there is a process of evaluating or clarifying the responses submitted by students. Sometimes, this question is used by the teacher to check the truth of the students' answers. [8]	"No, anyone else" (NS-at 2 min 4 sec) "Do you understand?" (IL-at 8 minutes 14 seconds) "Profit, how much is the profit, write over here what is known, got it?" (IY-at the 7th minute the 20th second)

Table 5.
Percentage of questions types asked by teachers.

Questions types	**Subject**		
	IY	**IL**	**NS**
Convergent question	9.02%	22.89%	7.37%
Divergent question	13.53%	10.84%	13.11%
Probing and follow up	67.66%	60.24%	52.45%
Evaluative question	9.7%	6.02%	27.04%

4.2. Convergent Questions

Convergent questions are asked by the teacher to get responses from students. This convergent question requires one stage of student thinking to answer the teacher's question. Of the three subjects, IL mostly asked convergent questions. Based on the results of the IL teacher interviews asking convergent questions to find out students' initial abilities before studying the next material, the impact that occurs on students is that with these questions students are able to think and be active in group discussions.

The following is an excerpt from the interview with the IL teacher

Researcher : Why do you ask this question in group learning? (While showing the results of the learning video recording)

Teacher IL : I ask this question because I want to know the initial concept that students have.

Researcher : After you gave this question, how did the students respond?

Teacher IL : Alhamdulillah, the responses given by the students were good and they answered my questions about triangles well

Based on the interview excerpts above, the teacher said that the students' responses to the convergent questions given by the teacher were very good. Students convey their initial knowledge about the concept of triangles and Teacher IL submits convergent questions during early learning activities.

4.3. Divergent Questions

Divergent questions are asked by the teacher to get student responses without limiting student answers. Usually, teachers use open questions to find out student responses. Of the three subjects above, subject IY asked the most divergent questions. Based on the interview, teacher IY asked divergent questions to give freedom to students to express their ideas, and the impact of this was that students could express their opinions in solving problems.

The following is an excerpt from the interview with teacher IY

Researcher : Why do you ask this question to students in learning? (While showing the results of the learning video recording when teacher IY asked a divergent question)

Teacher IY : I ask this question to find out the ideas that students have, especially what ideas students have while determining the value of gains and losses.

Researcher : What is the impact of the questions that you ask on students?

Teacher IY : With the questions I ask, I can find out the ideas the students have. In addition, I can also train students' ability to express opinions.

Based on the interview excerpts above, the teacher said that the students responded well to the teacher's questions. Students express ideas how to determine profit and loss. Teacher IY delivered divergent questions during the core learning activities.

4.4. Probing and Follow Up Questions

The teacher uses probing and follow-up questions to find out more about student responses, and the teacher gives follow-up questions on the answers given by students. The three teachers above were mostly asked probing and follow-up questions. Based on the results of the three interviews the teacher argued that the questions used by the teacher could help students solve problems and help students understand the material being studied. So that the impact of students is able to solve problems properly and precisely.

The following is an excerpt from the interview with Teacher IY

Researcher : Why did you ask this question during the lesson? (While showing the results of the learning video recording when teacher IY asked probing and follow up questions)

Teacher IY : I am used to not directly answering questions asked by students. I try to lure them to remember the material that has been studied before. So, I often ask this question in the learning process. In addition, I use these questions so that students can solve problems encountered in group discussions.

Researcher : How did the students respond when you asked the question?

Teacher IY : The students responded well to my question. Students answered the questions I asked according to their respective abilities.

The following is an excerpt from the interview with Teacher IL

Researcher : Why did you ask this question during the lesson? ((while showing the results of the learning video recording when the IL teacher asked probing and follow up questions)

Teacher IL : I ask this question because I want to help students understand the learning

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2427-2440, 2024
DOI: 10.55214/25768484.v8i6.2493

material and so that students can solve problems in group discussions.
Researcher : How did the students respond when you asked the question?
Teacher IL : Students try to answer the questions well. They try to put forward alternative answers they have

The following is an excerpt from the interview with Teacher NS

Researcher : Why did you ask this question during the lesson? (While showing the results of the learning video recording when the NS teacher asked probing and follow up questions)
Teacher NS : I ask this question so students can solve problems during group discussions.
Researcher : How did the students respond when you asked this question?
Teacher NS : If they understand the learning material, then they answer questions simultaneously.
Researcher: What if students don't understand the material you teach?
Researcher : What if students don't understand the material you teach?
Teacher NS : Students will ask questions about material they don't understand.

