Journal of Teacher Education and Educators
Öğretmen Eğitimi ve Eğitimcileri Dergisi
Volume/Cilt 1, Number/Sayı 2, 2012, 159-184

Introducing Questioning Techniques to Pre-service Teachers

Öğretmen Adaylarının Soru Sorma Teknikleri

Yan Zhang[1] and Patricia Patrick[2]

Abstract
The global world of today influences education systems, schools, and programs of teacher education. This paper focuses on the relative impact of global and local forces on the process of teacher education. Based on the work of Anderson-Levitt (2003) on global and local aspects of schooling we developed a hypothesized model of global aspects of teacher education. The paper is based on the analysis of studies on teacher education, official documents and mission statements of colleges, and teacher education programs. The paper concludes with a discussion of the various implications of the balance between global and local influences on teacher education. The global model of teacher education programs suggested in this paper provides an overall image of the nature of programs and might be used productively for the analysis of programs in other countries and cultures.

Keywords: Globalization, local influences, teacher education, scheme of analysis, uniformity, diversity

Öz
Bugünün küresel dünyası eğitim sistemlerini, okulları ve öğretmen eğitimi programlarını etkilemektedir. Bu makale ile küresel ve yerel güçlerin öğretmen eğitimi süreci üzerindeki göreceli etkisine odaklanılmıştır. Araştırmayla Anderson-Levitt'in (2003) okullaşmanın küresel ve yerel yönleri çalışmasına dayanarak öğretmen eğitiminin küresel yönlerinin kuramsal bir modeli geliştirilmiştir. Makale öğretmen eğitimi üzerine araştırmalara, kolejlerin resmi belgelerine ve görev ifadelerine ve öğretmen eğitimi programlarının analizine dayandırılmıştır. Makale öğretmen eğitimi üzerindeki küresel ve yerel etkiler arasındaki dengenin çeşitli manâlarının bir tartışması ile sonuçlandırılmıştır. Makalede önerilen öğretmen eğitimi programlarının küresel modeli programların doğasının genel bir imajını sunar ve diğer ülkelerdeki ve kültürlerdeki programların analizi için verimli bir şekilde kullanılabilir.

Anahtar Sözcükler: Küreselleşme, yerel etkiler, öğretmen eğitimi, analiz şeması, tektiplilik, çeşitlilik

Introduction

Teachers have been known to ask more than 300 hundred questions a day (Levin&Long, 1981) and half of their instructional time is spent on questioning (Cotton, 1988). Therefore, questioning may be identified as one of the most popular instructional strategies in the classroom (Ainscow, 2000). Even though questioning is a

[1] Yan Zhang : Splendora Early College High School, Texas: For correspondence; ronaldochang@hotmail.com

[2] Patricia Patrick: Texas Tech University; trish.patrick@ttu.edu

popular component of classroom discourse, pre-service teachers may leave the university without an extensive understanding of questioning. Prior to a university teaching practicum, pre-service teachers' experiences with teaching and questioning have been through their classroom encounters as a student (Lortie, 1975). These experiences were most likely traditional lecturing. Traditional lecturing is seen as a chalk and talk or filling the passive student with valuable information, but when questioning is incorporated correctly it can promote active participation rather than passive learning (Overholser, 1992). Moreover, employing high-quality questioning techniques can encourage students to no longer be passive listeners. When appropriately used, questioning strategies can inspire curiosity, stimulate interest, and intrinsically motivate students to seek new information (Caram&Davis, 2005). If teachers spend their instructional time asking high-quality questions, students will have an opportunity to actively participate in the learning process, engage in the lesson, explore their own questions, and develop higher order thinking skills. Therefore, one role of university professionals in pre-service teacher education programs is to emphasize the importance of quality questioning and to provide pre-service teachers with an opportunity to master a variety of questioning techniques.

Because proper questioning techniques are important for the classroom, this paper aims to synthesize previous research about questioning and suggest classroom activities for teacher educators that may improve pre-service teachers' questioning skills. This paper fulfills the following purposes: (1) Provide an overview of the literature in questioning techniques; and (2) Suggest practices that pre-service teachers should master in order to improve their questioning techniques.

Theoretical Framework/Contents

Social constructivism is the primary theoretical framework guiding this paper. Social constructivists believe social interaction, cultural tools, and activity shape individual development and learning (Resnick, 1991; Tudge&Scrimsher, 2003; Wertsch, 1991). Chin (2007) stated that in the classroom "knowledge was constructed through language and other semiotic means" (p. 816). If we take into consideration that much of this language takes place in the form of teachers asking questions (Levin & Long, 1981), then the teachers' questions are an essential part of classroom discourse. Teacher's questions represent the social constructivist concept of Scaffolding. Scaffolding refers to the assistance provided by more competent peers or adults (Wood, Bruner&Ross, 1976). Students do not explore the world in isolation. Therefore, student's learning may be facilitated by parents or teachers who are usually more knowledgeable (Vygotsky, 1978). During the classroom discourse, questions can be used as a psychological tool that mediates students' knowledge construction (Chin, 2007), triggers classroom interactions, and aids students in building content knowledge.

In 1978, Vygotsky made a major contribution to the social constructivist theory. Vyo-

gtsky (1978) added the Zone of Proximal Development (ZPD) and defined ZPD as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). Based on this theory, teacher's questions should be neither too easy nor too difficult and new knowledge should be built on student's prior knowledge. The teacher needs to know the current developmental level of a student so that the question asked is appropriate and is located in the student's ZPD. When students interact socially within their ZPD, students are more likely to discover new knowledge and bridge the new knowledge with prior knowledge (Schunk, 2007). In other words asking a confused student a higher cognitive question will not help the student with knowledge construction because the question is not in the student's ZPD. Asking an appropriate follow-up question is more likely to facilitate connections between previous knowledge and the current question. Feedback should enhance the questions teachers ask and the subject being studied and should be asked in such a way that it guides student learning. Moreover, feedback must direct attention to the intended learning, point out strengths and offer specific information for improvement, be timely and occur during the learning, address partial understanding, and limit the corrective information to advice the student can act on (Chappuis, 2009). Effective feedback is important because it is specifically related to achievement no matter the grade level, race, or socioeconomic status (Bellon, Bellon,&Blank, 1991). Vygotsky's ZPD theory and the social constructivist theory provide us with a lens through which we may identify the importance of follow-up questions and feedback.

A question is defined as an utterance that is posed in the form of an interrogation or has a grammatical form which seeks to find out some information about a student's knowledge or thinking (Chin, 2007). Socrates recognized the importance of questioning as early as the fifth century BC (Ellis, 1993; Harrop&Swinson, 2003; Overholser, 1992). When Socrates taught he did not answer students' questions by providing direct answers (Moore&Rudd, 2002), instead he posed further questions to place the responsibility of thinking on the students. This technique became known as the Socratic Method and required students to be active thinkers rather than passive listeners. The Socratic Method of questioning seldom requests factual information, but persuades and permits students to express their opinions and explore the rationale for their responses (Overholser, 1992). Questioning should challenge students to think critically and creatively (Ellis, 1993; Wilen, 1991), stimulate student participation, arouses student interest (Wilen, 1991), identify student abilities (Ellis, 1993; Wilen, 1991) and misconceptions, confirm students' understanding of the material being taught and allow students to apply new knowledge (Ross, 1860).

Even though the Socratic Method of questioning is a successful model and questioning is widely used in the classroom, the cognitive level and the purpose of ques-

tions teachers ask indicate that classroom teachers possess inadequate questioning techniques. There are three reasons why questioning by classroom teachers is failing to meet the rigor of the Socratic Method. First, the majority of the questions teachers ask in the classroom are lower level questions that emphasize rote memory and recall of factual information (Cunningham, 1987; Gall, 1984; Myhill&Dunkin, 2005; Wilen, 1991). A study conducted by Pate and Bremer (1967) revealed that most teachers regarded questioning as a means to check student understanding, diagnose misconceptions, and urge students to recall specific facts. Ten percent of the participants mentioned generalizing and making inferences. However, teachers' questions should go far beyond memorizing. Teachers should understand that authentic thoughts are stimulated by questions that require making inferences, drawing conclusions, and creating meaning (Elder&Paul, 1998).

