Sakarya University Journal of Education, 3/3 (Aralık /December 2013) ss. 17-36.

Teachers' Awareness and Acquisition of Questioning Strategies: A Case Study

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Abstract

The importance of teachers' questioning strategy cannot be underestimated due to its widespread usage and pivotal role in teaching and learning regardless of grades and subjects. This qualitative case study design was employed to investigate middle school mathematics teachers' awareness of asking two types of questions, probing and guiding. The study further explores teachers' habits or skills of questioning and their acquisition of this behavior through face-to-face interviews with four middle school mathematics teachers. It was found that teachers were asking questions consciously and purposefully. Also, teachers' answers revealed that *why* questions require more higher order thinking than *how* questions. For the second question, several themes emerged indicating how to acquire more effective questioning skills; student teaching or field experiences, watching and observing their colleagues, and workshops. It was also found that the colleges our participants attended did not provide good education for developing questioning skills. Video clips played important roles in reminding teachers what and why they taught. Importance of letting teachers' watch their own teaching's videotape and questioning strategies in teacher trainings was discussed.

Key Words: Guiding questions, probing questions, questioning strategies, teachers' skills, and teachers' awareness

Öğretmenlerin Soru Sorma Stratejileriyle İlgili Farkındalıkları ve Bu Stratejileri Kazanma Süreçleri: Bir Durum Çalışması

Özet

Öğretim stratejilerinin amaçlarından birisi öğrencilerin neler bilip bilmediklerini yanlamalarını sağlamaya yardımcı olmaktır (Marzano, Pickering, & Pollock, 2001). Dolayısı ile öğretmenlerin görevlerinden birisi öğrencinin daha önce öğrendiği bilgileri harekete geçirmesi ve bu sayede öğrencinin yeni bilgiler öğrenmesini kolaylaştırmasıdır. Gerçekten de, National Council of Teachers of Mathematics (NCTM) (2000), yayınladığı öğretim raporunda, başarılı ve verimli öğretmenlerin, öğrencilerin sadece ne bildiklerini anlamayıp, onların neleri öğrenmeye ihtiyaçları olduğunu ortaya çıkaracak ve yeni şeyler öğrenmelerini sağlayacak görevler vermesi gerektiğinden bahsetmiştir. NCTM (2000) ayrıca öğretmenlerin bu görevi başarması için iyi soru sorma tekniklerini geliştirmeleri gerektiğini tavsiye etmiştir. Kısacası, öğretmen-öğrenci iliksisini geliştirecek düzeyde kaliteli öğretim yöntemleri geliştirmek, öğretmenlerin NCTM'in iyi öğretmen olma modeline uyması anlamında da önemlidir.

Anahtar Kelimeler: Rehberlik soruları, yönlendirme soruları, soru sorma teknikleri, öğretmenlerin yetenekleri, öğretmenlerin farkındalığı

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Introduction

One of the many purposes for any instructional strategy is to help students retrieve what they already know about a subject being discussed (Marzano, Pickering, & Pollock, 2001). Thus, one goal teachers attempt to achieve is to activate students' prior knowledge, which is critical to learning a new material (Marzano, Pickering, & Pollock, 2001). Indeed, according to the National Council of Teachers of Mathematics [NCTM] (2000), "effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well" (p. 4). NCTM (2000) shows teachers how to accomplish this by telling them to develop good questioning skills so they can know what questions to ask in order their students to reveal their knowledge and whether they learn the material well. Therefore, developing discourse strategies that promote teacher-student interactions at levels conducive to meeting the NCTM's teaching principle is paramount.

Questioning is one of the primary and most influential discourse strategies (Piccolo, Carter, Harbaugh, Capraro, & Capraro, 2008). From the research literature, teacher questions have been found to be indispensable in classroom interaction (e.g., Center For Faculty Excellence, 2009; Edwards & Bowman, 1996). Questioning is an important part of classroom teaching and learning and more expedient than paper and pencil tests to gauge what students know (Şahin & Kulm, 2008; Center For Faculty Excellence, 2009). Often times, teachers' primary instructional strategies consist of using different types of questioning to determine whether students understand the material being taught (Appalachian Educational Laboratory, 1994; Bond, 2007; Center For Faculty Excellence, 2009). A larger issue, however, is whether teachers use the questioning strategy consciously and purposefully.

Theoretical Framework

This qualitative case study is based on the hypothesis that the interaction among teachers, curriculum materials, professional development, and ongoing support for teachers that can lead to lasting improvements in students' learning (Nelson et al., 2000, p. 2).

The following review of recent literature provides a context for a model that characterizes

the relationship between teachers' use of probing and guiding questions and their purposes of asking those questions in middle grades mathematics classrooms. We first consider a brief review of general teacher questioning, then discuss research that supports and provides information on teachers' awareness and skill/habit of questioning. Thus, we develop a framework to analyze teachers' intention of asking questions and acquisition of their questioning skills.

Teachers' Questioning

The role of questioning in a classroom setting is pivotal. Accordingly, the importance of use of questioning techniques in students' understanding has been recognized for years by researchers and teachers (e.g., Ahtee, Juuti, Lavonen, & Suomela, 2011; Harrop & Swinson, 2003; Şahin & Kulm, 2008; Stevens, 1912). Question-answer process is the most prevalent type of teacher-student interactions in classrooms (Bond, 2007; Ellis, 1990; Kavanaka & Stigler, 1999) and recent research shows that this has not been changed (e.g., Ahtee, Juuti, Lavonen, & Suomela, 2011; Bond, 2007; Nassaji & Wells, 2000).

Questions are used for different purposes including stimulating thinking, checking student comprehension and clarification (Center For

Faculty Excellence, 2009; Yackel, Cobb, & Wood, 1998), capturing attention (Bond 2007; Newmann, 1988;), classroom management (Bond, 2007), initiating discussion, reviewing material (Buggey, 1971), and formative assessment (Centre for Educational Research and Innovation, 2008). Hence, it is not surprising to see that use of questioning is so prevalent in all grade levels and one of the most used teaching skills regardless of subject matter.