Based on the excerpts of the interview above, the three teachers IY, IL and NS asked probing and follow-up questions in the core activities or when explaining learning material. Probing and follow up questions are used to help students understand the material and solve problems during group discussions. Students respond to the teacher's questions by providing answers and can solve the problems given.

4.5. Evaluation Questions

Evaluate Questions are asked to find out the understanding gained by students. Whether students understand the topic of learning or not. Of the three teachers above, the NS teacher submitted more evaluation questions. Based on the interview results, the NS teacher explained that evaluation questions were asked to assess whether the material or solutions provided/written were truly understood by students. So, the impact of this type of question is that the teacher knows students' understanding of the material being studied.

The following is an excerpt from Teacher NS

Researcher : Why did you ask this question during the lesson? (While showing the results of the learning video recording when the NS teacher asks evaluation questions)
Teacher NS : In every lesson, I always ask this question because I want to know whether my students really understand the material that I have learned.
Researcher : When did you ask this question?
Teacher NS : If they understand the learning material, then they answer questions simultaneously.
Researcher : What if students don't understand the material you teach?
Teacher NS : I ask this question when I want to check student understanding, maybe at the beginning of learning, when finishing delivering learning material and during closing activities or concluding learning outcomes.
Researcher : How did the students respond when you asked this question?
Teacher NS : Students try to give answers according to the questions I gave.

Based on the interview excerpts above, it can be seen that the teacher's question evaluation ends in all learning activities, both initial activities, core activities and closing activities. The purpose of the teacher asking this question is to find out students' understanding of the material that has been studied. The response given by students was that they tried to show their understanding by answering questions given by the teacher.

A part from the 4 types of questions asked by the teacher, there are responses given by students. Students responded well to the questions asked by the teacher. Students answer the teacher's questions according to the substance of the question the teacher asks. After that, the teacher provides feedback in

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2427-2440, 2024
DOI: 10.55214/25768484.v8i6.2493

the form of follow-up questions as a form of teacher validation that the students understand the material that has been explained. The impact of follow-up questions from the teacher can stimulate students' thinking to continue to think and consider every answer given. So, this can increase students' understanding so that students can solve problems. Below is an example of a conversation that occurred between a student and a teacher.

Students : Ardi bought a sewing machine for 150,000, a month later he sold it for 120,000. Determine the percentage of its profit and loss

Teacher IY : So, what do you know about the question above, what is known from the question above?

Students : Ardi bought a sewing machine for 150,000

Teacher IY : What does 150000 costs for?

Students : Purchase price

Teacher IY : Purchase price means it is known that the purchase price is 150,000, and then?

Students : It was sold for 120,000

Teacher IY : Yes, what does price 120,000 means?

Students : Sell

Teacher IY : Selling price, does that mean that's all that is known?

Students : Yes

Teacher IY : Yes, okay, then after that, you can already calculate what it's called, you've got that conclusion, profit if the selling price is greater than the purchase price, loss if the purchase price is greater than the selling price

Students : Sell

Teacher IY : From there, from problem 2, the selling price is the same as the buying price, which is greater?

Students : purchase price

Teacher IY : purchase price, does that mean there is a profit or loss?

Students : loss

Teacher IY : significant loss, can you find out the loss, how much loss?

Students : 30,000

4.6. Discussion

In this study, small-group discussion is a method that is often used by teachers in learning. Teachers use group learning methods to maximize student learning outcomes, improve student communication skills and increase student emotional intelligence. As expressed by [54] that discussion groups are used in mathematics learning to deepen students' understanding through debate and discussion so that they can sharpen their analytical and logical thinking skills. Small-group discussions can facilitate students to improve learning outcomes because this method emphasizes friends as peer tutors. In addition, students can improve their communication competence because in this method students are required to convey their opinions, ideas about a problem, etc. With communication between friends, students' emotional intelligence is honed because students are able to adapt to their friends, can respect their friends' opinions, and can work well together. [55] revealed that the application of a learning model centered on small-group discussions can facilitate students' increased understanding of mathematical ideas.