Second, classroom discourse is considered to be transmissive (Myhill&Dunkin, 2005), because teachers provide the information and students are passive recipients. Traditionally, teachers' statements have been exploited for informing and instructing. For example, a typical interaction pattern in the classroom is question-response-judgmental feedback. The teacher asks a question, the student answers the question, and the teacher provides positive or negative feedback and the interaction is complete. Although researchers state that they encourage using "discussion" and "interaction" during teaching activities, the teacher still dominates classroom discourse (Kawanaka&Stigler, 1999; Wilen, 1991). Teacher-centered classrooms do not promote active student involvement, because students are busy memorizing and receiving information through listening. In the question-response-judgmental feedback classroom, students rarely have an opportunity to develop their own understanding by teacher/student, student/student, or student/technology interactions.

Third, students' responses to questions do not always correspond with the level of questioning, i.e. higher-level questions may not promote higher-level answers. Studies conducted by Dillon (1982) and Mills, Rice, Berliner, and Rousseau (1980) examined the correspondence between the cognitive level of teachers' questions and the level of students' responses in elementary, junior high, and secondary classrooms. These two studies found similar results in that higher-level questions produced higher-level responses only about half of the time. The findings of these two studies indicate that even if teachers' employ higher-level questioning there is no guarantee that higher-level thinking will occur. However, the problem may not be that higher-level thinking questions are being employed. The issue may be that the students do not understand the questions (Adams, 1974; Winne&Marx, 1980). If the question goes beyond a student's intellectual capability or comprehension, the teacher must provide follow-up questions that redirect the student's thinking and afford the student time to reflect. Questioning should present students with intellectual obstacles, but at the same time should be within the students' ZPD (Vygotsky, 1978).

A positive classroom climate encourages and motivates students to answer questions. When students do not want to answer questions there are two major reasons why: (1) the student does not know the answer and/or (2) the student is not confident in his/her answer and seeks to avoid making mistakes in front of the class. If confidence is the issue, a positive classroom environment may give students the confidence they need to express their thoughts. In a positive classroom climate the teacher and students are mutually respectful and encourage others to respond and students feel safe and non-threatened (Gallagher, 1985; Letzter, 1982; Strasser, 1967). If students feel safe in responding and know that other students will not make fun of their incorrect answers, students will be more willing to share their thoughts.

Positive classroom environments are encouraged when teachers maintain eye contact with students (Goodwin et al., 1983) and provide non-judgmental feedback (Ellis, 1993). If the purpose of a question is to develop higher-order thinking skills that require long, thoughtful answers, the teacher should not interrupt and should not provide immediate feedback. During classroom discourse the teacher's evaluation usually indicates the end of a conversation. Teachers should wait until the student finishes the answer and then pose further questions if required. If a student appears defensive while answering a follow-up question, a positive classroom climate has not been established (Shaunessy, 2000).

When follow-up questions are used in the classroom, teachers may "catch the meaning of student's prior utterance and throw responsibility for thinking back to the student" (Chin, 2007, p.818). Schleppenbach, Perry, Miller, Sims, and Fang (2007) sorted follow-up questions into six categories based on purpose: (1) request for computation, (2) request for procedure or method, (3) request for reasoning, (4) request for rule or term recall, (5) check for student understanding or agreement, and (6) request for short answer (Table 1). Because students are expected to explain, explore, and debate their points of view (Scott, 1998), teachers need to ask more follow-up questions based on reasoning instead of on memory recall. To establish the result of asking follow-up questions, a study comparing Third International Mathematics and Science Study (TIMSS) videos (1999) of mathematics classrooms across five countries was conducted (Zhang&Matteson, 2012). The results determined that teachers from low-performing countries such as the Czech Republic and the United States of America asked more follow-up questions than teachers from high-performing countries such as Australia, Japan, and Hong Kong. However, the purpose of the follow-up questions varied in nature. Teachers from high-performing countries asked more follow-up questions that focused on reasoning skills and teachers from low-performing countries paid more attention to computation, procedures, and rule/term recall. The purpose of teachers posing follow-up questions should be to build a bridge between students' actual developmental level and their potential development level. Therefore, lower level questions cannot dominate classroom discourse.

Table 1. Schleppenbach et al.'s (2007) six types of follow-up questions

Type of Follow-up Question	Example/Description
Request for computation	What is 9 minus 3?
Request for procedure or method	How do you get 1/3 from 3/9?
Request for reasoning	Why did you multiply by 5? What did you notice about those three numbers? What happens when you multiply the numerator and denominator by the same number?
Request for rule or term recall	How do you find the area of a rectangle?
Check for student understanding and/or agreement	Do you agree? Do you understand?
Request for short answer	Is this correct?

Saunders, Gall, Nielson, and Smith (1975) found that pre-service teachers who engaged in regular microteaching and peer microteaching produced more consistent and substantial gains in the use of questioning skills than pre-service teachers who received observation and lecture-discussion treatments. In the regular microteaching group, pre-service teachers taught a 20-minute lesson to four junior high school students. In the peer microteaching group, pre-service teachers taught a 15-minute lesson to their peers who were role-playing junior high school students. Pre-service teachers in the observation group watched instructional and modeling tapes in the college class and made two trips per week to observe middle school classes. In the lecture-discussion group, pre-service teachers were taught by lectures using various levels of questions. Microteaching provided an opportunity for pre-service teachers to practice questioning skills to a few students in a scaled down lesson. Pre-service teachers in the microteaching groups asked more questions at a higher cognitive level than those in the observation and lecture-discussion groups. The length of students' responses was also longer in the microteaching groups.

To build effective interactions between pre-service teachers and their students, Nicol (1999) adopted a pedagogy of investigation in her pre-service teacher training course. A pedagogy of investigation "shifts the emphasis of learning to teach from a focus on only limiting instruction to the best teaching methods and techniques to an emphasis on discussion, critique, and investigation of pedagogical problems as they might arise in the context of practice" (p. 47). She implemented two alternative methods, video-analysis and self-reflection, that emphasized the investigation of classroom practice. After implementing video-analysis and self-reflection, she discovered that pre-service teachers' questioning skills improved. By watching videos of their teaching, pre-service teachers noticed the discrepancy in their beliefs and actions. Moreover, video-analysis provided a second chance for pre-service teachers to analyze stu-

dents' answers, assess students' understanding, and examine and scrutinize their own responses. As the program progressed, pre-service teachers' interactions with students improved as well as pre-service teachers' questioning, listening, and responding skills. Due to their video-analysis and self-reflection pre-service teachers created a learning environment that developed students' knowledge, promoted pre-service teacher/student interactions, and actively engaged students in mathematical inquiry.

In 2002 Moyer and Milewicz (2002) attempted to improve the interactions between pre-service teachers and students by providing the pre-service teachers with an opportunity to conduct clinical interviews. The clinical interviews were meant to cultivate pre-service teachers' skills in follow-up questioning and enhance their ability to reflect on their own questioning behaviors. Pre-service teachers followed a protocol to administer clinical interviews to elementary students on the topic of rational numbers. After the interviews, pre-service teachers analyzed the audio-taped interviews and reflected on their questioning behaviors. The results revealed that some pre-service teachers tended to lecture during the interview and did not interact with students by asking appropriate follow-up questions. In this study, the clinical interview combined with self-reflection was successful in demonstrating to pre-service teachers how they actually interact with students.

Korkmaz and Yesil (2010) developed an alternative method to improve Turkish pre-service social studies teachers' questioning techniques. Turkish pre-service teachers were divided into three groups. The first group of pre-service teachers prepared questions prior to class and the instructor taught the class by answering the pre-service teachers' questions. The second group did not prepare their own questions and received instruction based on the professor's questions. This group was taught in a traditional manner in which the instructor led the discussion. The third group was taught by using a blend of the pre-service teachers' questions and the professor's questions. Results indicated that when pre-service teachers' questions were incorporated into the lesson, the pre-service teachers' abilities to ask higher-level, quality questions increased. Korkmaz and Yesil (2010) study informs university and classroom educators that questioning skills can be improved by daily instructional activities.

The studies discussed in the literature review incorporated only one or two aspects of questioning skills or practices. For teacher education programs to successfully prepare pre-service teachers to be classroom teachers, who incorporate high-level questioning, university professionals should be aware of the connections between questioning theory and practice. Therefore, the next section of this paper describes questioning techniques and suggests activities for use in teacher education programs.

