

Discussing the capacity and functions of questioning in mathematics at School level

Sneha Tyagi

Student Ph. d dept. of IASE Jamia Millia Islamia, Delhi

Introduction

Questioning is a central aspect of the mathematical classroom context. If Questions are felt dangerous among students then they can be the mean to reduce the phobia of mathematics as well. But somehow teachers are not using questions up to their full capacity; they use them only to check previous knowledge and for the summative evaluation. "Research indicates that almost 40% of classroom time is spent in a question-response mode (Johnson, Markle, & Haley-Oliphant, 1987). Nevertheless, many teachers do not ask questions effectively (Gall, 1984). Ineffective or inappropriate practices include asking questions at only lower cognitive levels (Ornstein, 1987), directing a disproportionate percentage of questions toward limited number of students (Jones, 1990), or waiting only for a short time after asking a question and before reacting to the student's response - typically one second or less (Rowe, 1986). Questions too often flow in only one direction and become a way of maintaining control rather than stimulating thought. For example, teachers are likely to ask at least 50 questions during a typical class period while it is unlikely that the students in the class ask even one question (McGlathery, 1978 as cited from Barnette, 1994)." (Source: page no 3, The Role of Questioning in The Classroom, Mehmet Arslan, Faculty of Education, Erciyes University, 38039 Kayseri, Turkey, <https://www.academia.edu/22222826/>)

Reasons to Ask Questions

"Teachers frequently regard mathematics as a fixed body of facts and procedures that are learned by memorization, and that view carries over into their instruction. Many have little appreciation of the ways in which mathematical knowledge is generated or justified." (Source: pg no 373, Developing Proficiency In Teaching Mathematics, The National Academic Press retrieved from <https://www.nap.edu/read/9822/chapter/12>).

It is seen in a mathematics class, "Teachers ask questions for several reasons (Morgan and Saxton, 1991 as cited from Brualdi, 1998):

1. The act of asking questions helps teachers keep students actively involved in lessons
2. While answering questions, students have the opportunity to openly express their ideas and thoughts
3. Questioning students enables other students to hear different explanations of the material by their peers
4. Asking questions helps teachers to pace their lessons and moderate student behavior
5. Questioning students helps teachers to evaluate student learning and revise their lessons as necessary" (Source: pg no. 3, The Role Of Questioning In The Classroom, Mehmet Arslan, Faculty of Education, Erciyes University,

38039 Kayseri, Turkey, <https://www.academia.edu/22222826/>)

Questions as Classroom Discourse

The role of questioning supposedly is to know and understand the students' problem solving ability and critical thinking, but it does not happen rather only convergent questions are considered the best and the only suited questions, students opt for getting the right answers through mechanical means without understanding. Considering that their conceptual base is weak, it adversely affects students' attitude towards the mathematics. "Questioning is the strongest tool at a teacher's disposal as it teaches students how to think. Teachers ask hundreds of questions every day many of which are concerned with recall of textbook information; few questions require students to think beyond a level of recall. Some questions are designed to clarify matters of classroom procedure. Questioning is naturally a two sided affair. Not only is it that teachers put forth questions but equally students are involved in the process through the responses they offer". (Source: pg no.1, The Role Of Questioning In The Classroom, Mehmet Arslan, Faculty of Education, Erciyes University, 38039 Kayseri, Turkey, <https://www.academia.edu/22222826/>)

Questions can be used to develop the concept, in breaking the misconceptions, to explore, to translate and to make subject interesting. "Teachers and students' interactions about mathematics iteratively shape the effectiveness of their instructional work. Teachers' expectations of students can shape the nature of the tasks the teachers pose, what they ask, how long they wait, how and how much encouragement they provide— elements that together compose students' opportunities to learn as well as their motivation and confidence to learn. The students' responses, in turn, affect teachers' estimates of their capacity and progress, shaping their next moves with students." (Source: pg no 357, Teaching For Mathematical Proficiency, The National Academic Press retrieved from <https://www.nap.edu/read/9822/chapter/11>)