The results of this study are in line with research conducted by [56]. Hsieh [56], stated that a collaborative small-group discussion approach to improve the use of academic, relational, social and emotional vocabulary. Chen [57] stated that small-group discussions can improve student communication, even though introverted students only receive opinions from their peers. Group discussions can also help students eliminate weaknesses and strengthen internal strengths so that they can complete their work satisfactorily [54] and can significantly improve students' academic performance [58-59]. Students' activeness during the discussion can also positively affect their long-

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2427-2440, 2024
DOI: 10.55214/25768484.v8i6.2493

term memory [60]. Thus, the application of the small-group discussion method will greatly assist teachers in implementing learning. Baxter et al. [61] stated that, research through small-group discussions in proving mathematical formulas obtained the following results, (1) course rubrics, (2) peer confidence, (3) forms and symbols, and (4) logical structures. Thus, the application of small-group discussions in mathematics learning is also highly recommended, especially in proving mathematical formulas.

Not only the application of the small-group discussion method, the teacher's role as a facilitator in the classroom is also influential. By the teacher asking questions in small group discussions, this can also affect learning outcomes because teacher questions are one of the important factors and contribute to supporting student engagement in productive interactions between teachers and students in mathematics classes [62]. Teacher questioning in the mathematics classroom can also be an important diagnostic tool to measure students' academic development and understanding [6]. By asking questions at the right time, students can be challenged so that they can improve their understanding [30] and almost no subject matter lends itself better to questioning than mathematics [63].

This study explored the types of questions asked by mathematics teachers in group discussions. There are four types of questions asked by teachers in the discussion, namely convergent questions (13.09%), divergent questions (12.49%), exploring and following up questions (60.11%), and evaluating questions (27.04%). Teacher questioning has a positive impact on learning outcomes, especially in small group discussions. This is in line with research [64-66]. Each type of question asked by the teacher has a specific purpose. If the teacher's questions are not presented correctly, it will have a negative impact on student learning [6]. In this learning documentation, probing and follow-up questions are widely used by teachers in group learning. This is in accordance with previous research, where probing and follow-up questions can increase group learning activities and make students think critically [32] and the study contradicts previous research by [2] that although teachers realize that asking higher-order questions is so important in student learning, they still use relatively few probing and leading questions, and previous research by [65] that teachers generally still ask directive or memory-oriented questions because they may not have a clear understanding of effective questioning strategies and their implementation [6]. Effective questions are those that ask students to explain and justify their work and probe students' understanding [65].

The specific purpose of asking questions is to get a good response from students. Students' responses in this study depended on the type of questions the teacher asked. The questions were asked not only in the introductory activities, but also in the core activities and closing activities. Asking convergent, divergent, probing, and follow-up questions as well as evaluation questions has a positive impact on students, namely increasing student understanding so that it has an impact on student learning outcomes. Giving a series of questions to students is in line with the results of research conducted by [26, 27, 64, 67, 68].

5. Conclusion

In mathematics learning, especially in small group discussions, there are four types of questions that can be asked by teachers to fostering students' potential understanding or ability to solve problems. The four types of questions that can be asked by teachers in small group learning discussions include convergent questions, divergent questions, probing and follow-up questions, and evaluation questions.
Each question asked by the teacher has a specific purpose and is different from one another. Convergent questions aim to find out students' initial understanding or check students' initial abilities. Divergent questions aim to force students to express all their ideas. Evaluation questions aim to evaluate students' understanding of the explanation given by the teacher. While probing and follow-up questions are follow-up questions given by the teacher to help students solve problems and improve their understanding of mathematics.

In addition, each question asked must have a different response from students. Each response given by students depends on the treatment given by the teacher. In small-group discussions, students always

Edelweiss Applied Science and Technology
ISSN: 2576-8484
Vol. 8, No. 6: 2427-2440, 2024
DOI: 10.55214/25768484.v8i6.2493

give good responses and respond to questions asked by the teacher. This can help students in understanding so that they are able to improve their problem-solving abilities.