Most K-12 teachers are familiar with Bloom's Taxonomy as a scaffold for questioning, but few have had substantive training in their teacher education courses that included effective questioning based on Bloom's Taxonomy (Hannel, 2009). Being aware of Bloom's Taxonomy is not enough to persuade classroom teachers to design

questions based on the six levels within the cognitive domain. Moreover, pre-service elementary mathematics teachers struggle when listening to and responding to students (Nicol, 1999). Therefore, today's pre-service teacher education courses cannot focus solely on posing questions. Teacher educators must pay equal attention to questioning skills with regard to posing, listening, and responding to students. Because posing questions without listening and responding to students does not build a constructive discussion, teachers must listen to students, make sense of students' answers and questions, and identify students' understanding of the questions posed in order to provide constructive feedback or ask constructive follow-up questions. Questioning should be a two-way interaction between teachers/students and students/students. The following section defines six questioning techniques and outlines suggestions for pre-service teacher training activities that may increase pre-service teachers' abilities to engage students in higher-level questioning. The questioning techniques and the pre-service teacher training activities for university educators suggested in the next section may be reviewed in Table 2.

Table 2. Questioning techniques and related training activity

Technique	Theorists/Researcher	Pre-service Teacher Activity
Classification of question levels	Bloom et al. (1956) • Knowledge, Comprehension, Application, Analysis, Evaluation, Synthesis Sanders' taxonomy (1966) • Memory, Translation, Interpretation, Application, Analysis, Synthesis, Evaluation Cunningham's classification (1987) • Factual recall, Low/High convergent, Low/High divergent	• categorize written questions into different levels • categorize TIMSS video questions • generate questions at each level for TIMSS video
The phrasing of questions	Ellis (1993) • avoid "yes/no" questions • avoid ambiguous questions • question itself should not reveal the answer	• critique questions from the activity and TIMSS videos • generate new questions for TIMSS video • work in pairs to review the questions for each other and provide feedback to partners
Order of questions	Rodriquez & Kies (1998) • students think logically Vygotsky (1978) and Wrath & Brown (2001) • logical order of questioning Penick, et al. (1996) • history • relationship • application • speculation • explanation	• organize a list of questions that are in random order to a logical order. • specify the purpose of each question and tell the reason for such an order

Bloom's Taxonomy, Sanders' Taxonomy, and Cunningham's Five Levels of Questions provide teacher educators with examples of levels of questioning. Bloom's Taxonomy (Bloom et al., 1956) is the most popular and has been used to categorize questions into hierarchical cognitive levels. Bloom's Taxonomy divides learning objectives into three domains: cognitive, affective, and psychomotor. The cognitive domain includes six hierarchical categories: knowledge, comprehension, application, analysis, synthesis, and evaluation. Knowledge is the lowest cognitive level and evaluation is considered the most complex. Each category of the cognitive domain is associated with specific verbs, which may be used to phrase learning objectives and questions. Sanders' Taxonomy (1966) divides cognition into seven hierarchical categories: memory, translation, interpretation, application, analysis, synthesis, and evaluation. Bloom's and Sanders' Taxonomies are based on the verbs that describe learning objectives and have been criticized for being too narrow to allow for an accurate measurement of each level (Riegle, 1976). Moreover, Gall (1970) claimed that "a weakness of the cognitive-process approach to question classification is that these processes are inferential constructs" (p.710) that cannot be directly observed.

Because of deficiencies in Bloom's and Sanders' Taxonomies mentioned above, we propose Cunningham's Five Levels of Questions (1987) as a better choice for observable and measureable categorizing of questions (Table 3). The lowest level of questioning emphasizes rote memory and the answer to the question is predictable. The middle level of questioning is convergent and is divided into low and high levels. Low-convergent questions require students to put facts together and construct a response using comparing, contrasting, generalizing, transferring form, or explaining. High-convergent questions require students to look for evidence to support the answer, give reasons for behaviors or outcomes, and draw conclusions. However, teachers also look for specific answers at this level. The highest level is composed of divergent questions that and are divided into low and high levels. Divergent questions are usually open-ended. Low-divergent questions require students to find alternative solutions. High-divergent questions promote creative thinking.

Table 3. Cunningham's five levels of questions

Question level	Characteristics	Example question
1. Factual recall question	Emphasizes rote memory instead of thinking skills.	What is natural number?
2. Low-convergent question	Requires students to put facts together and construct a response using comparing, contrasting, generalizing, transferring form, or explaining.	What are the similarities between natural number and integers?
3. High-convergent question	Requires students to look for evidence to support answer, give reasons for behaviors or outcomes, and draw conclusions.	How do you control the variables in this experiment?
4. Low-divergent question	Requires students to find alternative solutions.	How can we use square tiles to build a different rectangle with the same perimeter?
5. High-divergent question	Promotes creative thinking.	How can we build the largest house with limited materials?

To support pre-service teachers in promoting classroom interactions through higher-level questioning, pre-service teachers should be aware of the types of questions that encourage higher level thinking. Pre-service teachers should be able to identify and classify questions according to their cognitive purposes such as lower level knowledge questions and higher-level evaluation questions. We introduced and provided examples of the Taxonomies discussed above and asked the pre-service teachers to confer in groups about which Taxonomy they preferred or thought was the most useful and why. After the discussion we used Cunningham's Five Levels of Questions to facilitate an activity in which pre-service teachers sorted 30 questions into factual, convergent, and divergent.

Once the pre-service teachers were comfortable with Cunningham's Taxonomy, we asked them to watch a TIMSS video and provided them with the video transcript (TIMMSVIDEO,1999). The pre-service teachers were asked to organize the questions from the video into Cunningham's Five Levels of Questions and expose any strengths and/or weaknesses in the teachers' questioning. When pre-service teachers were able to identify factual recall, convergent, and divergent questions, they generated questions (at the five levels) that could have been used by the teacher in the video. Note: We asked students to view TIMSS videos, but these are not the only useful videos. Other video clips may be captured by the professor, taken from YouTube.com, or found at Annenberg Learner (www.learner.org).

Pre-service teachers need to be aware that questions have different purposes and that there are three suggestions for phrasing successful questions (Ellis, 1993). First,

if a question requires higher order thinking skills, "yes/no" questions should be avoided. Yes/no questions do not cultivate or advance student's reasoning skills. Second, ambiguous questions should be avoided. Vague, unclear questions frustrate students because the questions are confusing. Being a comprehensible question that is easily understood by students is a basic requirement of a good question. Therefore, the leading questions teachers employ in the classroom to initiate discussions should be well-planned prior to class. Third, the questions should not reveal the answer. For example, a question such as "Should we find the greatest common factors or the least common multiples for…?" reveals too much information. Students will randomly choose an answer. A simple way to avoid this mistake is to start a question with "How" or "What". For example, if students are required to find the least common multiple, the teacher might ask "How can we find the smallest number that is divisible by 2 and 5?" or "What is the smallest number that is divisible by 2 and 5?"

Pre-service teachers need to be aware that the way a question is phrased is an important questioning technique. A well-phrased question transfers the teacher's purpose for a question to the students in an efficient, transparent manner. Using the 30 questions from the TIMSS videos that were sorted according to Cunningham's (1987) Five Levels of Questions and the questions written for the previous activity, the pre-service teachers worked in groups to establish whether or not these questions were well-phrased, efficient, and provided a transparent look at what was being asked . Not only did the pre-service teachers make conclusions about the phrasing of the questions they also explained their criticisms. Pre-service teachers were then directed to adjust the questions they composed in the previous activity taking into account their knowledge of phrasing. The student groups exchanged their written questions for a peer-review, which was followed up with a class discussion. This allowed pre-service teachers to check their peers' work, express differences of opinion, and provide constructive feedback. Peer-reviews and class discussions allowed the pre-service teachers to give and receive feedback and offered them an opportunity to hear various viewpoints.

Questions should be organized in a logical order and build upon the previous question (Vygotsky, 1978; Wragg & Brown, 2001). If teachers focus on the logical capacities of students' minds, learning is easier for students (Rodriguez&Kies, 1998) and students do not get lost before trying to answer. To aid teachers in developing a valid questioning sequence Penick, Crow, and Bonnstetter (1996) developed the HRASE system. The essence of the system is that teachers construct new knowledge based on students' prior knowledge and misconceptions. When teachers know their students and identify misconceptions, they are more likely to scaffold new knowledge on a solid foundation. HRASE is hierarchical, but focuses on the sequence of questions instead of verb usage. History: Questions relate to students' experience (e.g. How did you solve that problem?). Relationship: Questions engage students in comparing concepts such as ideas, activities, and data (e.g. Where have you seen something like

this before?). Application: Questions require students to use knowledge in new contexts (e.g. How could you use that to…?). Speculation: Questions require thinking beyond given information (e.g. What do you think would happen if…?). Explanation: Questions require underlying reasons, processes, and mechanisms (e.g. How does that work?).

