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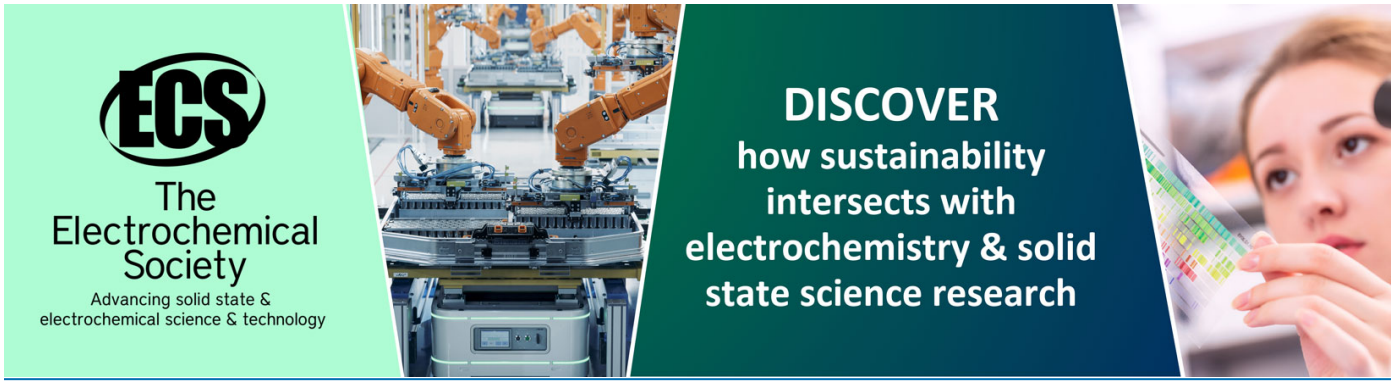

Types and the role of teacher's questions in science classroom practice

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Abstract. In science experiment, questioning is a major scientific skill in science classroom practice. Questions that encourage scientific investigation can come from many sources including teachers and students. The purpose of this study is to provide an overview of how the teacher presents the questions and find out the role of teacher's questions in science classroom. This research involves a teacher who taught two science classes at a Junior High School. The learning activities were audio and video recorded. Then recorded was transcribed and analysed. The analysis is devoted to interactions involving questions. Interactional issues related to the way of speaking and questions that encourage student's responses and thinking are discussed in this study. The results show that types and characteristic of teacher's questions involve explication questions, scientific practice questions, explanation questions, and science concept questions. The role of teacher's question are to guide students in building knowledge and help students learn about scientific practice, explain phenomena, and develop explanations of the phenomenon This information provides a description of effective investigation questions in science learning practice, and also useful for teachers in identifying appropriate skills for teacher education and further professional development.

1. Introduction

Current curriculum 2013 (K-13) that applied in Indonesia has an effect on learning process especially on science that demands student center learning where students are actively finding their own concepts. In science learning, students and teachers work together to learn a phenomenon using a scientific approach. Scientific approach learning is conceptualized as a question-based learning. This is a complex process included investigating problems or phenomena with initial questions, thinking of ways to answer them, looking for evidence, explaining, evaluating and communicating them.

In learning activity, questions are asked either by students or teachers. Questions are asked by students to satisfy curiosity and clarify things that are poorly understood. The way teachers respond to student questions and teachers' questioning have an influence on the learning process, learning outcomes, and enhancing students thinking [1]. Thus it can be said that the ability to ask is very important in the learning process.

Questions and their role in the questioning process are an important element of classroom discourse [2,3]. Teachers use questions to structure classroom interactions are significant forms of such scaffolding. The kind of questions teachers ask and the way in which they are asked can, to a large extent, influence the nature of students' thinking as they engage in the process of constructing scientific

knowledge [1]. Appropriate questioning is positively associated with development of critical thinking faculty in students along with reinforcing their understanding [4]. Questions that initiated by teacher or in response to student questions and observations have the potential to engender and stimulate students' thinking, further the teacher makes it explicit in creating an atmosphere conducive to continuous reasoning and argumentation. Thus, teachers play an important role in bringing about this change, especially the emphasis in classroom interaction [5,6,7]. This means that the teachers' ability to ask questions needs to be practiced so that the learning can bring up the classroom discourse. Teachers as facilitators who help students build knowledge and develop scientific skills especially in science learning that involving investigation of a phenomenon.

Not all teachers have the ability to ask good questions in science classroom either new teachers or teachers who already have a long experience. The absence of discussion in science learning suggests that teachers may not provide opportunities for students. In particular, teachers may not have a clear example of how to engage their students in sensory discussions. Educators who focus on preparing teachers to be effective questioners may not provide explicit support to help teachers facilitate these interactions [8]. They may use an unclear term to describe the role of teachers and students in this discussion.

The main aim of the present study was to provide an overview of how the teacher presents the questions in the science classroom on the topic the liquid pressure. By doing this, we wanted to contribute to the current literature on teacher questions by providing data. Moreover, we believe that categorization of teacher questions is vital because teachers can direct learning process. The following questions guided this study:

1. What are the types and characteristics of teacher questions in two classes observed?
2. How is the role of teacher question in science learning?