This research has limitations, where the sampling explored by the researcher only took 3 mathematics teachers as research subjects. Therefore, it is necessary to carry out further research that allows more involvement of mathematics teachers who use group discussion models and ask a variety of questions so that they can increase students' understanding.

Copyright:

References

[1] Barnes, D. (1976). From communication to curriculum. Penguin books.

[2] Sahin, A., & Kulm, G. (2008). Sixth grade mathematics teachers' intentions and use of probing, guiding, and factual questions. *Journal of Mathematics Teacher Education*, *11*(3), 221–241. https://doi.org/10.1007/s10857-008-9071-2

[3] Rodrigues, R. V. R., Oliveira, H. M., & de Costa Trindade Cyrino, M. C. (2022). Promoting Prospective Mathematics Teachers' Professional Vision on a Whole-class Reflective Discussion: Contributions of Digital Resources. *International Journal of Education in Mathematics, Science and Technology*, *10*(4), 773–794. https://doi.org/10.46328/ijemst.2181

[4] DeJarnette, A. F., Wilke, E., & Hord, C. (2020). Categorizing mathematics teachers' questioning: The demands and contributions of teachers' questions. International Journal of Educational Research, 104(October), 101690. https://doi.org/10.1016/j.ijer.2020.101690

[5] Hal, A., Masalah, M., & Dua, K. (2019). Journal of Educatio and Management Studies Koneksi Matematis Mahasiswa Kaitannya dengan Folding Back dalam. 2(2).

[6] Mccarthy, P., Sithole, A., Mccarthy, P., Cho, J.-P., & Gyan, E. (2016). Teacher Questioning Strategies in Mathematical Classroom Discourse: A Case Study of Two Grade Eight Teachers in Tennessee, USA. Journal of Education and Practice, 7(21), 80–89. www.iiste.org

[7] Van den Kieboom, L. A., Magiera, M. T., & Moyer, J. C. (2014). Exploring the relationship between K-8 prospective teachers' algebraic thinking proficiency and the questions they pose during diagnostic algebraic thinking interviews. Journal of Mathematics Teacher Education, 17(5), 429–461. https://doi.org/10.1007/s10857-013-9264-1

[8] As'ari, A. R., Zayyadi, M., Puspa, R. D., & Purnawati, L. (2021). Bertanya dan Berpikir (Pengembangan High Order Thinking Skill).

[9] Nurdiansyah, Johar, R., & Saminan. (2019). Keterampilan Bertanya Guru SMP dalam Pembelajaran Matematika. Jurnal Peluang, 7(1), 44–54.

[10] Buschman, L. (2001). Using student interviews to guide classroom instruction: An action research project. Teaching Children Mathematics, 8(4), 222–227.

[11] Susiswo. (2014). Folding Back Mahasiswa dalam Menyelesaikan Masalah Limit. Universitas Negeri Malang.

[12] Myhill, D., & Dunkin F. (2002). What is a good question? Literacy, 8.

[13] Anwar, L., Sa'dijah, C., Yerizon, & Arnawa, I. M. (2023). Teachers' Perception of Teaching and Learning During to Post Covid-19 Pandemic Era: A Case of Indonesian Mathematics Teachers. Journal of Higher Education Theory and Practice, 23(8), 18–29. https://doi.org/10.33423/jhetp.v23i8.6060

[14] Anghileri, J. (2006). Scaffolding practices that enhance mathematics learning. Journal of Mathematics Teacher Education, 9(1), 33–52. https://doi.org/10.1007/s10857-006-9005-9

[15] Di Teodoro, S., Donders, S., Kemp-Davidson, J., Robertson, P., & Schuyler, L. (2011). Asking Good Questions: Promoting Greater Understanding of Mathematics Through Purposeful Teacher and Student Questioning. The Canadian Journal of Action Research, 12(2), 18–29. https://doi.org/10.33524/cjar.v12i2.16

[16] Koellner, K., Jacobs, J., Borko, H., Schneider, C., Pittman, M. E., Eiteljorg, E., Bunning, K., & Frykholm, J. (2007). The Problem-Solving Cycle: A Model to Support the Development of Teachers' Professional Knowledge. Mathematical Thinking and Learning, 9(3), 273–303. https://doi.org/10.1080/10986060701360944

[17] Walter, J. G., & Gibbons, S. J. (2010). Student Problem-Solving Behaviors: Traversing the Pirie-Kieren Model for Growth of Mathematical Understanding. Thirteenth SIGMAA on Research in Undergraduate Mathematics Education Conference.