Bifurcation of Questions

Since questions are supposedly asked to know and understand the students' critical thinking, problem solving skill but it does not happen rather only objective questions are considered the only questions for mathematics like subject, hence teachers and students get monotonous in asking questions. This effects their attitude towards the mathematical questions. They expect nothing else but only the right answers which in turn diminish the questions variety, creativity and value. If variety of questions can be introduced and are asked intelligently then they would be a help in fulfilling the goal and objectives of CCE i.e. changing the classroom situation dynamically to

improve as it proceeds and helping in reducing the teacher's stress and burden.

On the basis of thinking level, Questions can be divided into two categories i.e. High-level and Low-level. "Teachers should ask questions that promote higher-level thinking. That does not mean that a teacher should not be asking questions at the lower end of Bloom's Taxonomy of cognitive rigor. In fact, it is important that a teacher begins a lesson with questions at the Recall and Understand levels of Bloom's Taxonomy. However, in order to solve meaningful problems, students must be challenged with higher-level questions that follow the lower-level questions. Students will find difficulty applying their mathematical ideas or analyzing a mathematical situation if they are not asked higher-level questions in classroom activities and discussions." (Source: pg no. 3, Algebra Readiness, Cycle 1, The Effective Mathematics Classroom retrieved from https://www.andrews.edu/sed/leadership_dept/webinars/presentationdocuments/the_effective_mathematics_classroom.pdf)

So, what would be if there are convergent and divergent questions in mathematics? If teacher asks question in both the ways. "Woolfolk (1998) suggests categorizing questions into divergent questions, which have many possible answers, or convergent questions, which have one right answer." (Source: page no. 80, The Role Of Questioning In The Classroom, Mehmet Arslan, Faculty of Education, Erciyes University, 38039 Kayseri, Turkey, <https://www.academia.edu/2222826/>)

"A teacher's questioning technique, correlating with enhanced achievement, should include a balance of convergent and divergent questions, probing questions, listening to student responses, redirecting student responses to other students, providing respectful feedback, and allowing for appropriate time after asking a question. Convergent questions serve the purpose of getting low level cognitive information from students; divergent or open-ended questions are more likely to stimulate a discussion and foster an interactive and democratic classroom atmosphere" (Wood; Carol, 2001), (Source: page no. 2, The Role Of Questioning In The Classroom, Mehmet Arslan, Faculty of Education, Erciyes University, 38039 Kayseri, Turkey, <https://www.academia.edu/2222826/>)

The subject "mathematics" would be perceived as subjective as well. "The use of dialogical discourse (or interaction) by mathematics teachers through the use of open-ended questioning can induce conceptual change among students during teaching, as it targets and probes students' alternative conceptions (Mortimer & Scott, 2003; Roth, 1996; Yip, 2004), and narrows students' "zones of proximal development", to use the expression coined by Vygotsky (1978)." (Source: page no. 3, Teachers' use of productive questions in promoting mathematics classroom discourse, Duncan Mhakure¹ & Mark Jacobs retrieved from https://www.academia.edu/21822049/Teachers_use_of_productive_questions_in_promoting_mathematics_classroom_discourse)

Moreover, verbal questioning is not the only mean to assess the child's mathematical learning rather a teacher can evaluate the child through the hands on experience activity as well. "If the question is asked in verbal form, even with a diagram, only 60% of the students would solve it correctly. If the ratios are indicated by the format and numbers are used, nearly 80% students give the correct response." (cited in Chapter 7, page 4

Piaget and Mathematics Students by Melvin C. Thornton ; Piagetian Programs in Higher Education, 1982, edited, 2007)^[6]

