

GOOD QUESTIONS OR GOOD QUESTIONING: AN ESSENTIAL ISSUE FOR EFFECTIVE TEACHING

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It is the contention of this paper that it is not good questions that are essential for good teaching, rather, it is good questioning. We illustrate the significance of question-asking in mathematics classrooms by presenting the case studies of two teachers teaching the same topic to two different classes. Comparison of the two cases highlights important differences between “good questions” and “good teacher questioning practice.” Our analysis suggests that good questions cannot be meaningfully considered or promoted independent of good questioning practice and that this distinction has significant implications for teacher education.

Key words: questioning practice; mathematics education; effective teaching

INTRODUCTION

Teacher questions are viewed as a critical teaching tool by many researchers and educators (e.g. Cunningham, 1987; Dillon, 1988; Ellis, 1993; Morgan & Saxton, 1991; and Martens, 1999). A question is an expression of inquiry that invites or calls for a reply. In a classroom, questions are used by teachers as instructional cues to assess student progress and to motivate student thinking. ‘To question well is to teach well’ (De Garmo (1911), p. 179 as cited in Wilen (1991), p. 5). It is clear that teacher questioning is universally viewed as a highly important instructional practice. Yet even this apparently unequivocal endorsement of the importance of teaching questioning conceals the essential distinction between “good teacher questioning” as instructional practice and the concept of a “good question” as an instrument of that practice (eg Benedict, Kaur & Clarke, 2007; Clarke & Sullivan, 1992). This distinction and the two constructs of “good question” and “good questioning” provide the theoretical and empirical focus of this paper.

The value of good teacher questioning is particularly endorsed in mathematics education. Yet teacher questioning can take many different forms and serve many commendable purposes. Therefore, within this general recommendation about question asking are many interesting and important questions about how teachers might implement question asking. The purpose of the analysis reported in this paper was to investigate some of the issues associated with the implementation of this important practice. The characteristics of a “good question” or of “good teacher questioning” as a practice can only be identified once the teachers’ goals are known. A question intended to provide information on the current state of a student’s understanding is likely to take a different form from a question intended to promote student self-regulation of learning and this would be different again from the sort of question that might stimulate engaging and productive whole class discussion.

Many researchers (Bingham, 2005; Black, 2001; Boyer & Piwek, 2010; Hufferd-Ackles et al. 2004, Moberg, 2008; Sigel & Kelley, 1986) have examined the culture of asking questions in class. Although there is consensus on the importance of question-asking, a variety of research has indicated that math teachers are not particularly good at asking questions (and/or at asking good questions). For example, studies have shown that teachers in an average class ask between 12 and 20 questions, yet approximately half of the questions are procedural questions regarding timetable, attendance, clarifying various technical issues, etc. Furthermore, most of the questions are closed questions for testing knowledge (straight recall). Only a very small percentage of questions encourage higher-order thinking. In addition, teachers tend not to allow students opportunities to think about questions; wait time has been found to average 1.2 seconds. Finally, 70% of the students' answers consist of three words and their duration is five seconds or less (eg Nystrand, 1997).

Curricula have been designed to help teachers improve their question posing, but based on the existing research it is not clear how successful these question-asking curricula have been at improving teachers' ability to ask good questions. It is this relationship - between curricula that aim to improve teachers' question asking and teachers' implementation of these curricula - that provided the focus of the analysis reported in this paper. More specifically, does teacher experience in using curricula explicitly focused on improving question asking lead to their regular and independent use of such advanced instructional strategies? Is good questioning a matter of using good questions or of questioning well? Are we talking about tools (good questions) or practice with those tools (good questioning)? The two case studies reported in this paper exemplify this distinction very clearly.

RESEARCH QUESTIONS

This study aims to provide evidence for the following research questions: What constitutes good teacher questioning and what contribution does the provision of “good questions” make to the enhancement of teacher questioning practice? That is, our research investigates the difference between good questions as an instructional tool and good questioning as instructional practice.

METHODS

We explored the question above through two case studies, each of which involved a teacher teaching the same content in a junior high school Algebra I class. The two teachers, Robert and Naomi (fictional names) were experienced algebra instructors (20 and 15 years of math teaching experience, respectively), who participated in a larger year-long project from which the present data are drawn. The data collection central to the analysis reported in this paper consisted of classroom observations and interviews with each of the teachers. We have analyzed two types of lessons taught by these two teachers. The first type was a regular lesson according to the curriculum adopted at the teachers' school, while the second type was a lesson provided to the

teachers by the researchers, which was designed to promote the skill of question-asking. Both teachers participated in a one-week professional development institute in the summer prior to the data collection year. The institute focused on the use of the supplemental question-asking curriculum materials and was intended to facilitate the teachers' implementation of particular questioning strategies. Both teachers took part in this institute.