[18] Umisuzimah, H. et al. (2017). Integrating the Use of Interdisciplinary Learning Activity Task in Creating Students' Mathematical Knowledge. International Journal of Research in Education and Science, 3(1), 280-298.7)

[19] Viseu, F., & Oliveira, I.B. (2012). Open-ended tasks in the promotion of classroom communication in Mathematics. International Electronic Journal of Elementary Education, 42(2), 287-300.

[20] Carpenter, T.P., Fennema, E., Franke, M.L., Levi, L., & Empson, S.B. (2000). A Research-Based Teacher Professional Development Program for Elementary School Mathematics. In National Center for Improving Student Learning and

Achievement in Mathematics and Science. Wisconsin-Madison.
[21] Aizikovitsh-Udi, E., & Star, J. (2011). The skill of asking good questions in mathematics teaching. Procedia - Social and Behavioral Sciences, *15*, 1354–1358. https://doi.org/10.1016/j.sbspro.2011.03.291
[22] Choi, J. (2024). The effect of project-based cooperative learning on disability empathy in pre-service early childhood teachers. *Edelweiss Applied Science and Technology*, *8*(2), 100–107. https://doi.org/10.55214/25768484.v8i2.750
[23] Keeley, M. B. dan M. (2018). Asking the Right Questions: A Guide to Critical Thinking, 12th edition. Pearson
[24] Zayyadi, M., Nusantara, T., Hidayanto, E., Sulandra, I. M., & Asari, A. R. (2019). Exploring prospective student teacher's question on mathematics teaching practice. *JOTSE*, *9*(2), 228-237.
[25] Paoletti, T., Krupnik, V., Papadopoulos, D., Olsen, J., Fukawa-Connelly, T., & Weber, K. (2018). Teacher questioning and invitations to participate. *Educational Studies in Mathematics*, *98*(1), 1–17.
[26] Salmon, A. K., & Barrera, M. X. (2021). Intentional questioning to promote thinking and learning. Thinking Skills and Creativity, 40(March). https://doi.org/10.1016/j.tsc.2021.100822
[27] Santagata, R., & Lee, J. (2021). Mathematical knowledge for teaching and the mathematical quality of instruction: a study of novice elementary school teachers. Journal of Mathematics Teacher Education, *24*(1), 33–60. https://doi.org/10.1007/s10857-019-09447-y
[28] Franke, M. L., Webb, N. M., Chan, A. G., Ing, M., Freund, D., & Battey, D. (2009). Teacher questioning to elicit students' mathematical thinking in elementary school classrooms. Journal of Teacher Education, 60(4), 380–392. https://doi.org/10.1177/0022487109339906
[29] Hufferd-Ackles, K., Fuson, K. C., & Sherin, M. G. (2004). Describing Levels and Components of a Math-Talk Learning Community. Journal for Research in Mathematics Education, *35*(2), 81–116. https://doi.org/10.2307/30034933
[30] Martino, A. M., & Maher, C. A. (1999). Teacher questioning to promote justification and generalization in mathematics: What research practice has taught us. *Journal of Mathematical Behavior*, *18*(1), 53–78. https://doi.org/10.1016/S0732-3123(99)00017-6
[31] Wilen, W. W. (2001). Exploring Myths about Teacher Questioning in the Social Studies Classroom. The Social Studies, *92*(1), 26–32. https://doi.org/10.1080/00377990109603972
[32] Bata, K. W., & Zamzani. (2020). Teachers' Questioning Strategies in Indonesian Language Learning. 461(Icllae 2019), 67–73. https://doi.org/10.2991/assehr.k.200804.013