"In the constructivist-based model of questioning, teachers orchestrate mathematics classroom discourse by asking questions that are open-ended, and that encourage students to "elaborate on their previous answers and ideas, and to help students construct conceptual knowledge" (Chin, 2006, p. 1319), in addition to making the students' misconceptions and thinking processes visible to the teachers. We posit that, through the use of open-ended questions, teachers can enhance classroom mathematics discourse. Open-ended questions allow teachers to engage students in activities that require higher-order thinking, and to reflect on the students' developments of conceptual knowledge; it also employs other learning strategies such as, for example, problem solving (Baird & Northfield, 1995; Martino & Maher, 1999)." {Source: page no. 2, Teachers' use of productive questions in promoting mathematics classroom discourse, Duncan Mhakure¹ & Mark Jacobs retrieved from https://www.academia.edu/21822049/Teachers_use_of_productive_questions_in_promoting_mathematics_classroom_discourse)

Teacher can ask students to translate or modify the visuals into language of mathematics or vice-versa. She can ask students to relate few symbols, visuals and language of mathematics. "Teachers need to find out what a student knows, choose how to respond to a student's question or statement, and decide whether to follow a student's idea. These are problems that every teacher faces every day, and most do not have readymade solutions." (Source: page no 383, Developing Proficiency in Teaching Mathematics, The National Academic Press retrieved from <https://www.nap.edu/read/9822/chapter/12>).

"That's why it is aimed to be the asking the right question in order to receive right answer. For this the teachers or the 'askers' should settle the structure in a clear way, wait for the student to think and judge on the question for a while after asking, help them lighten the ambiguity if/he has, encourage the students to answer in some way. The efficiency of the answer based on the efficiency of the question. To maximize the productivity of the students, the teacher and also all the audio - visual classroom materials should be careful of what to ask and how to ask. Because asking is the best way of communicating with the pupils and make them involved in the lesson." (Source: page no.23, The Role of Questioning in the Classroom, Mehmet Arslan, Faculty of Education, Erciyes University, 38039 Kayseri, Turkey, <https://www.academia.edu/2222826/>)

Effective Techniques for Questioning

"After reviewing the literature, William, *et al.* (1991) come up with five techniques that are effective in employing higher-order questioning skills. These are (1) wait-time, which allows students a few seconds to think before responding to the question, (2) open-ended questions, which assist the students in developing intellectual inquiry skills, (3) involving all students, so that a collaborative vision emerges with the teacher making a deliberate attempt to include everyone, (4) student conversations, so that students can share their opinions and (5) having students elaborate. Further, educators suggest teachers ask such questions as "What if... How would... Why ?" To promote deeper thinking (Ramsey, *et al.*, 1990, p. 421;

Swicegood and Parsons, 1989, p. 4 as cited from Supon & Pat, 1994)." (Source: page no 22, The Role of Questioning in the Classroom, Mehmet Arslan, Faculty of Education, Erciyes University, 38039 Kayseri, Turkey, <https://www.academia.edu/22222826/>)

Suggestions

Researches can investigate, by doing the intervention with the teachers, the changes occurs by questions variety (assessment) and therefore its impact on teaching-learning of mathematics. The findings of this (qualitative and quantitative) study could be of great help to the teachers in designing their lesson plan and classroom questions. This study can suggest the policy designers and schools to provide in-service programs and orientation to the teachers for breaking the monotonous handling of confusions and abstractions of mathematics and to include more than the just questioning techniques in teacher training programs. "Teacher education and professional development programs that take into account the strategic decision making in teaching can help prepare teachers to be more effective in solving instructional problems. Rather than being designed to resolve teachers' problems, programs of teacher education and professional development can engage prospective and practicing teachers in the analysis of instructional problems and potential ways of dealing with them. Teachers can learn to recognize that teaching involves solving problems and that they can address these problems in reasonable and intelligent ways."(Source: pg no 383, Developing Proficiency in Teaching Mathematics, The National Academic Press retrieved from <https://www.nap.edu/read/9822/chapter/12>)

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