2. Method

Research method used in this research is qualitative research method of case study to identify how Ms. Sri (teacher of class VIII Senior High School) use teacher question integrated in science learning. Qualitative research methods are often called naturalistic research because the research is done on natural conditions or natural objects that develop what it is, not manipulated by researchers and the presence of researchers does not affect the dynamics of the object [9].

This study involves a science teacher (Ms. Sri) in Junior High School who is a model teacher in the Lesson Study program in Sumedang District. This study aims to provide an overview of the emerging teacher questions and their role in science learning. Ms. Sri taught in two science classes consisting of 31 students per class on the topic Liquid Pressure. Learning consists of two cycles for different classes. The first cycle lessons were recorded using video and audio and were observed by teachers who involved in the Lesson Study program in Junior High School. Then do the reflection activities related problems and findings of the observer during the learning process first cycle. Then we do re-designing learning for further learning. Second cycle is also observed by teachers and recorded.

To analyze Ms. Sri's teacher questions, the researcher transcribed the video tape lessons and focused on the example that Ms. Sri was involved in discussions with two or more students. To identify the type of teacher questions in learning, the researcher notes a series of questions expressed by Ms. Sri in each learning. Teacher questions are encoded as academic if they are related to the subject matter related to (a) that day's lesson or (b) the previous homework or class assignment. Questions are encoded as non-academic if the question is social, organizational, or managerial or otherwise unrelated to the content [10].

Furthermore, on the academic question yielded four types of questions that involve *explication questions* provided students with an opportunity to describe their evidence in the form of 'what' happened [11]. *Explanation questions* asked students to explain 'why' or 'how' a phenomenon worked. *Science concept questions* guided students to use scientific language to name observed phenomena. *Scientific practice questions* could support students in developing knowledge and skills in using scientific practices [6].

3. Result and Discussion

3.1. Types and Characteristics of Teacher's Question

Based on the analysis science learning in SMPN 1 Tomo conducted by Ms. Sri, found that the number of student questions is lower than the number of teacher questions. This means that teachers help students lead to find the concepts. This study focused on teacher questions in science learning process. The findings of this study are presented in two answers problem; (1) to provide an overview of the type and characteristics of teacher questions that present in the learning and (2) the role of questions in the science classroom. In the first cycle, we obtained 171 teacher questions and on the second cycle is 294 questions that include academic and non-academic category teachers questions. The percentage of academic questions in learning is greater than non-academic questions. The examples of academic and non-academic questions of teachers are listed in Table 1.

Table 1. Percentages and examples of academic and non-academic questions

Types Questions	1st Cycle	2nd Cycle
Academic questions		
a. Percentage	85.96%	81.29%
b. Example	*If not yet floating means what to do, what must we add?*	*If the object is put into the liquid, how will be?*
Non-academic questions		
a. Percentage	14.04 %	18.71 %
b. Example	*Who will lead the prayer?*	*For the back position, is it clear?*

Furthermore, for academic questions related to instructional materials, four questions are yielded that include explication questions, scientific practice questions, explanation questions, and science concept questions. Explication questions, these questions encourage students to share the observations. For instance, Ms. Sri used explication questions to elicit students' observations at the end which focused on helping students compare position egg. The percentage of explication questions in 1st and 2nd cycle are 55% (of 147 questions) and 45% (out of 239 questions). This means that some of the lessons are almost half presented in the explication question. An example of an explication question is shown in the following conversation;

(Teacher approached group 5)
Teacher : *Have you started? How is the initial observation? How is this position?*
Student : *Sink*
Teacher : *Sink, already added salt yet*?
Student : *Alright*
Teacher : *Has there been a change of position*?
Student : *Yes miss, slightly floating*

Then, scientific practice questions with proportion 23% (from 147) in 1st and 26% 2nd cycle (from 239). These questions are provided to develop the knowledge and skill in using scientific practices to develop explanations. Ms. Sri focused on helping students learn about the elements of an investigation design. Ms. Sri uses an encouraging analogy between someone with the others (push each other) to help students find the concept of strength of pressure in the liquid. The following are examples of teacher questions presented in the form of conversations;

Teacher : *In front of you, there are experimental materials. what will happen to the egg when put into liquid? What do you think?*
Student : *Sink*
Teacher : *Is that all?*
(Student thinking)

Explanation questions often occur after students had made observations in an investigation. Ms. Sri using the word "Why?" to explore students' understanding in explaining the evidences resulting from the observation activities. Although student explanations are not yet scientifically correct, this question helps students familiarize themselves with connecting phenomena in everyday life with the concepts they learn [11]. Percentages in 1st cycles and 2nd are respectively 15% (from 147) and 16% (out of 239). For more details, the following conversation shows an example of explanation questions;

Teacher : *How is the position of the object? At the first?*
Student : *Sink*
Teacher : *Why did it sink?*
Student : *Due to the absence of salt added*
Teacher : *Means its density, how the effect to the egg?*
Student : *The egg's density is bigger than water*

In both cycles, the science concept questions had the smallest percentage of the other questions of 7% (out of 147 questions) in 1st cycle and 13% in 2nd cycle (out of 239 questions). This question provides an opportunity for students to use the scientific language in naming a phenomenon and develop an understanding of the phenomenon.