[33] Conner, A. M., Singletary, L. M., Smith, R. C., Wagner, P. A., & Francisco, R. T. (2014). Teacher support for collective argumentation: A framework for examining how teachers support students' engagement in mathematical activities. Educational Studies in Mathematics, 86(3), 401–429. https://doi.org/10.1007/s10649-014-9532-8
[34] Parta, I. N. (2017). Model Pembelajaran Inkuiri. Universiitas Negeri Malang, I, 125.
[35] Darmawan, Puguh, Purwanto, I. Nengah Parta, and Susiswo. (2021). "Teacher Interventions to Induce Students' Awareness in Controlling Their Intuition." Bolema - Mathematics Education Bulletin *35*(70):745–65. doi: 10.1590/1980-4415v35n70a10.
[36] Koizumi Y. Similarities and differences in teachers' questioning in German and Japanese mathematics classrooms. ZDM - Int J Math Educ. 2013;45(1):47–59
[37] Jo Boaler and Karin Brodie. THE IMPORTANCE, NATURE AND IMPACT OF TEACHER QUESTIONS. 2016;1–23
[38] Wong KY. Use of Student Mathematics Questioning to Promote Active Learning and Metacognition. Sel Regul Lect from 12th Int Congr Math Educ. 2015;(July):877–95
[39] Weiss, I. R., & Pasley, J. D. (2006). Scaling Up Instructional Improvement Through Teacher Professional Development: Insights from the Local Systemic Change Initiative. CPRE Policy Briefs, RB-44(March), 1–16.
[40] Heinze, A., & Erhard, M. (2006). How much time do students have to think about teacher questions? an investigation of the quick succession of teacher questions and student responses in the German mathematics classroom. ZDM - International Journal on Mathematics Education, 38(5), 388–398. https://doi.org/10.1007/BF02652800
[41] Hargie O. The Handbook Communication Skills. 3rd Editio. London: Routledge; 2006. 600 p
[42] Paul R, Elder L. Socratic Questioning Techniques. Thinker's Guid to Art Socrat Quest [Internet]. 2007;1–10. Available from: papers://df4e6a14-7c54-4225-a83d-27d9610b1791/Paper/p66, 2006
[43] Jiang, Y. (2014). Exploring teacher questioning as a formative assessment strategy. RELC Journal, *45*(3), 287–304. https://doi.org/10.1177/0033688214546962
[44] Council, N., & Education, M. (2016). Cognitive Emphasis of Geometry Teachers' Questions Authors (s): Morton Friedman Source: Journal for Research in Mathematics Education, Vol. 7, No. 5 (Nov., 1976), pp. 259- Published by: National Council of Teachers of Mathematics Stable URL: 7(5), 259–263.
[45] Aziza, M. (2021). A teacher questioning activity: The use of oral open-ended questions in mathematics classroom. Qualitative Research in Education, 10(1), 31–61. https://doi.org/10.17583/qre.2021.6475
[46] Darragh L. Asking questions and performing mathematics identity. Curric Focus Res Guid Pract Proc 37th Annu Conf Math Educ Res Gr Australas. 2014;(1968):175–82
[47] Rofiki, I. (2020). Teacher' S Mistakes Related to Declarative Knowledge in. 7(7), 229–233.
[48] Darragh, L. (2014). Asking questions and performing mathematics identity. Curriculum in Focus: Research Guided Practice: Proceedings of the 37th Annual Conference of the Mathematics Education Research Group of Australasia,