Teachers' Awareness of Questioning

Questioning operates within an interaction frame (Barnes & Todd, 1995) and has various functions. Young (1992) identified the teacher-student question-and-answer process as *Guess What Teacher Thinks*, in which the teacher controls the topic and the student guesses what the teacher expects as an answer. Thus, the student's answer is judged according to the teacher's mental framework, creating a link between the teacher's mental process and the student's answer. In other words, the teacher's purpose frames the answers that are expected. Even though teacher's questioning is a major form of student and teacher interaction, we are not sure what their reasons of asking questions are or whether they are aware of why they use certain questions. This study explores teachers' awareness of their use of questioning by comparing their reasons of asking questions with their actual practice, achieved by looking at indicators of questions.

Skill/Habit of Questioning

Of all the characteristics identified in effective schools, the teaching approaches have the greatest affect on student achievement (Brown et al., 1995; Mortimore et al., 1988). Research on classroom discourse and dialogue indicated that classrooms were dominated by teacher talk in the form of questioning (Dillon, 1990; Kawanaka & Stigler, 1999; West & Pearson, 1994). In the question-and-answer interaction, the teacher typically asked questions and the student often provided answers to those questions (Cooper & Simonds, 2003).

Developing teacher questioning skills is important (Şahin & Kulm, 2008; Saunders, Gall, Nielson, & Smith, 1975). Several reasons have been identified for why questioning was a critical skill: (1) it was the most common form of interaction between teacher and pupil (Bond, 2007; Kawanaka & Stigler, 1999); (2) it was the most-used teaching strategy in every type and model of lesson (Şahin & Kulm, 2008; Stigler 1912); (3) it was a key strategy for providing appropriate challenges for pupils (Ahtee, Juuti, Lavone, & Suomela, 2011); (4) it was an important way to increase the quality of teaching (Marzano, Pickering, & Pollock, 2001); and (5) it was the shortest and easiest way for a teacher to evaluate learning (Cotton, 1998). Therefore, the two primary research questions that guided the inquiry were, 1) do the teachers ask the types of questions (probing or guiding) they intend to ask, and 2) how do teachers develop and acquire their questioning skills?

Methodology

I used a case study method in this study. The data were collected through systematic observations of videotaped lessons at four public schools in Texas as part of a five-year longitudinal Middle School Mathematics Project (MSMP) funded by the Interagency Educational Research Initiative through a grant to the American Association for the Advancement of Science (AAAS). The overall goal of the project was to explore the hypothesis that the interaction among teachers, curriculum materials, professional development, and ongoing support for teachers that can lead to lasting improvements in students' learning.

The participants were chosen purposefully from all the participants in the larger project because videos of each were available for the duration that covered the same objectives. These teachers were female and also all were teaching Algebra in middle school. However, different textbooks were used: two taught from *MathThematics* (Billstein et al., 1999) and two taught from *Glencoe Algebra* (Collins et al., 1998) and the videotaped lesson from both textbooks covered the same learning goals and content. The teachers used different textbooks, but the lessons addressed the same mathematical content dealing with variables, equality and equations, and change in algebra (grade 7 and 8). The teachers and researchers examined the lessons and decided the lessons were directly covering the intended content as described in Table 1.

Table 1. Learning Goals of the Lessons

Content	Description of Content
Variables	Students were asked to recognize both variables and non-variables in problem situations, to recognize variable expressions as representations of problem situations, and to recognize that variables can be used to represent a generalized rule or principle.
Equality and Equations	Students were asked to demonstrate understanding of the idea that the equals sign indicates equivalence between two expressions. They were asked to find a set of ordered pairs to solve a simple equation, to recognize the representation of a problem situation with a 1-variable equation, and to solve simple 1-variable equations.
Change	The questions used to assess this group of ideas were mostly conceptual in nature. Students were asked to demonstrate understanding about change in a variable over time, as well as how the change in one variable relates to change in another. They were asked to recognize when the relationship between two variables is linear and the relationship between two variables when represented in the form of an equation.

Procedure

In this study, two main TEACHERS' questioning types were used: (1) Probing (2) Guiding questions. Probing questions are similar to higher order questions in which you use it to ask for clarification, justification, or explanation (Şahin & Kulm, 2008). Guiding questions are usually set or cluster of questions consisting of factual or open-ended or mix of factual and open-ended questions (Şahin & Kulm, 2008). Our primary reasons for choosing probing and guiding questions were based on one of the goals of the project in which mathematics teachers were trained in using probing and guiding questions. We were interested in how teachers who were trained would implement questions in their classes.

As part of the larger study, the questions they asked of their students (as contained in the video tapped lessons) were categorized as either *probing* or *guiding*, using the criteria developed by the project (AAAS, 2002). Following section describes how those question types were coded.

Types of questions were obtained by coding videotapes of the lessons. A computer program was developed by the project to analyze videotapes of teachers' lessons. The lesson was first analyzed to identify the parts of the lesson that addressed one of the intended algebra learning goals. Next, trained analysts identified and time-coded segments of the lesson (sightings) according to their match with one or more of five criteria (two of them were about types of questioning; V-A/probing and V-B/guiding respectively).

To ensure reliability, graduate students and mathematics specialists were trained to do classroom observations. Using videotapes of teaching, protocols were followed for video analysis to ensure that analysts applied the coding procedure in standard ways (e.g., the training should include at least three people watching the tape together and then sharing their observations) (Gallagher & Parker, 1995; Schoenfeld, 1992). The data were collected at the different sites where the research was being conducted. Protocols for analysis were developed by the researchers to assure that the same standards were used in the different sites for collection and analysis. All statistical analyses correlational in nature. Obtained results were attenuated by the reliability of the data; therefore, reliability scores must be reported (Capraro, Capraro, & Henson, 2001; Thompson, 2003; Vacha-Haase, 1998).