RESULTS

The findings presented here examine the practices and the character of interactions in the classes of the two teachers. We use these two teachers' cases to help illuminate important and unexplored issues in the implementation of question asking: the teacher's role in asking questions, the character of questions directed at students, and the way the questions are asked.

The Role of the Teacher

There were differences in the attitude of teachers to their role as "questioners." One teacher, Naomi, defined her teaching style as "direct teaching." She delivered each topic stage by stage, being responsible for every stage (e.g. choosing every step in solving a problem). She provided many instructions during the process of solution: how to solve equations, perform calculations, work with models, when to contract, etc. Her teaching was very detailed and precise and was accompanied by oral and written explanations. Naomi solved each equation completely and did not skip stages in problem simplification, including detailed substitutions and making all necessary calculations. Such teaching as Naomi's is well-described in literature about traditional teaching (Aizikovitsh-Udi & Star, 2011; Metz, 1978; Chazan, 2000). In contrast to Naomi, who saw herself as responsible for giving the suitable formula with explanations to the students, Robert preferred to allow the students to be the primary agents in finding solutions, while only assisting them to do so. Robert consistently applied methods that appear in recent educational literature as "innovative." For instance, he encouraged reliance on intuition and gave a minimum of laws and rules. Also he did not function as an authority for deciding whether an answer is correct (Cazden, 1988). The practices of these two teachers embody the alternatives discussed by Lobato, Clarke and Ellis (2005) in their reformulation of "teacher telling" as the strategic alternation of initiation and elicitation.

Naomi

Naomi taught her class according to traditional patterns of teaching (Aizikovitsh-Udi & Star, 2011; Bauersfeld, 1988; Voigt, 1989). In this tradition, the place of the teacher in the teaching process is central. She gave ample explanations and instructions directly to the students while solving problems. In Naomi's practice, the teacher served as a source of knowledge and was responsible for establishing correctness or incorrectness of answers. The teacher dominated the discourse in class, posing multiple questions but answering most of them herself. She did not encourage

discussion. Most of the questions were focused on mathematical content and were intended to obtain information and evaluate answers rather than attempting to understand the individual student's way of thinking. The students' answers to the teacher's questions were very brief, and their own questions aimed at clarifying points they did not understand rather than furthering their investigations.

Robert

Robert taught his class in a method that was characterized by features of the contemporary "reform agenda" (Darling-Hammond, 1996; NCTM, 2000). While Naomi's place in teaching was central, Robert's place was central as well, but with different emphases: he guided the students, gave few rules and laws and allowed the students to choose different ways for solving a particular problem.

Robert did not answer his own questions, but waited for students to respond. In cases when the answer was slow to arrive, he repeated the question in different ways. He encouraged discussion in class, which can be seen from the encouragement he gave to students who replied, from his repeated questioning of students who could not reply, and from the fact that students asked investigative questions themselves. The purpose of the teacher's questions was not only to evaluate knowledge of mathematical content but also to understand how the students think. Davis (1997) called this mode of listening to answers "interpretive listening." In this practice, the teacher does not function as the authority for establishing the correctness or incorrectness of the solution or for correcting the solution, but directs students by means of questions to correct their mistakes. Such a pattern has been termed by Wood (1998) "the focused pattern" and contrasted with the more directive and convergent "funnelling pattern." The two teachers offered a remarkable contrast: each employing instructional practices that have come to be identified with the stereotypes of "conventional" and "reform" teaching. In the following discussion, we juxtapose their actual practices in order to facilitate reflection on the role of questioning in both instructional models.

DISCUSSION

Although both teachers were considered good teachers and lesson structure was the same in both classes (an important point), the practice and "culture of question asking" of the two teachers were quite different and were shaped and applied differently. This has to do with the differences in the patterns of the teachers' discourse. For instance, the pattern of Naomi's discourse can best be described from the literature as the "funnel" pattern (where the teacher directs the students by means of questions toward the expected answer), while the pattern of Robert's discourse is similar to the "focused" pattern (where the teachers leaves the responsibility for arriving at the solution to the students, while helping them to focus on the important aspects of the problem), as described by Wood (1998). Also the ways of listening of the two teachers were different, where Naomi predominantly exercised evaluative listening, while Robert applied both evaluative and "interpretive" listening (Davis,

1997). While most questions by both teachers were concerned with mathematical content, Naomi's questions were not directed personally to the students, that is, the purpose of the question was to receive a mathematical answer and not to emphasize the individual student (we have termed this type of question "technical"). By contrast, most of the questions in Robert's classes required more explanation and argumentation than those in Naomi's classes (we have termed this type of question "investigative").