This activity provided a guideline for pre-service teachers to organize their questions in advance. Pre-service teachers were given a list of questions in a random order and asked to sequence them based on the HRASE and present their reason(s). After practicing with a list of questions pre-service teachers referred to the TIMSS video and discussed the sequence of questions used by the TIMSS teacher.

Wait time refers to the time a teacher allows for a student to respond (Tama, 1989). Students need at least three seconds to comprehend a question, consider the available information, formulate an answer, and begin to respond (Dyer, 2008). English language learners may need even longer to translate back and forth (Mohr&Mohr, 2007). However, some teachers allow one second or less for students to respond before providing the answer or moving on to someone else (Rowe, 1986). Thinking takes time, especially high-order thinking. If a student needs to recall information from memory, (s)he may be able to call out an answer within one second. However, when teachers pose questions requiring reasoning skills, students are not able to offer immediate responses. When wait time increases to five seconds the length of students' responses, student-to-student interactions, and students' response questions increase (Rowe,1986). Although appropriate wait time should be longer than three seconds, too much wait-time will not facilitate students' problem-solving ability. Too much wait time can actually be viewed as a punishment and destroy learning interactions (Goodwin, et al., 1983). Therefore, it is important for teachers to adjust the length of wait time so that the learning interaction will not be interrupted.

Pre-service teachers watched two TIMSS videos. For each question in the video the pre-service teachers recorded the teachers' wait time, the students' facial expressions and ability to answer the question, and the level of questioning. Although it is not a skill that pre-service teachers can master immediately, by watching the TIMSS videos and analyzing the teacher/student and student/student interactions pre-service teachers may become more aware of wait time and its educational benefits.

As previously stated in the theoretical framework student knowledge is constructed through classroom interactions. Teachers should extend classroom discourse by including nonjudgmental feedback. In order to provide useful feedback teachers should incorporate the Initiation-Response-Feedback (IRF) model (Mortimer&Scott, 2003). The IRF model provides more interactions between the teacher and students and the teacher's feedback is no longer a signal that the discussion has ended. Instead, the IRF encourages further discourse.

Chin (2006) sorted a teacher's feedback based on whether or not the student's an-

swer was correct or incorrect (Table 4). When a student's answer is correct, a teacher either shows affirmation and continues direct instruction or extends the questioning with responsive questions. If a student answers incorrectly, a teacher either makes an explicit correction or challenges the student by asking another question. According to the IRF model, the second and fourth types of feedback promote more interactions and teachers should be encouraged to take advantage of these feedback techniques. The first and third types of feedback relate to direct instruction in which the teacher dominates the classroom. Making pre-service teachers aware of the IRF and Chin's types of feedback will provide them with applicable information and an opportunity to develop their reflection skills.

Table 4. Chin's (2006) four types of feedback

Type of feedback	Nature of student's response	Description
1. Affirmation-Direct instruction	Correct	Affirm and reinforce response followed by further exposition and direct instruction
2. Extension by responsive questioning: Focusing and Zooming	Mixture of correct and incorrect	Accept response followed by a series of related questions that build on previous ones to probe or extend conceptual thinking
3. Explicit correction-Direct instruction	Incorrect	Explicit correction followed by further expounding of the normative ideas
4. Constructive challenge	Incorrect	Evaluative or neutral comment followed by reformulation of the question or challenge via another question

We begin this exercise by asking pre-service teachers to identify Chin's types of feedback in a TIMSS video. Pre-service teachers are asked to fold a piece of paper in half lengthwise and collect data from the video by writing the teacher's feedback on one half of the paper and the student's response on the other half of the paper. On another sheet of paper pre-service teachers make a chart using Chin's types of feedback and fill in examples from their data.

Once pre-service teachers have an idea of the function of feedback and how feedback relates to questioning, they are asked to individually solve a mathematical problem. The pre-service teachers are grouped into pairs and asked to interview each other about how they solved the problem. The clinical interview is videotaped and the pre-service teachers are asked to view the video and analyze the interview by applying the method described above. Based on Chin's classification pre-service teachers should incorporate the second and fourth types of feedback. Therefore, if the pre-service teachers identify numerous attempts at directed feedback, they should reflect on how to improve their questioning skills.

Using Follow-up Questions

Schleppenbach, et al. (2007) classified follow-up questions into six types according to different purposes in the mathematics classroom (Table 1). Because students are expected to have strong logical thinking and communication skills, follow-up questions should not be restricted to procedure or rule/term recall questions. Follow-up questions extend classroom interactions, explore students' thinking, facilitate the thinking process, encourage students to express their thinking process, and provide an opportunity to identify students' inability to understand the question (Adams, 1974).

We began this exercise by giving pre-service teachers questions and asking them to divide the questions into Schleppenbach et al.'s (2007) types of follow-up questions. Once the pre-service teachers were able to identify the six types of follow up questions, we asked them to watch a TIMSS video and identify the types of follow-up questions being used. As a follow up exercise, we asked students to watch the video they made for the Providing Feedback activity (described above) and label their follow-up questions based on Schleppenbach et al.'s (2007) types of follow up questions.

Conclusion

Teachers' questions should promote active participation and delve deeper into students' thinking rather than seek factual information. However, lower level questions still dominate the classroom (Cunningham, 1987; Gall, 1984; Myhill&Dunkin, 2005; Wilen, 1991) and students are passive recipients (Myhill&Dunkin, 2005). Pre-service teachers have difficulty in posing questions and listening and responding to students (Nicol, 1999). Therefore, teacher education program should not only focus on the initial cognitive level of the question, but also the use of feedback and follow-up questions.

This paper discusses six questioning techniques and activities that are based on a literature review. The literature review indicates that teacher education courses should teach pre-service teachers how to promote classroom discourse and the classification of question levels, phrase of questions, order of questions, wait time, feedback, and follow-up questions. Moreover, by the end of a teacher education course the pre-service teachers should understand how to: (1) differentiate and ask factual recall, convergent, and divergent questions for varied purposes, (2) phrase questions, (3) organize questions in a logical order, (4) provide appropriate wait time for student's thinking, (5) build a positive classroom environment that encourages and motivates student's participation, (6) provide constructive feedbacks that facilitate classroom interaction, (7) ask follow-up questions focusing on student's reasoning skills, and (8) apply various questioning techniques while teaching a mini-lesson.

To achieve these learning objectives teacher education programs should define and explain the purpose of questioning and incorporate theory and application. Teacher educators should define and demonstrate good questioning techniques through their

own lecturing. When teacher educators model good questioning techniques they present the pre-service teachers with a lens through which the pre-service teacher views good classroom practice. This lens allows the pre-service teachers to observe the bridge between theories and real classroom application. Teacher educators must allow pre-service teachers to practice applying what they have learned through the activities suggested in this article and through microteaching. Microteaching offers the teacher educator and the pre-service teacher's peers an opportunity to provide the pre-service teachers with feedback about their questioning skills. When pre-service teachers receive feedback they are more aware of their lack of proficiency in questioning techniques and begin to develop their skills.

Although educators are aware of the importance of questioning techniques, these techniques may not be systematically and comprehensively introduced in teacher preparation program. This paper is offered as a resource for those teacher educators who plan to offer a course regarding questioning techniques. We are not saying that the six questioning skills introduced in this paper are the only questioning techniques, but they are important for pre-service teachers as they develop their classroom skills. The questioning techniques should be considered a foundation for teacher education courses that allow for practice and application of the theories and technique. Moreover, we are not suggesting that these techniques be discussed and forgotten.

The techniques and activities should be spread over a semester, because questioning is a skill that requires repeated practice and reflection. Moreover, these techniques should be extended into the pre-service teachers' student teaching experience. Through repeated practice, regular self-reflection and receiving frequent feedback questioning techniques may be improved.

Summary

Teachers ask more than 300 hundred questions a day (Levin&Long, 1981) and half of their instructional time is spent on questioning (Cotton, 1988). Therefore, questioning may be identified as one of the most popular instructional strategies in the classroom (Ainscow, 2000). Prior to a university teaching practicum, pre-service teachers' experiences with teaching and questioning occur during their classroom encounters as a student (Lortie, 1975) and are most likely traditional lecturing. When questioning is incorporated correctly it can promote active participation rather than passive learning (Overholser, 1992), inspire curiosity, stimulate interest, and intrinsically motivate students to seek new information (Caram&Davis, 2005). Socrates recognized the importance of questioning as early as the fifth century BC (Ellis, 1993; Harrop&Swinson, 2003; Overholser, 1992) and placed the responsibility of thinking on the students (Moore&Rudd, 2002; Scott, 1998). This paper: (1) Provides an overview of the literature in questioning techniques; and (2) Suggests practices that pre-service teachers should master in order to improve their questioning techniques.