The first criterion, V-A/probing, focused on teacher questions that "*encourage students to explain their ideas.*" This criterion reflected teachers' use of probing and follow-up questions to encourage each student to express, clarify, justify, interpret, and represent his or her knowledge/understanding of the learning goals (e.g., with tasks, real-world examples, representations, and/or readings related to the learning goals) and get feedback. The following indicators defined the quality of questions for this criterion:

Indicator 1: The teacher encourages students to express their knowledge/understanding relevant to the learning goals.

Indicator 2: The teacher encourages students not only to express their views but also to clarify, justify, interpret, and/or represent their knowledge/understanding.

Indicator 3: The teacher provides opportunities for each student (rather than just a few) to clarify, justify, interpret, and/or represent their knowledge/understanding.

The second criterion, V-B/guiding, reflected teachers' use of questions that *guide interpretation and reasoning* by students. The following indicators were used for this criterion:

Indicator 1: The teacher includes specific questions and/or tasks to address a mathematical dilemma and to support student progress toward a more complete conceptual understanding of the learning goals without leading.

Indicator 2: The guiding questions/tasks are responsive to evidence of student thinking rather than generic in nature and directly target the students' mathematical dilemma regarding the learning goals.

Indicator 3: The teacher is persistent is supporting student progress toward a deeper understanding of the learning goals.

The video segments containing each of teacher's probing or guiding questions and the responses of their students was captured and transcripts were prepared. Each teacher was interviewed separately after reading the transcript and watching the video.

Interviews

To examine teachers' awareness in relation to the use of teachers' probing and guiding questions, individual interviews were conducted.

The lessons used in this study were videotaped in 2003. The four schools were contacted to conduct interviews with the four teachers in January 2006. As Pajares (1992) indicated, it is important to make inferences about individual's primary statements but this is difficult because individuals are not always willing or able to represent their beliefs accurately. "For this reason, beliefs cannot be directly observed or measured but must be inferred from what they say, intend, and do-fundamental prerequisites that educational researchers seldom followed" (Pajares 1992, p. 314).

In coding transcripts of videotaped lessons, we evaluated questions in the context of the lessons or topic being discussed rather than looking each question separately. All of the questions in the lesson were classifiable as one of the two types and fit one of our categories. Because teachers wore the microphones, the student interactions and questions were limited to those we could hear clearly.

The interviews were conducted using a key informant paradigm with the actor and informant being the same person and the informant giving authentic explanation for providing insights about their questioning (Babbie, 1998; Maxwell, 2005). After showing teachers 2-3 minutes short video clips from the lessons they taught, they were asked a serious of questions (see Appendix) about their reasons for asking probing and guiding questions. Later, the indicators of those question types were shown to the teachers and they were asked how many of them they had meant to accomplish. The types of teacher-student interactions varied from one-on-one teacher to student interactions to one-to whole teacher to whole class. As part of the project, experienced project staff trained teachers annually each year starting from 2002 until 2005 on different instructional skills such as teachers' questioning skills. Therefore, the teachers in the study used question-and-answer technique rather than direct lecturing. Students often worked collaboratively in groups, followed by a class discussion and question-and-answer session.

First, the teacher interviews were transcribed. Then, I provided thick descriptions for the transferability of the study. Then, the data were considered in terms of their match to the existing categories of probing and guiding questions. For the first research question to fulfill triangulation of the data, I asked two types of questions. First, I asked, "Why did you ask or what were you expecting by asking those questions" without showing the indicators of the questions they asked. Then, I showed them the indicators of probing and guiding questions developed by AAAS and compared the answers from both sources to see if they were correlated. For the inter-coder reliability of the data, a second trained researcher on the utility rated the match of question types in order to estimate the inter-coder reliability. The inter-coder reliability was .80.

For the second research question, transcripts were analyzed for main themes and then coded according to those themes using the Nueman (2000) phases of coding system. During the first phase of coding, the first author performed an initial scan of data by highlighting words or phrased used by the teachers and locating initial themes. Then, both researchers identified the core themes to the aims of the study. In the second phase, researchers focused on connecting similarities and differences and finding links in the data. In the final stage, the primary author reread the data and assigned excerpts that show the final themes.

Role of videotapes

The interviews were conducted face-to-face with the four teachers. Each interview lasted

30-45 minutes and was audiotaped. Because the lessons we used for the study were videotaped in 2003, there was a serious time lag between the lessons were taught and interviews were done. Therefore, short videos were critical and helpful in reminding teachers of their perceptions of their teaching and intentions (Şahin & Kulm, 2008). The dependability of the data was paramount. So to ensure dependability, eight short video clips were developed to determine how much they remembered about the lesson and their purposes for instruction. Teachers watched two of their video clips, one for each question type. All four teachers remembered the class they taught and explained why they asked specific questions after watching the video clips.

These examples illustrate how the video clips helped in obtaining reliable data. In all cases, the teachers were able to recall specific information about students and the lesson directly without using any other means.

Ms. L.'s answers showed that the short video clips were very helpful to her in remembering specific information about the lessons she taught. She remembered the actual lesson and the students she taught. It was also nice to see that she remembered almost every detail about the child in addition to what she was trying to do with those questions.

Interviewer: Do you remember the lesson? What was the class doing here?

Ms. L.: Yes. I was kind of guiding him through it. Basically, this is the thing we talked about the year before he was in my class. I did not have him in 7th grade. Normally, I teach 6th, 7th grade and pre-algebra and the other teacher teaches 8th grade. That year, I just took 7th and 8th grade as well. So, it was my first year to teach them. Prior to my teaching them, they really lost some of the concepts. Maybe, they just really passed through really fast and he did not learn it well. I pretty much guided him through, this is x, this is y.

Ms. S. also remembered the specific class she taught after watching the video clip.