In evaluating the teachers' implementation of the practices advocated in the question-asking institute, we observed that both Naomi and Robert essentially preserved their teaching styles both in the supplemental question-asking portions of their classes and in the regular classes that adhered to their regular curriculum. Thus, in order to foster and encourage question asking in class, it appears that it is not enough to provide the questions to the teachers. The way in which the questions are asked, the timing and the number of times each question is asked have a central role in the culture of question-asking. In other words, even investigative questions can be asked in a technical way and consequently not give rise to any significant process of investigation. In particular, in relation to the professional development program that provided a key research site for this study, our results suggest that in order to change traditional teaching styles, it is not enough to give the teacher a small, narrowly focused exemplary learning unit (in this case, the supplemental questioning materials), even if, like Robert and Naomi, the teacher has previously taken a course in implementing related innovative teaching methods.

The initial evidence shows that teachers such as Robert, who have already assimilated some of the practices of the reform agenda into their teaching, are more likely to incorporate advanced instructional strategies into their practice than more conservative teachers, such as Naomi, whose pedagogical practice mirrors a personal commitment to stability and the inviolability (non-negotiability) of mathematical knowledge. However, the exposure of both teachers to the question asking teaching methodology was very brief, and it remains to be seen whether a more extensive exposure might or might not change a less innovative teacher's questioning strategies. Certainly, consistent with the existing literature on teacher change (eg. Clarke & Hollingsworth, 2002), neither the brief program nor the provision of the questioning material was sufficient to catalyse serious reconstruction by Naomi of her existing practices. And it may be that the efficacy of her existing practice was never seriously challenged by the institute. A new tool is less likely to be used, if the teacher's goals can be achieved successfully with existing, more familiar, tools.

Many in-service programs aim at enhancing teachers' teaching capabilities and expanding their repository of instructional strategies by emphasizing the connections between theory and practice. Indeed, making the connections between educational theories and practice in the classroom has been identified as essential (Zoller, Ben-Chaim, Ron, Pentimalli, & Borsese, 2000; Osborne, Erduran, & Simon, 2004). Certainly, the institute in which both teachers participated sought to establish or at

least demonstrate this connection. However, it would appear from the two case studies that we have reported, that the motivation to change practice requires more than logical argument. We suggest, consistent with existing teacher change literature, that the inclination to change either resides in a teacher's existing willingness to experiment in the on-going improvement of her practice, or in a desire or need to change, arising from dissatisfaction with her ability to achieve her teaching goals. In the case of Naomi, neither condition was met. In the case of Robert, the institute and the materials provided, did not really constitute a change in practice, but rather an extension of existing practice and of an existing inclination to experiment and to innovate.

Questioning is so fundamental to a teacher's practice that a change in questioning methods may require a fundamental shift in teacher beliefs (similar to that documented by Tobin et al., 1994). Certainly, the two cases that we have reported suggest that this is the case. We have two distinct issues here: the nature of good question-asking by teachers, its form and its function; and, the means by which teachers can be led to change their practice in the direction of good question-asking. The two teachers that we have described, Naomi and Robert, exemplify two distinct questioning styles. Each style is in such widespread use that it is clear we are dealing with two sets of pedagogical beliefs and aspirations characteristic of two co-existing constituencies within the teaching community. The advocacy of one model of teacher questioning over the other (focusing over funnelling) is based on contemporary curricular aspirations to promote more than just facility with mathematical concepts and skills but rather more ambitious conceptions of "mathematical thinking" that integrate identifiable components, such as algebraic thinking, statistical thinking, critical thinking and metacognition¹.

In summary, good questioning is central to good mathematics teaching and it is essential that teachers understand the importance of good question-asking skills in mathematics lessons. Good questioning involves the use of good questions as part of good questioning practice by teachers. What constitutes good questioning practice is directly reflective of the goals of the curriculum and the teacher and will differ significantly according to the cultural setting (Clarke, 2012). Teachers must create situations in which their own questions relate to the mathematical problem in hand, as well as modelling the skill of question asking for their students' benefit immediately and in the longer term (Holton & Clarke, 2006). To achieve this, it is necessary to plan teaching by choosing questioning tools that suit the student population, the teaching goals, the different needs and the teacher's own teaching style (and, we might add, the cultural milieu and traditions of practice that frame the classroom and

¹ Do these categories of "thinking" represent different modes of "thought" or are we categorising either the context in which thinking is undertaken (that is, mathematics) or the type of objects that are the subject of our reflection (mathematical objects)? Our success in promoting student higher-order thinking will depend on our capacity to resolve such questions.

constrain possibilities of change). The two case studies discussed in this paper demonstrate that the provision of good questions is not enough to stimulate significant change in teacher questioning practice. For many teachers, the implementation of good questioning practices may involve profound change, not only in teacher practice, but in teacher beliefs about the goals and purpose of mathematics teaching. Practical exemplars of good questioning practice must become a key resource in teacher education programs. Some interesting experiments have already been undertaken in this regard (Aizikovitsh-Udi, 2012).

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