1968, 175–182.
[49] Lestari DR. The student responses of teacher questioning probing strategies to promote the student critical thinking in classroom interaction. RETAIN (Research English Lang Teach Indones 2021;09(03):77–83. https://ejournal.unesa.ac.id/index.php/retain/article/view/40344
[50] Yin Robert K. (2018). Case Study Research and Applications Design and Methods Sixth Edition (Sixth).
[51] Permendiknas. (2007). Standar Proses Untuk Satuan Pendidikan Dasar dan Menengah.
[52] Zhuang Y, Conner A. Teachears' use of rational questioning strategies to promote student participation in collective argumentation. 2022. https://doi.org/10.1007/s10649-022-10160-6
[53] Tofade T, Elsner J, Haines ST. Best practice strategies for effective use of questions as a teaching tool. Am J Pharm Educ. 2013;77(7)
[54] Wayesa, N. N. (2020). Research on: Improving Students Group Discussion Skill in Mathematics Class. *Science Journal of Education*, *8*(4), 94–99. https://doi.org/10.11648/j.sjedu.20200804.11
[55] Zahroh, U., Maghfiroh, W., Darmayanti, R., & Hidayat, A. (2023). Innovation in mathematics education for high school students using small group discussion as a case study. *Assyfa International Scientific Journal*, *01*(01), 8–14.
[56] Shieh MD, Hsieh HY. Study of Influence of Different Models of E-Learning Content Product Design on Students' Learning Motivation and Effectiveness. Front Psychol. 2021;12(September):1–4.
[57] Bonesrønning H, Finseraas H, Hardoy I, Iversen JMV, Nyhus OH, Opheim V, et al. Small-group instruction to improve student performance in mathematics in early grades: Results from a randomized field experiment. J Public Econ. 2022;216.
[58] Algani, Y. M. A., & Alhaija, Y. F. A. (2021). The Effect of The Cooperative Learning Method on Students' Academic Achievement in Mathematics. *Multicultural Education*, *7*(3), 329–339. https://doi.org/10.56556/jssms.v1i2.81
[59] Bonesrønning, H., Finseraas, H., Hardoy, I., Iversen, J. M. V., Nyhus, O. H., Opheim, V., Salvanes, K. V., Sandsør, A. M. J., & Schøne, P. (2022). Small-group instruction to improve student performance in mathematics in early grades: Results from a randomized field experiment. *Journal of Public Economics*, *216*, 1–8. https://doi.org/10.1016/j.jpubeco.2022.104765
[60] Blankenstein, F. M. van, Dolmans, D. H. J. M., Vleuten, C. P. M. van der, & Schmidt, H. G. (2011). Which cognitive processes support learning during small-group discussion? The role of providing explanations and listening to others. *Instructional Science*, *39*(2), 189–204. https://doi.org/10.1007/s11251-009-9124-7
[61] Kooloos C, Oolbekkink-Marchand H, Kaenders R, Heckman G. Developing mathematical whole-class discussions: An exploratory study of teachers' learning paths. Teach Teach Educ. 2023;134(August)
[62] Zhuang, Y., & Conner, A. (2018). Analysis of Teachers' Questioning in Supporting Mathematical Argumentation by Integrating Habermas' Rationality And Toulmin's Model. *Proceedings of the 40th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education. Greenville, SC: University of South Carolina & Clemson University*, 1323–1330.
[63] Bagnato, R. A. (1973). Teaching College Mathematics By Question and Answer. *Educational Studies in Mathematics*, *5*, 185–192.
[64] Appleton, K. (1995). Problem solving in science lessons: How students explore the problem space. Research in Science Education, *25*(4), 383–393. https://doi.org/10.1007/BF02357384
[65] Kosko, K. W., Rougee, A., & Herbst, P. (2014). What actions do teachers envision when asked to facilitate mathematical argumentation in the classroom? *Mathematics Education Research Journal*, *26*(3), 459–476. https://doi.org/10.1007/s13394-013-0116-1
[66] Şengül S, Kaba Y, Argat A. The analysis of understanding factorial concept processes of 7th grade students who have high academic achievements with pirie-kieren theory. Turkish Online Journal Education Technology 2016 730–7. Available from: http://dx.doi.org/10.1016/j.sbspro.2015.07.398
[67] Kosko, K. W. (2016). Primary teachers' choice of probing questions: Effects of MKT and supporting student autonomy. Mathematics Education, 11(4), 991–1012.
[68] Putri, Octavina RU., Susiswo, Erry Hidayanto & Slamet. (2023). Problem Solving: Growth of Students' Mathematical Understanding in Producing Original Solutions. *Mathematics Teaching Research Journal*, 15(3). https://eric.ed.gov/?id=EJ1408190
[69] Bulent Dos, E. al. (2016). An anlysis of teachers' questioning strategies. Academicjournal, 11(22).