According to the social constructivism theory social interaction, cultural tools, and activity shape individual development and learning (Resnick, 1991; Tudge&Scrimsher, 2003; Wertsch, 1991). Chin (2007) stated that in the classroom "knowledge was constructed through language and other semiotic means" (p. 816). If we take into consideration that much of this language takes place in the form of teachers asking questions (Levin&Long, 1981), then the teachers' questions are an essential part of classroom discourse. Teacher's questions represent the social constructivist concept of *Scaffolding.* Scaffolding refers to the assistance provided by more competent peers or adults (Wood, Bruner,&Ross, 1976). In 1978, Vyogtsky added the Zone of Proximal Development (ZPD) and defined ZPD as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (p. 86). Based on this theory, questions should be neither too easy nor too difficult and new knowledge should be built on student's prior knowledge (Schunk, 2007). Asking an appropriate follow-up question and providing good feedback is more likely to facilitate connections between previous knowledge and the current question (Bellon, Bellon,&Blank, 1991; Chappuis, 2009).

There are four reasons why questioning by classroom teachers is failing to meet the rigor of the Socratic Method. First, the majority of the questions teachers ask in the classroom are lower level questions that emphasize rote memory and recall of factual information (Cunningham, 1987; Gall, 1984; Myhill&Dunkin, 2005; Pate & Bremer, 1967; Wilen, 1991), but questions should require making inferences, drawing conclusions, and creating meaning (Elder & Paul, 1998). However, this varies among countries (Zhang&Matteson, 2012). Second, classroom discourse is considered to be transmissive (Myhill&Dunkin, 2005), because teachers provide the information and students are passive recipients. Although researchers state that they encourage using "discussion" and "interaction" during teaching activities, the teacher still dominates classroom discourse (Kawanaka&Stigler, 1999; Wilen, 1991; Ross, 1860). Third, students' responses to questions do not always correspond with the level of questioning, i.e. higher-level questions may not promote higher-level answers (Adams, 1974; Dillon, 1982; Mills et al., 1980; Winne&Marx, 1980). Fourth, a positive classroom environment may give students the confidence they need to express their thoughts (Shaunessy, 2000). In a positive classroom climate the teacher and students are mutually respectful, encourage others to respond and feel safe (Gallagher, 1985; Letzter, 1982; Strasser, 1967). Positive classroom environments are encouraged when teachers maintain eye contact with students (Goodwin et al., 1983) and provide non-judgmental feedback (Ellis, 1993).

Several studies addressed the questioning skills of pre-service teachers. Saunders, Gall, Nielson, and Smith (1975) found that pre-service teachers who engaged in regular microteaching and peer microteaching produced more consistent and substantial

gains in the use of questioning skills than pre-service teachers who received observation and lecture-discussion treatments. Nicol (1999) asked students to watch videos of their teaching and complete a self-reflection. After the video analysis and self-analysis pre-service teachers noticed the discrepancy in their beliefs and actions and their interactions with students improved. Moyer and Milewicz (2002) asked students to conduct clinical interviews, listen to the taped interview, and reflect on their questioning skills. The results revealed that some pre-service teachers tended to lecture during the interview and did not interact with students by asking appropriate follow-up questions. Korkmaz and Yesil (2010) divided pre-service teachers into three groups: group one prepared their own questions prior to class and the instructor taught the class by answering the questions, group two was not allowed to provide questions, and group three was taught using the pre-service teachers' questions and the professors questions. When pre-service teachers' questions were incorporated into the lesson, the pre-service teachers' abilities to ask higher-level, quality questions increased.

In order to aid pre-service teachers in identifying and formulating good questions, we address the research in questioning and provide practice activities. The activities presented below may be used by university professionals who teach pre-service teacher training courses and want to develop good questioning skills.

Bloom's Taxonomy (Bloom et al., 1956; Hannel, 2009) divides learning objectives into three domains: cognitive, affective, and psychomotor. The cognitive domain includes six hierarchical categories: knowledge, comprehension, application, analysis, synthesis, and evaluation. Sanders' (1966) Taxonomy divides cognition into seven hierarchical categories: memory, translation, interpretation, application, analysis, synthesis, and evaluation. These Taxonomies are based on the verbs that describe learning objectives and have been criticized for being too narrow to allow for an accurate measurement of each level (Riegle, 1976; Gall, 1970). Therefore, we propose Cunningham's Five Levels of Questions (1987). The lowest level of questioning emphasizes rote memory and the answer to the question is predictable. The middle level of questioning is convergent and is divided into low and high levels. Low-convergent questions require students to put facts together and construct a response using comparing, contrasting, generalizing, transferring form, or explaining. High-convergent questions require students to look for evidence to support the answer, give reasons for behaviors or outcomes, and draw conclusions.

To support pre-service teachers in promoting classroom interactions through higher-level questioning, we introduced and provided examples of the Taxonomies discussed above and asked the pre-service teachers to confer in groups about which Taxonomy they preferred or thought was most useful and why. After the discussion we asked pre-service teachers to sort 30 questions into factual, convergent, and divergent based on Cunningham's Five Levels of Questions. Pre-service teachers need to be aware that questions have different purposes and that there are three suggestions for

phrasing successful questions (Ellis, 1993). Using the Five Levels of Questions the pre-service teachers worked in groups to establish whether or not the questions were well-phrased, efficient, and provided a transparent look at what is being asked.

If teachers focus on the logical capacities of students' minds, learning is easier for students (Rodriguez&Kies, 1998; Wragg&Brown, 2001) and students do not get lost before trying to answer. To aid teachers in developing a valid questioning sequence, Penick, Crow, and Bonnstetter (1996) developed the HRASE system: History: Questions relate to students' experience (e.g. How did you solve that problem?). Relationship: Questions engage students in comparing concepts such as ideas, activities, and data (e.g. Where have you seen something like this before?). Application: Questions require students to use knowledge in new contexts (e.g. How could you use that to…?). Speculation: Questions require thinking beyond given information (e.g. What do you think would happen if…?). Explanation: Questions require underlying reasons, processes, and mechanisms (e.g. How does that work?). Pre-service teachers were given a list of questions in a random order and asked to sequence them in order based on the HRASE and present their reason. After practicing with a list of questions, pre-service teachers sequenced the questions in a Third International Mathematics and Science Study (TIMSS) video.

Wait time refers to the time a teacher allows for a student to respond (Tama, 1989). Students need at least three seconds to comprehend a question, consider the available information, formulate an answer, and begin to respond (Dyer, 2008). English language learners may need even longer to translate back and forth (Mohr&Mohr, 2007). Thinking takes time, especially high-order thinking. When wait time increases to five seconds the length of students' responses, student-to-student interactions, and students' response questions increase (Rowe, 1986). Although appropriate wait time should be longer than three seconds, too much wait-time will not facilitate students' problem-solving ability and may be viewed as a punishment and destroy learning interactions (Goodwin, et al., 1983). Pre-service teachers watched two TIMSS videos and recorded the teachers' wait time, students' ability to answer the question, and the level of questioning.

In order to provide useful feedback, teachers should incorporate the Initiation-Response-Feedback (IRF) model (Mortimer&Scott, 2003). The IRF model provides more interactions between the teacher and students and the teacher's feedback is no longer a signal that the discussion has ended. When a student's answer is correct, a teacher either shows affirmation and continues direct instruction or extends the questioning with responsive questions. If a student answers incorrectly, a teacher either makes an explicit correction or challenges the student by asking another question. Pre-service teachers were asked to identify types of feedback in a TIMSS video. Pre-service teachers were asked to fold a piece of paper in half lengthwise and collect data from the video by writing the teacher's feedback on one half of the paper and the

student's response on the other half of the paper. On another sheet of paper pre-service teachers make a chart using Chin's types of feedback and fill in examples from their data.

Schleppenbach, Perry, Miller, Sims, and Fang, (2007) classify follow-up questions into six types. Follow-up questions should extend classroom interactions, explore students' thinking, facilitate the thinking process, encourage students to express their thinking process, and provide an opportunity to identify students' inability to understand the question (Adams, 1974). We provided the pre-service teachers with questions and asked them to divide the questions into Schleppenbach et al.'s (2007) types of follow-up questions.