Interviewer: Do you remember this lesson? What was the class doing here?

Ms. S.: I think we were adding and subtracting integers. I think that is what it was. Actually, I don't remember I was doing that but once I see that I remember teaching that way.

FINDINGS

Research Question 1

The four teachers usually facilitated whole class discussions. At other times, they helped individual students during in-class practice work. The teachers' awareness for questioning was analyzed according to the level of match between their reasons for asking questions and the indicators of the two questions types.

Probing questions.

The analysis of interviews for the first question revealed four main themes for probing questions: *checking students' understanding, use of why and how questions, effect of classroom size,* and *importance of peer teaching.*

Checking students' understanding.

Two teachers spoke about the importance of *why* and *how* questions in terms of their role in checking students understanding. As research indicated, use of higher order questions is very limited in K-12 classrooms (Kawanaka & Stigler, 1999; Şahin & Kulm, 2008). Most teachers do not verify that their students really answered the questions with supportive explanations or just guessed at it. The teachers said they wanted to see if the students really understood the content through checking their knowledge by using why and how questions.

The following excerpts from two teachers show how they used probing questions:

Ms. L had a small classroom with only 6 students. That was why she was giving a chance to talk to every student during her teaching. But she wanted to make sure they tell the things they understood instead of talking for talking. This led her to ask probing questions to overcome her concern.

A big part of the math in the junior high level is making kids explain what they do. A lot of times they'll tell something in my classes and I want to know how they got it. . . I am always asking them like as I said before, "tell me what are you doing" and how did you do that?" So, you know, checking on their knowledge and what they are really understanding . . . (Ms. L).

On the other hand, Ms. S had a class of more than 20 students. She had to teach and lecture simultaneously. The only way to check if her students understand what she was doing was to ask them probing questions such as why questions so they could realize why and what she was doing.

I was trying to get them to think about what we were doing and read them in their mind. I know a lot of times they don't understand like why you have to do both sides. They don't realize you have to go both sides because you can't do one thing one side and not do the other side you know what I mean. So, when I asked why questions I wanted them to think why I am doing this instead of saying this is what you have to do… (Ms. S).

Use of why and how questions.

Three teachers reported the difference between why and how questions in terms of the amount of knowledge each required to answer. According to Ms. L, students usually panicked when they were asked *why* questions. Therefore, it was better to start with a *how* question. Then, teachers could continue with *why* questions to receive more explanations or thought from students. So, as in the indicators, *how* questions were more related to the first indicator of *probing*, which was to *encourage students to express their knowledge or understanding. Why* questions were more similar to the second indicator, which *encourages students to clarify, justify, interpret, or represent their knowledge or understanding*.

I want to know how they got it. If I ask them "why is that?" a lot of times, kids don't know where to go. So, I usually start with how questions so they can explain what they did first and then I can lead them into why questions to make them explain a little more in detail…some of the "how" questions may be have them okay, they may tell me something. But to really test their understanding, I have them clarify or explain even further into their understanding. . . (Ms. L).

Effect of classroom size.

One teacher emphasized class size in asking probing questions to each and every child in the classroom, thus engaging them. But we do not know if the success of all students were directly linked to their experience of being asked a probing questions in each lesson because Şahin & Kulm's (2008) study found that students learned better when they were asked enough quality probing questions.

... providing opportunities for each student to express their understanding; you may see or may not see in that video but the class was only six people total. So, with only six kids, you know if you had a bigger class, sure there is a lot more kids asking questions but whenever you have a small group like that I try to give every kid a chance. (Ms. L).

Importance of peer teaching.

Ms. L highlighted the importance of learning from peers when you ask questions to more than a few students about their answers. It may sometimes be easier for students to understand from their peers than their teacher because

students use more familiar language to each other than their teacher's does. So the more questions directed at students, the more chances of understanding the materials being taught for those who have difficulties learning.

…some kids if they aren't getting it; I ask some others who explain it. They listen to them just as much as they listen to me. Thus, they learn from each other (Ms. L).

The teachers' purposes for asking probing questions were similar. 2 shows the relationship of the four teachers' responses to the *probing* questions. Even though they were not shown the indicators in the first question, the teachers' answers about the reasons for asking *why* and *how* questions were very similar to their choice of indicators in the second question.

Table 2. Level of Teachers Awareness

Teacher	Question 2 Why did you ask *why* and/or *how* questions?	Question 3 How many of these purposes were your questions intended to accomplish?
Ms. L.	*How* questions to let them explain *Why* questions to make them explain a little more	All three indicators
Ms. S.	She asked why questions to let them think about what they were doing and find out what they were thinking	First and second
Ms. M.	*Why* questions to let them articulate what they are thinking. She believes that being able to articulate is a key to learning	All three indicators
Ms. D.	*Why* and *how* questions to make them explain if two things are similar or not. Probing questions to make them analyze the topic under discussion.	All three indicators

Overall, the four teachers talked about several functions of why and how questions: (1) develops students' metacognitive thinking skills; (2) encourages (all) students to express, clarify, explain and justify their answers/understanding; (3) pushes students to articulate their own ideas/thinking; and (4) enables students to analyze the situation, thus explain differences and similarities. These are almost same with the three indicators of the longitudinal study. The only difference would be the representation part of the materials being taught.

Guiding questions.

For the guiding questions, all four teachers gave similar responses for the, first question, reasons they asked guiding question. The analysis of teacher interviews revealed one main theme in which teachers used guiding questions *when students were stuck or did not understand the question or did not know how to proceed.* The purposes for using guiding questions varied from re-teaching the material to scaffold student learning and from refreshing student knowledge to reinforcing problem solving. The following excerpts from the teachers' interviews are provided to show how they used guiding questions:

… She was (either) stuck or did not understand the lesson you know. . I was giving some points or clues. It seems I solved pretty much whole problem for her (Ms. S).