Teacher : *If position in the middle, what's its name? is it same with the initial position?*
Student : *Different*
Teacher : *What this means?*
Student : *Floating*
Teacher : *Okay, what about the last position?*
Student : *Above*
Teacher : *Eggs are on or appear on the surface of water, called what? Earlier it was mentioned sink, drift and the last one?*
Student : *Floating miss*

The results of the teacher question comparison contained in the study Ms. Sri are presented in Figure 1. It shows that almost all the percentages of each teacher question types from 1st cycle to 2nd cycle increased. This means that the ability of teachers in presenting questions will be better if the teacher always practice lists questions before learning. Then another factor that affects the ability of teachers is the existence of reflection activities that are implemented after the learning first cycle. Teachers participating in the Lesson Study program carry out reflection activities aimed at expressing problems during learning and conveying findings in the learning process. This Lesson Study Program is one form of teacher professional development [12].

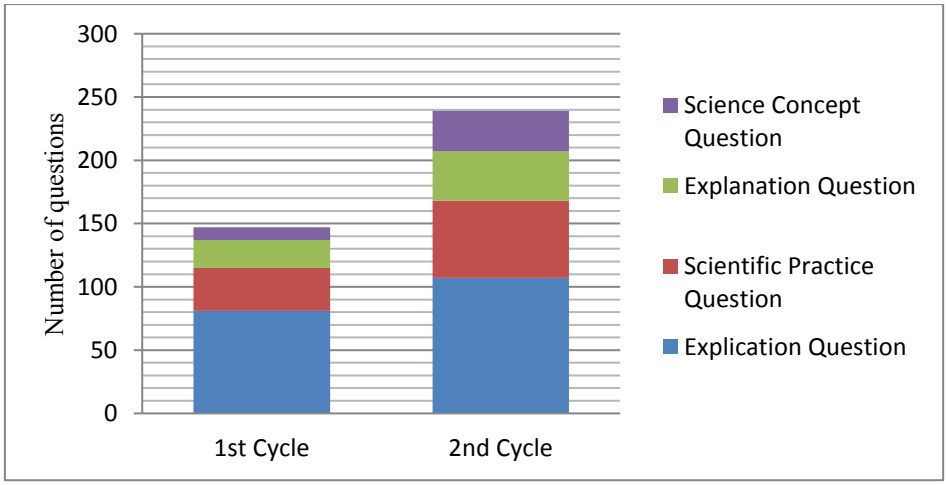

Figure 1. Comparison the number of teacher's question in every cycle

3.2. The Role of Teacher's Question in Science Classroom

The results of the previous analysis show that Ms. Sri consistently raises questions on cycles I and II. Teacher questions can be academic or non-academic questions. Non-academic questions manage classroom management to be more conducive and provide opportunities for all students to engage in social activities in learning. Academic questions have a very important role in learning science. In general, teachers' academic questions are important to ensure student knowledge [13]. This study focuses on the question of teacher to facilitate classroom learning.

Earlier teacher academic questions in the learning process are grouped into four groups one of them scientific practice questions, to focus students in scientific practice activities in learning. Bu Sri used these questions in two ways. First, she ask scientific practice questions at the beginning of a class as question problem that can lead student in data collecting. Second, she asked the students to accurately interpret their data as they developed explanations. In addition, students are able to predict what will happen when students try to use the ideas they have not observed to develop the explanations, for example;

Teacher: *Before ending I have a question, I have stone, and I have egg. The egg was put into a floating salt water. Now rock put into the salt water, how is the position?*

Teacher: *Is it possible that the stone can be lifted?*

In science classroom, the questions aided in stimulating students' thinking and making it explicit to the student as well as to the entire class. Also, teachers made active attempts to engage all the students in the discussions and move them towards conceptual understanding. Teacher's role is to help students in developing understanding of concepts and to build their personalities [5,6]. A good facilitator of communication as one who is able to get students to explain things in an easily understandable manner. The explication of the data also reveals that students learn to think and evaluate in presence of an expert facilitator [14]. The role of teachers' question emerges to be of utmost significance in initiating discussion through the selection of appropriate questions, allowing students to be heard and on the hunt to the possibility of further discussion. It is noted that the questions asked should be oriented towards discussion and communication of different ideas that are directly associated with the in-depth knowledge of the subject. These questions should provide opportunities for students to reinvent ideas through exploration and refining of previous ideas.

4. Conclusion

The main results of this study is categorized into two answers the questions problem show that (1) types and characteristic of teacher's questions involve explication questions, scientific practice questions, explanation questions, and science concept questions. The percentage for each questions in 1st cycle is 55%, 23%, 15%, 7%, for the 2nd cycle is 45%, 26%, 16%, 17% (2) The role of teacher's question is to help students in developing understanding of concepts and to build their personalities. Their own roles might be in helping students develop scientific understanding through science learning process. It is important to identify mechanisms employed by practicing teachers as they strive to implement effective teaching strategies in their classrooms.

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