Although educators are aware of the importance of questioning techniques, these techniques may not be systematically and comprehensively introduced in teacher preparation program. This paper is offered as a resource for those teacher educators who plan to offer a course regarding questioning techniques.

Özet

Giriş

Öğretmenler öğrencilerine bir günde 300'den fazla soru sormaktadır (Levin&Long, 1981) ve ders sürelerinin yarısı soru sormakla geçmektedir (Cotton, 1988). Bu yüzden, soru sorma sınıf içinde kullanılan en yaygın öğretim stratejilerinden biri olarak kabul edilir (Ainscow, 2000). Öğretmen adayları öğretmenlik ve soru sormayla ilgili ilk tecrübelerini öğrencilik yıllarında yaşarlar (Lortie, 1975) ve aldıkları eğitimde genellikle geleneksel ders anlatım tekniklerinin kullanıldığını görürler. Soru sorma, doğru bir şekilde kullanıldığında pasif öğrenmenin aksine etkin katılımı sağlayabilir (Overholser, 1992), merakı kuvvetlendirebilir, ilgiyi artırabilir ve aslında öğrencileri yeni bilgiler aramaya sevk edebilir (Caram&Davis, 2005). Sokrates soru sormanın önemini MÖ 5. yüzyıl gibi erken bir zamanda fark etmiştir (Ellis, 1993; Harrop&Swinson, 2003; Overholser, 1992) ve düşünmenin sorumluluğunu öğrencilere aşılamıştır (Moore&Rudd, 2002; Scott, 1998). Bu makale (1) soru sorma teknikleri üzerine bir alan yazın incelemesi sağlamakta ve (2) öğretmen adaylarının soru sorma tekniklerini geliştirmeleri için uygulamalar önermektedir.

Kuramsal Çerçeve

Sosyal yapılandırmacılık kuramına göre sosyal etkileşim, kültürel araçlar ve etkinlik kişinin gelişimini ve öğrenmesini şekillendirmektedir (Resnick, 1991; Tudge&Scrimsher, 2003; Wertsch, 1991). Chin'e (2007) göre: "Sınıf içinde bilgi, dil ve diğer gösterge bilimsel araçlar tarafından yapılandırılır." (s. 816). Bu durum göz önünde bulundurulursa dilin çoğu öğretmenin vazgeçilmez iletişim aracı olduğu söylenebilir ve bu iletişim aracını kullanırken öğretmenler bilgiyi yapılandırmaları için

öğrencilerine çoğunlukla soru sormaktadır (Levin&Long, 1981). Dolayısıyla öğretmenlerin sorduğu sorular sınıf içi söylemlerinin önemli bir parçasını oluşturmaktadır. Öğretmenlerin sordukları sorular sosyal yapılandırma kavramı olan İskele Yapısına benzemektedir. İskele yapısı, yetkin, akran ya da yetişkin tarafından sağlanan destek anlamına gelmektedir (Wood, Bruner,&Ross, 1976). 1978'de Vygotsky, Yakınsak Gelişim Alanı *(ZPD)* kavramını ortaya atmış ve "çocuğun bağımsız problem çözme beceri düzeyi ile yetişkin rehberliği veya akranlarıyla iş birliği yaparak problem çözme beceri düzeyi arasındaki fark" olarak tanımlamıştır (s. 86). Bu kurama dayanarak öğretmenlerin öğrencilerine soracakları soruların ne çok kolay ne de çok zor olması gerektiği söylenebilir. Ayrıca yeni bilgi öğrencinin daha önceki bilgilerinin üzerine inşa edilmelidir (Schunk, 2007). Konuya uygun tamamlayıcı sorular sormak ve öğrenciye dönüt vermek, mevcut sorularla önceki bilgiler arasındaki bağlantıların güçlendirilmesini sağlar (Bellon, Bellon&Blank, 1991; Chappuis, 2009).

Sınıf öğretmenlerinin soru sorma tekniklerinin, Sokratik yöntemin etkisini sağlayamamasının dört nedeni bulunmaktadır. Bunların ilki; öğretmenlerin sınıfta sordukları soruların büyük bir kısmının ezber bilgiye yönelik olması ve sadece bilginin hatırlanmasına vurgu yapan düşük düzeyde sorular olmasıdır (Cunningham, 1987; Gall, 1984; Myhill&Dunkin, 2005; Pate&Bremer, 1967; Wilen, 1991). Oysaki sorular çıkarım ve anlamlandırma yapmayı gerektiren nitelikte olmalıdır (Elder&Paul, 1998). Bununla birlikte, bu durum ülkeden ülkeye değişiklik göstermektedir (Zhang&Matteson, 2012). İkinci neden; sınıf içi söylemlerin sadece bilgiyi aktarıcı özelliğe sahip olmasıdır (Myhill&Dunkin, 2005). Bu durumda da öğretmenler sadece bilgi sağlayıcı ve öğrenciler de pasif alıcı konumunda olurlar. Araştırmacılar öğretme etkinliklerinde "tartışma" ve "etkileşim"in kullanılmasını teşvik ederler ancak öğretmenler bunu gerçekleştirmekten uzak davranışlar sergilerler (Kawanaka&Stigler, 1999; Wilen, 1991; Ross, 1860). Üçüncü neden; öğrencilerin sorulara verdiği cevapların her zaman sorunun düzeyi ile eşleşmemesidir. Öğrenciye sorulan yüksek düzeyde sorular her zaman yüksek düzeyde cevaplar ortaya çıkaramayabilir (Adams, 1974; Dillon, 1982; Mills et al., 1980; Winne&Marx, 1980). Dördüncü neden; pozitif bir sınıf ortamının eksikliğidir. Olumlu sınıf ortamı öğrencilere düşüncelerini ifade etmelerinde gereken güven duygusunu verebilir (Shaunessy, 2000). Pozitif bir sınıf ortamında öğretmen ve öğrenciler birbirlerine saygılı davranırlar ve öğretmen öğrencilerini cevap vermeleri ve güvende hissetmeleri için destekler (Gallagher, 1985; Letzter, 1982; Strasser, 1967). Pozitif sınıf ortamları, öğretmenlerin öğrencilerle göz teması kurmasıyla (Goodwin et al., 1983) ve eleştirel olmayan dönüt sağlamalarıyla (Ellis, 1993) elde edilebilmektedir.

Öğretmen adaylarının soru sorma becerilerine değinen birtakım çalışmalar mevcuttur. Saunders, Gall, Nielson ve Smith (1975), düzenli mikro öğretim ve akran mikro öğretimi ile meşgul olan öğretmen adaylarının, gözlem ve tartışma dersini alan öğretmen adaylarına göre daha tutarlı ve daha sağlam kazanımlar elde ettiğini bulmuş-

tur. Nicol (1999), öğrencilerden öğretim tekniklerini izlemelerini ve öz-yansıtmalarını tamamlamalarını istemiştir. Öz-analizden ve video analizinden sonra, öğretmen adaylarının inançları ve faaliyetleri doğrultusunda öğrencilerle yaşadıkları etkileşimler arasında farklılıklar olduğunu belirtmiştir. Moyer ve Milewicz (2002) öğrencilerden objektif görüşmeler yapmalarını, kayda alınmış görüşmeleri dinlemelerini ve soru sorma becerilerini değerlendirmelerini istemiştir. Sonuçlar, öğretmen adaylarının sadece düz anlatım kullandıklarını ve öğrencilerle uygun tamamlayıcı sorular kullanarak etkileşimde bulunmadıklarını ortaya çıkarmıştır. Korkmaz ve Yeşil (2010) öğretmen adaylarını üç gruba ayırmıştır: Birinci grup, dersten önce sorularını kendileri hazırlamış ve öğretim elemanı soruları cevaplandırarak dersi işlemiştir; ikinci grubun soru hazırlamasına izin verilmemiştir; üçüncü grupta ise, hem öğretmen adaylarının soruları hem de öğretim elemanının soruları doğrultusunda ders işlenmiştir. Öğretmen adaylarının soruları derse dâhil edildiğinde, daha yüksek düzeyde ve kaliteli soruların arttığı gözlenmiştir.