They did not understand where the one and three came from. So, by showing them how and where the one and three came from and hoping that they could figure out how to complete their chart (Ms. D).

The kid I was helping really had trouble understanding x and y the whole year and so I was trying to help him. You probably heard me saying more because it was hard to hear the kid, but he gets confused; that is what most junior high students do. They either really get x and y, where they are, how to move when you do all four quadrants. In 6thgrade, they only do the first quadrant. So, in 7th and 8th grade, they start doing all four quadrants. So, it gets confusing and they always mixed up which way to move first or which one is x and y. So, walking through step by step for the first one to reinforce them otherwise they would do nothing (Ms. L).

We were reviewing integers and so the point was that I was instructing and teaching them. But they needed to recognize specific things in order to take those words into account. That was what I was looking for. Could they identify the thing they already learned? I was trying to get them recall those. They had already done it but they were seen it in slightly different way and so they were relating the things they knew with this new situation. So, you know, I used the same kind of things we talked about when we did it in this situation and in new situation. Just kind of guide them to see that what they applied in this situation. So, in the clip, she was not confident with what she was doing. So, I wanted to make sure that, you know sometimes students get stuck. You don't want to direct them or teach it again. This was a review. So, you just want to keep them moving forward (Ms. M).

The four teachers said they used all three purposes as in Table 3. Overall, all teachers reported that they used guiding questions when students are stuck or need help or clue, need to refresh or recall knowledge, or need help which are very similar with the AAAS indicators.

Table 3. Level of Teachers Awareness

Teacher	Question 2	Question 3
	Why did you ask that set of questions?	How many of these purposes were your questions intended to accomplish?
Ms. L.	Trying to guide by re-teaching the topic. Students were stuck.	All 3
Ms. S.	Giving points or clues to refresh student's knowledge	All 3
Ms. M.	Instructing to help them recall knowledge	All 3
Ms. D	Helping students figure out how to solve the problem under discussion	All 3

Research Question 2

Participants were asked two types of questions in an attempt to determine how they acquired their habits and skills for asking questions. First, they were asked how teachers, in general, develop their habit or skill of questioning and how they developed their own questioning skills. Then they were asked if they learned questioning on their own or if it had been taught in college. Analysis of four teacher interviews revealed four main themes: watching other teachers, field experience/student teaching, workshops/trainings, and other methods.

Watching other (good) teachers.

Three teachers highlighted the importance of watching other (good) teachers and meeting with them to discuss why, what, and how they

ask questions. They may have chosen this, possibly, because when they sit and watch good teachers' teaching, they are not on the spot so they are able to focus on the teacher's teaching and classroom discourse. But the key point or requirement was to have a good teacher/questioner who is open and willing to discuss why they ask what they ask. Thus, teachers will be able to acquire new questioning techniques.

But I think watching a good teacher is really the key to finding out, you know, to happen to have the ability to watch them and to discuss that. That is really an opportunity to watch them and through field experiences. So, to me, that is the place where they acquire and learn how to do that…I think that a lot of teachers don't have the opportunity, or if they do have the opportunity . . . I mean . . . a good questioner has the opportunity to sit in the classroom and watch the teacher do that and ask why they do that. So, once you understand why you are trying to question, then you make the questions better… (Ms. M).

Field experience or student teaching

Three teachers reported that their field experience or observation during their student teaching helped them develop their questioning skills. They spoke about the importance of being with real teachers and students during their field experience. This enabled them to watch their mentor teachers' use of questioning techniques and also experience how students responded to those questions. Indeed, this was the first place they could practice and observe and test their learning after they took all their education courses that talk about different teaching skills and classroom management methods. So this place plays a paramount role in developing good teaching skills in addition to good questioning techniques. What's more, teachers reported that they had one prerequisite in order to develop good questioning skills from student teaching which was to have a good cooperating teacher who could explain why and how to ask questions:

… the classroom experience, going out in the field, being in the classroom with the actual teachers and helping them out, seeing how they are doing it. You pick up things and you get exposed to different strategies in the classroom. So, I think, having the exposure in the classrooms is very beneficial because you be taught a lot with lecture at A&M or at any college but real-life exposure out in the classrooms with real kids, what kind of questions kids are asking and how they are responding the questions, I think, is very helpful (Ms. L).

… I think that most teachers, if they had gone through traditional teaching education, do a lot of observing teachers, field observations and experiences. That is the beginning place, if you are fortunate to have people who are good at it and can explain why they do it... (Ms. M).

Workshops/trainings

Two teachers spoke of the importance of participating in workshops and training in developing good questioning skills as Ms. L described, "I would say in fact that [came] from different trainings". They explained that workshops or trainings are the places where most teachers either learn new teaching techniques and tools or improve what they already know. In addition, they interact with other teachers coming from/with different backgrounds, different contents, and different years of teaching experience. However, they reported that workshops on questioning techniques are very rare and there are not many opportunities for teachers to learn how's and why's of questioning technique.

A lots of training, different trainings, when you go to different workshops, you meet different people, hear different peoples' speak, experience different types of things, hands on or you may be the student

yourself. All those types of things and so you end up with hearing other peoples' questions or you may see video clips of other classes and see what works for them... (Ms. L).

…This program [Middle School Mathematics Project] was the only workshop (in fifteen years) I have ever been had a specific goal of teaching how to ask questions better (Ms. M).

Other methods to develop questioning techniques

In addition to all the above ways to acquire questioning techniques, four teachers talked about other methods to develop these skills: watching your own video, personality, from your middle or high school teachers, types of teachers, kids in your classroom, college classroom, and real life exposure.

Oh, that is a good one. Acquiring the habit of questioning, well, one, it depends on what type of teacher you are. If you are a very vocal teacher that is not afraid of asking questions, or not to be afraid of your students if they ask questions that you may not be able to answer and to be able to know where to go with that (Ms. L).