Öğretmen adaylarının iyi sorular oluşturmalarına yardımcı olmak için, bu araştırma soru sormayı ve soru sorma uygulamasının nasıl yapılması gerektiğini belirlemeyi hedef almaktadır. Aşağıda verilen etkinlikler, iyi soru sorma becerisi geliştirmek isteyen ve öğretmen adaylarının eğitiminde görev alan öğretim üyeleri tarafından kullanılabilir. Bloom'un taksonomisi (Bloom ve arkadaşları, 1956; Hannel, 2009) öğrenme hedeflerini bilişsel, duyuşsal ve psikomotor olmak üzere üç alana ayırmaktadır. Bilişsel alan altı hiyerarşik kategoriyi içermektedir. Bunlar bilgi, kavrama, uygulama, analiz, sentez ve değerlendirmedir. Sanders'in (1966) taksonomisi bilgiyi; hafıza, aktarma, yorumlama, uygulama, analiz, sentez ve değerlendirme olmak üzere yediye ayırmaktadır. Bu taksonomiler öğrenme hedeflerini ifade eden eylemlere dayanmaktadır ve her düzey için kesin ölçmeyi çok az sağlayan bir yapıda olmaları nedeniyle eleştirilmişlerdir (Riegle, 1976; Gall, 1970). Bu yüzden, Cunningham'ın (1987) beş soru düzeyi önerilmiştir. En düşük soru sorma düzeyi, ezber hafızasını yoklamaktadır ve cevap tahmin edilebilirdir. Orta soru sorma düzeyi yakınsaktır (convergent) ve düşük ve yüksek düzey olarak ayrılmaktadır. Düşük-yakınsak sorular, öğrencilerin olguları bir araya getirmesini ve kıyaslama, karşılaştırma, genelleme, aktarma ya da açıklama yöntemlerini kullanarak bir cevap oluşturmalarını gerektirmektedir. Yüksek-yakınsak sorular, öğrencilerin cevaplarını destekleyecek bulgular aramasını, davranışları ve sonuçları için nedenler vermesini ve sonuç çıkarmasını gerektirmektedir.

Öğretmen adaylarının daha yüksek düzeyde sorular sorarak sınıfta etkileşime girmelerini sağlamaya yardımcı olmak için, yukarıda adı geçen taksonomilerden örnekler sunularak taksonomiler tanıtılmış ve öğretmen adaylarına gruplar halinde hangi taksonomiyi tercih ettikleri, hangisinin en yararlı olduğunu düşündükleri ve nedenleri sorulmuştur. Görüşmenin ardından Cunnigham'ın beş soru düzeyi temel alınarak öğretmen adaylarından 30 soruyu olgusal *(Factual)*, yakınsak *(Convergent)* ve uzaksak *(Divergent)* olarak kategoriler altında toplamaları istenmiştir. Öğretmen adayları, so-

ruların farklı amaçlarının olduğunun ve başarılı sorular ifade etmek için üç önerinin bulunduğunun farkında olmalıdır (Ellis, 1993). Öğretmen adayları, beş soru düzeyini kullanarak, soruların iyi ifade edilmiş ve yeterli olup olmadıklarını, sorulan sorularla ilgili açık bir ifadenin yer alıp almadığını tespit etmek için gruplar halinde çalışmıştır.

Tartışma

Eğer öğretmenler öğrencilerin mantık yürütme kapasitelerine odaklanırsa, öğrenme öğrenciler için daha kolay olmaktadır (Rodriguez&Kies, 1998; Wragg&Brown, 2001) ve öğrenciler cevap vermeye çalışırken yollarını kaybetmemektedir. Öğretmenlere geçerli soru dizileri geliştirmelerinde yardımcı olmak için, Penick, Crow&Bonnstetter (1996) TBUYA *(HRASE)* sistemini geliştirmiştir. Tarih *(History):* Öğrencilerin deneyimlerine dayalı sorulardır (Ör: Sorunu nasıl çözdünüz?). Bağlantı Kurma *(Relationship)*: Öğrencilerin düşünce, etkinlik ve veriler gibi kavramları kıyaslamalarını gerektiren sorulardır (Ör: Bunun gibi bir şeyi nerede gördünüz?). Uygulama (*Application):* Öğrencilerin bilgilerini yeni bağlamlarda kullanmalarını gerektiren sorulardır (Ör: Bunu …… için nasıl kullanırdınız?). Yorumlama *(Speculation)*: Verilen bilginin ötesinde düşünme gerektiren sorulardır (Ör: Eğer…….. olsaydı sizce ne olurdu?). Açıklama *(Explanation)*: Bir durumun altında yatan neden, süreç ve mekanizmaları açıklamayı gerektiren sorulardır (Ör: Bu nasıl çalışmaktadır?). Öğretmen adaylarına karışık bir şekilde sorular listesi verilmiştir ve onlardan TBUYA sistemine göre soruları sıralamaları ve nedenlerini belirtmeleri istenmiştir. Sorular listesi üzerinde biraz çalıştıktan sonra, öğretmen adayları soruları Üçüncü Uluslararası Matematik ve Fen Çalışması *(TIMSS)* videosunda sıralamıştır.

Bekleme süresi öğretmenin öğrenciye tanıdığı süreyle belirlenmektedir (Tama, 1989). Öğrencilerin bir soruyu anlayıp, uygun bilgiye ulaşıp, cevabı oluşturup cevap vermeye başlaması için en az üç saniye süreye ihtiyacı vardır (Dyer, 2008). İngilizce öğrenenlerin ise çeviri yapıp bu süreci uygulamaları için daha fazla süreye ihtiyaçları olabilir (Mohr&Mohr, 2007). Düşünmek, özellikle üst düzey düşünmek, zaman almaktadır. Bekleme süresi beş saniyeye çıktığında, öğrencilerin cevap verme süreleri, öğrenciler arası etkileşim ve öğrencilerin soruya verdiği cevap kalitesi artmaktadır (Rowe, 1986). Uygun bekleme süresinin üç saniyeden fazla olması gerekse bile çok fazla bekleme süresi öğrencilerin problem çözme becerilerine katkı sağlamayacaktır ve bu durumda sorular öğrenciler tarafından bir ceza gibi görülebilir ve öğrenme etkileşimlerine zarar verebilir (Goodwin, et al., 1983). Öğretmen adayları iki ÜUMFÇ *(TIMSS)* videosu (1999) seyretmiş ve bu videolarda öğretmenlerin bekleme sürelerini, öğrencilerin cevap verme becerilerini ve soru sorma düzeylerini izlemişlerdir.

Yararlı dönüt sağlayabilmek için öğretmenler, Başlama-Cevap-Dönüt (BCD) *(Initiation-Response-Feedback – IRF Mode*l) modelini kullanmalıdır (Mortimer&Scott, 2003). BCD modeli öğretmen ve öğrenci arasında daha fazla etkileşim sağlar ve öğretmenin dönütü konuşmanın bittiğini gösteren bir belirti değildir. Bir öğrencinin cevabı

doğru ise, öğretmen onaylar ve kesin talimat vererek ya da cevap gerektiren sorular ile soru sormayı genişleterek devam eder. Eğer öğrenci yanlış cevap verirse, öğretmen açık bir düzeltme yapar ya da öğrenciye başka bir soru sorarak öğrencinin işini zorlaştırır. Öğretmen adaylarından, ÜUMFÇ (*TIMSS*) videosunda dönüt türlerini belirlemeleri istenmiştir. Kâğıdı ikiye katlayarak videodan elde ettikleri verilerden öğretmenlerin dönütlerini bir yarısına, öğrencilerin verdikleri cevapları ise diğer yarısına yazmaları istenmiştir. Başka bir kâğıtta ise, öğretmen adaylarında Chin (2006)' in dönüt türlerini kullanarak bir tablo oluşturmaları ve verilerden örnekler vermeleri istenmiştir.

Schleppenbach, Perry, Miller, Sims & Fang (2007), tamamlayıcı soruları altı türde sınıflandırmıştır. Tamamlayıcı sorular sınıf etkileşimini artırmalı, öğrencilerin düşünmenin önemini keşfetmesini sağlamalı, düşünme sürecine yardımcı olmalı, öğrencilerin düşüncelerini ifade etmeleri için onları cesaretlendirmeli ve öğrencinin bir soruyu anlayamamasının nedeninin belirlenmesine fırsat yaratmalıdır (Adams, 1974). Öğretmen adaylarına sorular verilmiş ve bu soruları Schleppenbach ve arkadaşlarının (2007) belirlediği tamamlayıcı soru tiplerine göre ayırmaları istenmiştir.

Sonuç

Eğitimciler soru sorma tekniklerinin öneminin farkındadırlar. Ancak bu teknikler öğretmen eğitimi programlarında sistematik ve anlaşılır bir şekilde sunulmayabilir. Bu makale, derslerini soru sorma teknikleriyle yürütmeyi planlayan öğretmen yetiştiricileri için bir kaynak olarak sunulmuştur.

References

Adams, M. F. (1974). An examination of the relationship between teacher use of higher level cognitive questions and the development of critical thinking in intermediate elementary students. Unpublished doctoral dissertation, Florida State University, Tallahassee.

Ainscow, M. (2000). The next step for special education: Supporting the development of inclusive practices. *British Journal of Special Education, 27, 76-80.*

Bellon, J.J., Bellon, E.C. & Blank, M.A. (1991) *Teaching from a research knowledge base: A development and renewal proces*s. Upper Saddle River, New Jersey: Prentice Hall.

Bloom, B. S., Englehart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: Cognitive domain.* New York: McKay.

Caram, C. A., & Davis, P. B. (2005). Inviting student engagement with questioning. *Kappa Delta Pi Record*, 42(1), 18-23.

Chappuis, J. (2009). *Seven strategies of assessment for learning.* Boston, MA: Allyn & Bacon.

Chin, C. (2006). Classroom interaction in science: Teacher questioning and feedback to students' responses. *International Journal of Science Education,* 28(11), 1315-1346.

Chin, C. (2007). Teacher questioning in science classrooms: Approaches that stimulate productive thinking. *Journal of Research in Science Teaching,* 44(6), 815-843.

Cotton, K. (1988). *Monitoring student learning in the classroom.* Portland, OR: Northwest Regional Educational Laboratory.

Cunningham, R. T. (1987). What kind of question is that? In W. W. Wilen (Ed.), *Questions, questioning techniques, and effective teaching* (pp. 67-94). Washington, D.C.: National Education Association.

Dillon, J. T. (1982). Cognitive correspondence between question/ statement and response. *American Educational Research Journal*, 19, 540-551.

Dyer, J. E. (2008). Effective questioning techniques. Retrieved from http://edis.ifas.ufl.edu/pdffiles/WC/WC08400.pdf

Elder, L., & Paul, R. (1998). The role of Socratic questioning in thinking, teaching, and learning. The Clearing House: A Journal of Educational Strategies, Issues and Ideas, 71(5), 297-301.

Ellis, K. (1993). Teacher questioning behavior and student learning: What research says to teachers. Retrieved from ERIC database. (ED 359572)

Gall, M. D. (1970). *The use of questions in teaching. Review of Educational Research,* 40(5), 707-721.

Gall, M. D. (1984). Synthesis of research on teachers' questioning. Educational Leadership, 42(3), 40-47.

Gallagher, J. (1985). *Teaching the gifted child.* Boston: Allyn and Bacon.

Goodwin, S. S., Sharp, G. W., Cloutier, E. F., & Diamond, N. A. (1983). Effective classroom questioning. Retrieved from ERIC database. (ED 285497)

Hannel, I. (2009). Insufficient questioning. *Phi Delta Kappan,* 91(3), 65-69.

Harrop, A., & Swinson, J. (2003). Teachers' questions in the infant, junior and secondary school. *Educational Studies*, 29(1), 49-57.

Kawanaka, T., & Stigler, J. W. (1999). Teachers' use of questions in eighth-grade mathematics classrooms in Germany, Japan, and the United States. *Mathematical Thinking and Learning,* 1(4), 255-278.

Korkmaz, O., & Yesil, R. (2010). A comparison of different teaching applications based on questioning in terms of their effects upon pre-service teachers' good questioning skills. *College Student Journal,* 44(4), 1006-1020.

Letzter, F. (1982). Meeting the special needs of the gifted and creative student in the world history classroom. *Social Education,* 46, 195-199.

Levin, T., & Long, R. (1981). *Effective instruction.* Washington, DC: Association for Supervision and Curriculum Development.

Lortie, D. C. (1975). Schoolteacher: A sociological study. Chicago, IL: The University of Chicago Press.

Mills, S. R., Rice, C. T., Berliner, D. C., & Rousseau, E. W. (1980). The correspondence between teacher question and student answers in classroom discourse. J*ournal of Experimental Education,* 48, 194-204.

Mohr, K, A. J., & Mohr, E. S. (2007). Extending English-language learners' classroom interac-

tion using the response tool. The Reading Teacher, 60(5), 440-450.

Moore, L., & Rudd, R. (2002). Using Socratic questioning in the classroom. *Agricultural Education Magazine,* 75(3), 24-25.

Mortimer, E. F., & Scott, P. H. (2003). *Meaning making in secondary science classrooms.* Maidenhead, UK: Open University Press.

Moyer, P. S., & Milewicz, E. (2002). Learning to question: categories of questioning used by preservice teachers during diagnostic mathematics interview. *Journal of Mathematics Teacher Education,* 5, 293-315.

Myhill, D., & Dunkin, F. (2005). Questioning learning. *Language and Education,* 19(5), 415-427.

Nicol, C. (1999). Learning to teach mathematics: Questioning, listening, and responding. *Educational Studies in Mathematics*, 37, 45-66.

Overholser, J. C. (1992). Socrates in the classroom. *The Social Studies,* 83(2), 77-82.

Pate, R. T., & Bremer, N. H. (1967). Guiding learning through skillful questioning. *Elementary School Journal,* 67, 417-422.

Penick, J. E., Crow, L. W., & Bonnstetter, R. J. (1996). Questions are the answer: A logical questioning strategy for any topic. *The Science Teacher,* 63, 27-29.

Resnick, L. (1991). Shared cognition: Thinking as social practice. In L.B. Resnick, J.M. Levine, & S.D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 1-20). Washing D. C. American Psychological Association.

Riegle, R. P. (1976). Classifying classroom questions. *Journal of Teacher Education,* 27, 156-161.

Rodriguez, I., & Kies, D. (1998). Developing critical thinking through probative questioning. *Reading Improvement,* 35(2), 80-89.

Ross, W. (1860). Methods of instruction. Barnard's *American Journal of Education,* 9, 367-379.

Rowe, M. B. (1986). Wait time: Slowing down may be a way of speeding up! *Journal of Teacher Education,* 37, 43-50.

Sanders, N. M. (1966). *Classroom questions: What kinds?* New York: Harper & Row.

Saunders, W., Gall, M., Nielson, E., & Smith. G. (1975). The effects of variations in microteaching on prospective teachers' acquisition of questioning skills. Retrieved from ERIC database. (ED 088835)

Schleppenbach, M., Perry, M., Miller, K. F., Sims, L., & Fang, G. (2007). The answer is only the beginning: Extended discourse in Chinese and U.S. mathematics classroom. *Journal of Educational Psychology,* 99(2), 380-396.

Schunk, D. (2007). *Learning theories: An educational perspective (*5th Ed.). Columbus, OH: Prentice Hall.

Scott, P. (1998). Teacher talk and meaning making in science classroom: A Vygotskian analysis and review. *Studies in Science Education*, 32, 45-80.

Shaunessy, E. (2000). Questioning techniques in the gifted classroom. *Gifted Child Today,*

23(5), 14-21.

Strasser, B. (1967). The use of questions as an aspect of a teacher's behavior. In J. Gowan, G.

Demos, & E. Torrence (Eds.), Cr*eativity: Its educational implications* (pp. 207-209). New York: John Wiley and Sons.

Tama, C. (1989). Critical thinking: Promoting it in the classroom. Retrieved from ERIC database. (ED 306554).

National Center for Education Statistics. (Producer). (1999). *TIMSSVIDEO*. Available from http://timssvideo.com/

Tudge, J. R. H., & Scrimsher, S. (2003). Lev S. Vygotsky on education: A cultural-historical, interpersonal, and individual approach to development. In B. J.

Zimmerman & D. H. Schunk (Eds.), *Educational psychology: A century of contributions* (pp. 207-228). Mahwah, NJ: Erlbaum.

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Wertsch, J. V. (1991). *Voice of the mind: A social-cultural approach to mediated action.* Cambridge, MA: Harvard University Press.

Wilen, W. W. (1991). *Questioning skills, for teachers. What research says to the teachers* (5th. ed.). Washington, DC: National Education Association.

Winne, P.H. & Marx, R.W. (1980). Matching students' cognitive responses to teaching skills. *Journal of Educational Psychology,* 78, 257–264.

Wood, D. J., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychiatry and Psychology,* 17(2), 89-100.

Wragg, E. C., & Brown, G. (2001). *Questioning in the primary school.* London: Routledge Falmer.

Zhang, Y., & Matteson, S. M. (2012, February). *The use of feedback and follow-up questions in mathematics classrooms from Japan, Hong Kong, Australia, Czech Republic, and the United States.* Paper presented at the 35th annual meeting of Southwest Education.