Oh yes, [personality is important] I have seen equal, if not more effective, teachers and they might ask differently. I do a lot of, you know, "what? Why? Explain to me?' The kind of questions does not differ but the presentation of that and, the way they ask may change (Ms. M).

… I was an undergraduate a long time ago and things changed a lot now and I think it is much better now. But when I was an undergraduate, [the skill came through] the time in the classroom… (Ms. L),

… So there are a lot of different things and some of those could stem from the kids in your classroom (Ms. L).

Table 4. Teachers' Responses Regarding Their Acquisition of Questioning Habits or Skills

Teacher	How do teachers acquire their questioning habits or skills?	How did you acquire your questioning habits or skills?	Did you acquire your questioning habits through college instruction?
Ms. L.	Depends on types of teachers: For ex: Local teachers tend to ask more questions? Training, workshops, meetings with different people, watching other teachers, watching your videos, depends on the students in the classroom	From different training, field experience, being with real teachers, lectures at college, real-life exposure to students	Yes and no
Ms. S.	Watching other teachers	Middle- and high-school teachers	No
Ms. M.	Watching good teachers, observing teachers, field observations, working with teachers	Teachers from student teaching, discussing with teachers, field experience, personality, MSMP* workshop	No
Ms. D	Personality, textbook	Teachers from student teaching, watching supervisor teacher	Yes

Table 4 summarizes the findings. All four teachers agreed on several things. First, specific questioning skills were not taught in college. Second, watching or observing good teachers, being in the field or from student-teacher interactions and workshops were other common

methods to develop their questioning skills. Personality, textbooks, and lectures from colleges were other infrequent methods teachers used to develop their questioning skills. So each teacher acquired her questioning techniques in different situations and unsystematic ways.

DISCUSSION

Teachers' Awareness of Questioning Techniques

This study showed that teachers mostly asked what they meant to ask for both probing and guiding questions. Teachers were aware of the functions of the questions they used to teach their lessons. In one instance, there was a difference, however, in the area of choosing purposes of asking probing questions. For instance, one teacher chose all three purposes even though only 3 students out of 6 had the opportunity to interact with the teacher. Another teacher did not choose the third purpose because she said there were some of her 20 students in the crowded classroom were merely sitting and watching. These differences may be due to the teachers' varying experience levels; the first teacher had taught more than 10 years while the other had taught for less than 5 years. Further study with more teachers with different years of teaching experiences would be interesting to see how teachers of different years of experience use questioning techniques.

This research revealed that *why* questions require more higher order thinking that *how* questions. Moreover, the teacher stated that starting with *why* question is not a good idea because this tends to panic students and they may not know how to proceed. In other words, teachers should start with *how* questions and lead into *why* questions if possible. But this should be tested with more students from different grade levels to see how they respond why and how questions.

Another important finding was that Ms. L said that *articulation* is the key to learning because if students start articulating the material they learn, they can understand what they are discussing. In other words, if a student doesn't speak out about the topic being discussed, it may mean that that student did not understand. So, discussion or articulation is a good indication for students understanding.

The key finding for the guiding question was that all four teachers said that they asked guiding questions when they think either a student was stuck or did not understand the question and how to proceed with the problem. Therefore, the implication of this finding would be for teachers to pose more guiding questions when their students have difficulties with the material but teachers should not provide the answers directly or call on another student before they help the student who has difficulty.

Because the students used in this study did not have microphone and we did not hear how they responded to teacher questions, further study would be to compare teacher questions with students' answers to see if they were associated with each other in order to conclude that teachers asked what they meant to ask.

Developing Good Questioning Skills or Habits

Questioning technique is a skill that can be acquired and improved through educational activities, as opposed to believing it as an inborn quality (Acikgoz, 2004; Mucher, 2007). Therefore, one of the goals of education, in general, is to improve individuals' questioning skills (Korkmaz & Yesil, 2010). Several methods emerged in the analysis of the interviews about how teachers develop their questioning skills. Watching and observing a (good) teacher

was one of the common techniques that teachers reported to learn how to ask questions. All four teachers mentioned this as a way to acquire good questioning strategy. This confirms the findings of previous studies that suggest seeing/listening to good examples are one of the main ways to learn questioning (Korkmaz & Yesil, 2010; Senemoglu, 1997). This could also be the case because watching or observing teachers does not expose the observer to any type of pressure. In this way, observers can see good models of teaching and later try to incorporate these strategies in their own teaching. The possible disadvantage in this technique could be that the level of students and the location may differ significantly. For instance, in small districts, it may be easier to ask any type of questions, as one of the teachers noted, because teachers may have the advantage of knowing all their students' parents. Therefore, they can ask many types of questions confidently.

Another most common method to learn how to question was going out in the field and being in the classroom with other teachers and students. Again, this has two parts: first, they observe how and what the other teachers use as part of their questioning skills and listen to the results of the questions as students respond. Second, they practice their questioning skills during their student teaching in the field. This is supported by previous research saying that the fact that question-asking skill can be learned better by doing and experiencing (Drake & Brown 2003; Martin 2005; Senemoglu, 1997). Therefore, students' student teaching opportunities have to be well planned in order to benefit most. For instance, each student teacher can be assigned a project or final report with a class presentation regarding specific teaching skill they will observe, videotape, and do research about. So they will remember and adopt those skills when they start teaching in a real classroom.

The third most frequent method for developing questioning skill was through attending workshops, however, they agreed it is not easy to find a workshop on questioning. For instance, Ms. M had more than 15 years of teaching experience but never had a chance to participate in a workshop on questioning prior to her work with the MSMP project. This finding implies that more workshops or training should be offered. Because teachers learn more when they watch other teachers' teachings, then each individual schools or districts should assign less teaching hours to teachers so they can have flexibility to go their colleagues' classrooms to observe and grow.

Questioning is not taught in colleges or colleges of education as part of teacher education programs. Three teachers said that they took no courses or training sessions on questioning. So it would be a good idea for colleges to work on this to provide better teacher education programs for future teachers.

Videotaping and watching their own or other good teachers' teachings are very helpful and an inspiring method to improve both beginning and in-service teachers teaching. Teachers can learn many different skills, including questioning, by watching videotapes of other teachers. This allows teachers to watch the video clips they want multiple times either alone or as a group with or without taking notes without having the fear of missing any interaction or moment (Star, & Strickland, 2007).

The strength of this study was that in-depth interviewing and reliable indicators of probing and guiding questions allowed for new themes to emerge in order to provide a more thorough understanding of the factors that affect teachers' awareness of asking questions and acquisition of questioning skills. One of the limitations of this study was that because the MSMP focused only on teachers and did not use micro-

phones to record students' answers, it was not possible to validate whether the teachers accomplished what they wanted to ask. Further study with a greater emphasis on student responses should be done to important confirmatory evidence of the theories offered here.

To what extent does student teaching affect students' questioning skills? What other questioning training methods can be effective? These questions, and many others, could be investigated and their answers could help improve teaching and learning practices in mathematics and other subject classrooms.

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Genişletilmiş Özet

Öğretim stratejilerinin amaçlarından birisi öğrencilerin neler bilip bilmediklerini yanlamalarını sağlamaya yardımcı olmaktır (Marzano, Pickering, & Pollock, 2001). Dolayısı ile öğretmenlerin görevlerinden birisi öğrencinin daha önce öğrendiği bilgileri harekete geçirmesi ve bu sayede öğrencinin yeni bilgiler öğrenmesini kolaylaştırmasıdır. Gerçekten de, National Council of Teachers of Mathematics (NCTM) (2000), yayınladığı öğretim raporunda, başarılı ve verimli öğretmenlerin, öğrencilerin sadece ne bildiklerini anlamayıp, onların neleri öğrenmeye ihtiyaçları olduğunu ortaya çıkaracak ve yeni şeyler öğrenmelerini sağlayacak görevler vermesi gerektiğinden bahsetmiştir. NCTM (2000) ayrıca öğretmenlerin bu görevi başarması için iyi soru sorma tekniklerini geliştirmeleri gerektiğini tavsiye etmiştir. Kısacası, öğretmen-öğrenci iliksisini geliştirecek düzeyde kaliteli öğretim yöntemleri geliştirmek, öğretmenlerin NCTM'in iyi öğretmen olma modeline uyması anlamında da önemlidir.

Soru Sorma Stratejisi

Sınıf ortamında soru sorma tekniğinin rolü göz ardı edilemez. Buna bağlı olarak bu tekniğin önemine değinen birçok araştırma yapılmıştır (e.g., Ahtee, Juuti, Lavonen, & Suomela, 2011; Harrop & Swinson, 2003; Şahin & Kulm, 2008; Stevens, 1912). Bu araştırmaların sonuçları soru-cevap tekniğinin sınıf içerisinde öğretmen öğrenci arasında en sik rastlanan iletişim turu olduğunu göstermekte (Bond, 2007; Ellis, 1990; Kavanaka & Stigler, 1999) ve son yapılan araştırmalar da bu durumu doğrulamaktadır (e.g., Ahtee, Juuti, Lavonen, & Suomela, 2011; Bond, 2007; Nassaji & Wells, 2000).

Soru sorma tekniği sınıf içerisinde birçok amaçla kullanılabilmektedir. Bunlar arasında; öğrencide yeni düşünceler uyarmak, öğrencinin konuyu anlayıp anlamadığını kontrol etmek ve anlaşılmayan konuları açıklamak (Center For Faculty Excellence, 2009; Yackel, Cobb, & Wood, 1998), sınıf yönetimini sağlamak (Bond, 2007), yeni tartışmalar başlatmak, konuyu gözden geçirmek (Buggey, 1971), ve öğrenmeye yönelik ölçme–değerlendirme yapmak sayılabilir (Center for Educational Research and Innovation, 2008). Bundan dolayıdır ki öğretmenin soru sorma tekniği sınıf seviyesi ve bölüm farkı olmadan yaygın ve yoğun bir biçimde kullanılmaktadır.

Bu çalışmada yukarıda belirtilen amaçlardan ikisine odaklanılmıştır: (1) Araştırmaya yönlendiren (neden, niçin, nasıl gibi (2) Yol gösterici (Bunu kastettin öyle değil mi?). Araştırma gerektiren soru tipi üst düzey düşünme becerileri gerektiren soru tipinden olup; genelde izah etme, ispatlama ve açıklama (Şahin & Kulm, 2008) için kullanılır. Yol gösterici soru tipi ise genelde birden fazla gerçekçi veya üst düzey düşünme gerektiren soruların ard arda kullanılması ile öğrenciye soruyu anlayamadığı, ya da çözmek için kullandığı metodun doğruluğundan emin olmadığı zaman kullanılır (Şahin & Kulm, 2008). Bu iki soru tipinin kullanılması aslında bunların sınıf içerisinde en çok kullanılan soru tiplerinden olmasından ve çalışma grubundaki öğretmenlerin bu soru tiplerinde seminere tabii tutulmalarındandır (Şahin & Kulm, 2008). Seminere katılan bu öğretmenlerin bu soru tiplerini ne kadar sınıf içerisinde uygulayabildikleri araştırmacının cevaplamak istediği sorulardan birisidir.

Yöntem

Bu araştırmada nitel araştırma yöntemlerinden durum çalışması kullanılmıştır.

Katılımcılar Amerika Birleşik Devletleri, Teksas eyaletinde, ortaokul matematik projesinin yürütüldüğü okullarda çalışan 4 ortaokul öğretmeninden oluşmaktadır. Bu öğretmenlerin seçilmesinde aynı konuyu anlatmaları dikkate alınmıştır. Bu amaca dayalı olarak seçilebilecek tüm öğretmenlerin kadın olması

nedeniyle araştırmaya katılan tüm katılımcılar kadındır. Verilerin toplanmasında ise gözlem ve görüşme yöntemleri kullanılmıştır.

Bulgular ve Tartışma

Araştırma bulgularında araştırma gerektiren soru tekniği ile ilgili bulgular incelendiğinde 4 farklı temanın ortaya çıktığı görülmüştür. Bunlar: öğrencinin anlatılan konuyu anlama düzeyinin bu sorularla kontrol edilmesi, *niçin* ve *neden* sorularının farklı amaçlar için kullanılması, sınıftaki öğrenci sayısının bu soru tipini kullanmada etkisi, ve öğrencilerin birbirlerinden öğrenmelerine katkısı.

Yol Gösterici Soru Tekniği ile ilgili bulgular dört öğretmenin de bu soru tipini benzer amaçlar için kullandığını ortaya koydu. Öğretmenlerin, öğrenciler takıldıklarında ya da soruyu anlamadıklarında ya da sorunun çözümüne nasıl devam edeceklerini bilmedikleri durumlarda bu soru tipini kullandıkları ortaya çıktı. Bir diğer bulgu ise öğretmenlerin soru sorma tekniğini nasıl kazandıklarıyla ilgilidir.

Öğretmenlere, kendi soru sorma yöntemlerini nasıl geliştirdikleri soruldu. Bulgular öğretmenlerin 4 farklı yöntemle soru sorma alışkanlığını kazandıklarını ortaya çıkardı. Bunlar; diğer öğretmen arkadaşlarını izleyerek staj yaptıkları dönemde, soru sormanın önemini ve nasıl yapılacağını anlatan seminerlere katılarak ve diğer yöntemler (kendi derslerinin videolarını izleyerek, öğrencilik yıllarında kendi öğretmenlerinin soru sorma tekniklerini taklit ederek). Ayrıca çalışma gösterdi ki öğretmenler üniversite eğitimleri boyunca soru sorma yöntemini öğreten yeterli sayıda ve nitelikte ders alma imkânına sahip olmamışlardır.

Sonuç

Bu çalışmada öğretmenlere sordukları soruları ne kadar bilinçli sordukları, sordukları soruların rollerini bilip bilmediklerini ve kendi soru sorma yöntemlerini ne şekilde geliştirdikleri sorulmuştur. 4 öğretmenin de sordukları soruları bilinçli sorduklarını ortaya çıkmıştır. Bu çalışmada ayrıca öğretmenlerin tecrübeleri ile görüşme sorularına verdikleri cevaplar arasında bir ilişki olduğu gözlemlenmiştir. Tecrübeli bir öğretmen sınıf içinde iki öğrenciye soru sorarak yapması gerekenleri hakkıyla yaptığını ifade ederken yeni başlayan bir öğretmen 5-6 öğrenciye soru sormanın yeterli olmadığını ifade etmektedir. Bu sonuç: birinci öğretmenin bir iki öğrenci ile sınıfın tümünün resmini çekebildiği ya da bıkkınlıktan daha fazla soru sormadığı ikinci öğretmenin ise yeni olmasından dolayı daha idealist olduğu şeklinde yorumlanabilir. Diğer önemli bulgu ise niçin ve nasıl soruları arasındaki farkın ortaya çıkmasıdır. Öğretmenler *niçin* türü soruların daha fazla üst düzey düşünme becerileri ve bilgi gerektiren sorular olduğunu, *neden* türü soruların ise daha az bilgi ve daha az üst düzey düşünce becerileri gerektirdiğini ifade ettiler. Dolayısı ile öğrenciye *neden* türü soruların daha önce sorulması gerektiği sonucu ortaya çıkmıştır.

Öneriler

Bu çalışmanın önemli bir eksiği sadece öğretmenlerde mikrofon olması bu nedenle öğrencilerin verdikleri cevapların duyulamamasıdır. Bu nedenle ileride planlanan araştırmalarda, öğrencilerin sorulara verdikleri yanıtlar da araştırma kapsamına dâhil edilmelidir. Bu sayede öğretmen sorularının amacına ulaşıp ulaşmadığı görülebilir/anlaşılabilir.

Araştırma sonuçları göstermiştir ki soru sorma çok önemli bir teknik olmasına rağmen, bu tekniğin öğretmenler tarafından kazanılmasına yönelik yeterli olanak sunulmamaktadır. Öğretmenlerin soru sorma becerilerini geliştirmek için: (1) Öğretmen adaylarının staj yaptığı dönemlerdeki tecrübeleri daha

planlı kazanmaları sağlanabilir. Örneğin, öğretmen adayları staja başlamadan önce birkaç hususta bilinçlendirilip o konularda stajı boyunca gözlem ve tecrübe kazanmaları istenebilir. Ayrıca derslerine girecekleri öğretmenlerin soru sorma yöntemini nasıl, ne zaman ve ne çeşit soruları hangi durumlarda hangi öğrenciler için kullandığına dair bir rapor hazırlanması istenebilir. Bu öğrencinin staj dönemini çok daha verimli geçirmesini sağlayabilir. (2) Yanında çalışacağı öğretmenin iznini alarak o öğretmenin birkaç dersini videoya alıp sınıfta ya da bir grup meslektaşı ile beraber o öğretmenin bir ya da bir kaç saatlik öğretim tarzını eğitim yöntemleri acısından analiz edip iyi buldukları yönlerini içselleştirebilirler. (3) Öğretmen adaylarının seçtikleri eğitim ve öğretim metotları (mesela, öğretmenin soru sorma tekniği ya da grupla öğretme yöntemi) hakkında bir edebiyat taraması yapmaları ve bu çalışmadan çıkardıkları bulguları rapor etmeleri istenebilir. Bu ve benzer yöntemler öğretmen adaylarımızın gerçek sınıfa girip öğretmeye başlamadan önce iyi bir hazırlık dönemi geçirmelerine katkı sağlayacaktır.